DEPARTMENT OF AVIATION

SECOND SYDNEY AIRPORT

SITE SELECTION PROGRAMME

Draft Environmental Impact Statement

KINHILL STEARNS

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Prepared for

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by

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645 Harris Street, Ultimo, NSW 2007

April 1985

ISBN 0 9592678 8 3

Printed by Macarthur Press, Parramatta

Foreword

Selecting a location for Sydney's second major airport is one of the most significant and difficult planning problems facing the Australian Government. The matter has been studied and debated publicly for more than three decades without resolution. This has caused uncertainty for many people living in areas which have been proposed at various times as possible airport locations.

The number of locations under consideration has now been reduced to two (Badgerys Creek and Wilton) and the Government intends to make a choice as soon as possible in order to end this uncertainty. Before such a decision is taken, however, it is important that the public, and in particular those who may be directly affected, are given full opportunity to examine and comment on the issues involved.

This Draft Environmental Impact Statement explains how the two locations were selected and what could be expected from an airport at either of them. It is the most detailed and comprehensive report on the subject to be made public and has been prepared in close co-operation with the New South Wales Government.

I commend this document to the reader and invite comment from all who have an interest in this vital question. All public comment received will be carefully considered and taken into account before the final decision is made. Only by considering all views and balancing the many conflicting social, technical, environmental and economic requirements can the best and fairest solution for all be found.

Peter Morris, M.H.R.
MINISTER FOR AVIATION

Preface

GOVERNMENT OBJECTIVES

In September 1983, the Minister for Aviation and the New South Wales Minister for Environment and Planning jointly announced that the Commonwealth and State governments had agreed on a programme which would lead to the selection and acquisition of a second airport site for Sydney. The main points in the announced programme were as follows:

- The resolution of Sydney's future airport needs in an environmentally acceptable manner was a primary objective of both governments.
- All suitable sites would be reviewed, including those considered in the Major Airport Needs of Sydney Study.
- The time was rapidly approaching when the opportunity to reserve a second site would be lost.
- The decision on a second airport site would be taken in the shortest possible time consistent with allowing ample opportunity for the Sydney community to contribute to the decision-making process.
- The public would be invited to comment on:
  - the ultimate role for a second Sydney airport
  - the site selection criteria
  - the Draft Environmental Impact Statement.
- Careful consideration would be given to the environmental and social impacts associated with each of the potential sites before the selected site was announced.
- Site boundaries would be specified and acquisition commenced at the time of the announcement of the selected site.
- This announcement could not be made before mid-1985.

Following release of this joint statement by the Commonwealth and State governments, the Department of Aviation undertook a review of a number of possible locations for a second airport site. From this review, the Department selected the following ten locations for evaluation:

- Badgerys Creek
- Bringelly
- Darkes Forest
- Goulburn
- Holsworthy
- Londonderry
- Scheyville
- Somersby
- Warnervale
- Wilton.

To assist in the evaluation of these ten locations, the Department of Aviation engaged a Consultant, Kinhill Stearns. The Consultant was briefed to accumulate sufficient information on the ten locations to undertake an evaluation to produce a short list of two locations (perhaps three), and to continue the evaluation of these short-listed sites, culminating in the preparation of a Draft Environmental Impact Statement.

In September 1984 the first stage of the Site Selection Programme, the short-listing of sites, was completed. On 18 September 1984, the Minister for Aviation announced that the number of locations being studied for reservation of a site for a second Sydney airport had been reduced to two: Badgerys Creek (on the western outskirts of Sydney) and Wilton (south-west of Sydney). Following this announcement the Consultant commenced preparing this Draft Environmental Impact Statement in accordance with the administrative procedures under the Commonwealth Environment Protection (Impact of Proposals) Act 1974 and taking into account as appropriate the terms of the agreement between the then Commonwealth Minister for Home Affairs and Environment* and the NSW Minister for Environment and Planning concerning procedural guidelines for environmental assessment involving the Commonwealth and New South Wales.

DECISION PROCESS

Following the period of public exhibition of this Draft Environmental Impact Statement, (during which time the public will make submissions on the document to the Department of Arts, Heritage and Environment) the following steps must be completed before the final site selection can be announced:

- The Department of Arts, Heritage and Environment will forward to the Department of Aviation and the NSW Department of Environment and Planning all public submissions on the Draft Environmental Impact Statement.
- The Department of Aviation will prepare responses to issues and concerns raised in the public submissions. These responses and any amendments to the Department of Aviation's proposals resulting from public submissions will be compiled in a Supplement to the Draft Environmental Impact Statement.
- The Supplement will be forwarded to the Department of Arts, Heritage and Environment, the NSW Department of Environment and Planning, and to all parties who made submissions on the Draft Environmental Impact Statement.
- The Department of Arts, Heritage and Environment and the NSW Department of Environment and Planning will each, with appropriate consultation, prepare its independent assessment of the Final Environmental Impact Statement (which comprises the Draft and the Supplement), and the departmental assessments will be forwarded to the respective Ministers for endorsement.
- The Minister for Arts, Heritage and Environment will pass his comments and recommendations on the proposal — which will take into account the New South Wales Government's views — to the Minister for Aviation.
- The Minister for Aviation will take into account the comments and recommendations of the Department of Arts, Heritage and Environment and the New South Wales Government's views and will then decide on a course of action to be recommended to Cabinet on the site to be acquired, and the programme and method of acquisition.
- The site will be announced and the acquisition process will commence.

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* Now the Minister for Arts, Heritage and Environment

At the time of publication of this Draft Environmental Impact Statement, it was expected that the announcement of the selected site would be made in the second half of 1985.

STRUCTURE OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

This Draft Environmental Impact Statement has been prepared in accordance with the guidelines established by the Commonwealth Department of Arts, Heritage and Environment in discussion with the NSW Department of Environment and Planning and the Department of Aviation. These guidelines are reproduced in Appendix A and include an outline of the agreement between the then Commonwealth Minister for Home Affairs and Environment and the NSW Minister for Environment and Planning on procedural guidelines for environmental assessment involving both governments.

This Draft Environmental Impact Statement is organized into the following five main parts:

- **Summary:** Summary of the site selection process, the environmental evaluation of the Badgerys Creek and Wilton sites, and the comparison of these two sites.

- **Part A (Chapters 1-6):** Description of the requirement to reserve a site for possible future development as a second airport, and the method by which the two short-listed sites, Badgerys Creek and Wilton, were selected.

- **Part B (Chapters 7-11):** Description of an acquisition area and possible development of an airport at Badgerys Creek, and the environmental effects arising therefrom.

- **Part C (Chapters 12-16):** Description of an acquisition area and possible development of an airport at the Wilton site and the environmental effects arising therefrom.

- **Part D (Chapters 17-18):** Comparison of the Badgerys Creek and Wilton sites and a description of the public consultation programme undertaken during the course of the study.

Parts B and C stand alone as descriptions of the proposals and likely environmental effects at each of the short-listed sites. On this account, there is some repetition of material common to the proposals at both sites.

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THE REQUIREMENT TO RESERVE A SITE

Objective of the proposal

In 1983 the Department of Aviation was directed by the Commonwealth Government to examine all possible locations for a suitable site for a second major airport to serve the Sydney region. Subsequently, the then Minister for Home Affairs and Environment directed that a Draft Environmental Impact Statement be prepared under the terms of the Commonwealth Environment Protection (Impact of Proposals) Act 1974. This document has been prepared in response to that direction.

The objective of the proposal assessed in this Draft Environmental Impact Statement is to acquire a site that would be suitable for possible future development as a second Sydney airport. The environmental evaluation of the two short-listed sites at Badgerys Creek (on the western outskirts of Sydney) and Wilton (south-west of Sydney) has been based on preliminary master plans which represent the maximum level of development (the 'worst case') that could be contemplated in the foreseeable future. This level of development would only be warranted if long-term air traffic growth followed the most optimistic forecasts, and it is probable that there would be very much lower levels of development at a second airport. The decision to acquire a site at this time does not imply a commitment to the level of development suggested under the worst case, nor to any other level of development.

Growth in air traffic

In the 1984 calendar year, the total air traffic at Sydney's Kingsford-Smith Airport was approximately 8.6 million passenger movements. Air traffic at Kingsford-Smith Airport is forecast by the Department of Aviation to grow at an annual rate of 1.6-3.8% between 1985 and 2010. (This forecast compares with an annual growth rate of approximately 4.7% between 1970 and 1984.) At these forecast rates, total passenger traffic at Kingsford-Smith Airport in the year 2010 would range between a low of 13.4 million and a high of 24 million annual passenger movements, provided that sufficient airport capacity were available to accommodate this growth. The corresponding range for aircraft movements forecast for the year 2010 is between 216,730 and 382,580 annual aircraft movements.

The possibility of long-term growth falling below the Department of Aviation's low forecast of a 1.6% increase per annum is very unlikely. For this to occur, the Australian economy would have to enter a period of long-term stagnation, a situation that is neither probable nor a sound assumption on which to base long-term planning. On the other hand, the possibility of the Department of Aviation's high forecast being exceeded cannot be excluded. This is because the forecasts are based upon the assumption that existing socio-economic and aviation industry factors will remain essentially unchanged, which may not prove to be the case. For example, greater exploitation of the leisure market, increased international tourist travel from overseas, or the possibility of some limited form of deregulation of the aviation industry in Australia being implemented and leading to a wider range of travel opportunities, are all factors that could lead to a higher long-term growth level than that forecast by the Department of Aviation.

Runway capacity of Kingsford-Smith Airport

The capacity of an airport is not fixed, as it depends on a number of factors such as the weather, the mix of aircraft, the profile of daily movements, aircraft passenger loads and air traffic control procedures, all of which can vary. In 1984 there were approximately 170,000 aircraft movements at Kingsford-Smith Airport. If the profile of daily movements and aircraft mix remained unchanged, then full capacity under the Department of Aviation's capacity criteria would be reached at 203,000 annual aircraft movements. Under the Department's forecasts, this could occur as early as 1988 or as late as 2000.

It is the policy of both the New South Wales and the Commonwealth governments to cater for any shortfall in runway capacity at Kingsford-Smith Airport by developing a second Sydney airport. The alternatives to this policy would be to:

- take no action, and allow congestion at Kingsford-Smith Airport to rise;
- regulate traffic flow at Kingsford-Smith Airport through the pricing of landing rights at peak periods or the allocation of quotas for landing rights at these periods;
- construct an additional runway at Kingsford-Smith Airport.

Policies of 'no-action' or of regulation of air traffic at Kingsford-Smith Airport are likely to result in increased costs for air travellers to or from Sydney, and in reduced opportunities for air travel. Such an outcome would be contrary to the Commonwealth Government's objectives of providing equality of access for all Australians to reasonably priced air services.

Previous studies have investigated the possibility of increasing runway capacity at Kingsford-Smith Airport by constructing an additional runway parallel to the existing north/south runway. Such a proposal is physically possible, although insufficient work has been undertaken to enable the associated facility requirements and environmental impacts to be established. Nevertheless, while a closely spaced parallel runway at Kingsford-Smith Airport could theoretically raise the capacity of that airport to approximately 240,000 annual aircraft movements, such an increase would do no more than defer the requirement for an additional major increment of runway capacity in the Sydney Region.

Capacity of general aviation aerodromes

As there are constraints on the expansion of the other general aviation aerodromes in the Sydney Region (Bankstown, Hoxton Park, Camden and Schofields), an uncongested second airport may be considered by general aviation interests as an attractive alternative. General aviation is therefore seen as an important potential activity at a second Sydney airport.

Loss of the opportunity to reserve a site

Sydney, a large city by world standards, has a finite and dwindling supply of land suitable for development because of the containment of the Cumberland Plain by mountains. Over more than three decades, a number of potentially suitable airport sites within the Cumberland Plain have progressively become unavailable as a result of continued population expansion, and replacement candidate airport sites are necessarily located further from the city's centre.

The population of the Sydney Region is expected to grow from a 1981 level of 3.28 million to approximately 4 million by the year 2000. By 2011, the population of Sydney would be between 4.3 and 4.7 million, depending upon the effects of immigration to Australia. The total capacity of the Cumberland Plain is estimated to be approximately 4.7 million people; to accommodate population increases beyond this figure, areas would have to be developed on the Central Coast and in the surrounding foothills and highlands.

There are a large number of competing uses for land in the Cumberland Plain. A site for a second Sydney airport is perhaps one of the most significant of these, as the site plus the noise-affected areas over which land use controls would need to be imposed would exceed 25 km^2. Under the projected population growth rate for the Sydney area, the population capacity of the Cumberland Plain of 4.7 million people could be reached by the year 2011, at which time, unless a site had earlier been acquired, there would be no land available for airport development.

The process of progressive introduction, evaluation, discarding and reintroduction of candidate second airport sites over more than three decades has introduced a great deal of uncertainty into the lives of those people living in the affected areas. This lack of a decision has also seriously affected the New South Wales Government's urban development programme, particularly as far as medium-term plans are concerned. This is because areas identified for urban development after about 1990, and for which a considerable amount of investigation and planning are being undertaken, have been limited to land not affected by these future airport options, which has closed off from consideration many areas that may be more suitable for medium-term urban development.

Consequences of no action

The issue of a second Sydney airport site is a persistent one. A decision to take no action or to defer or abandon the site selection process at this time is thus unlikely to remove the issue from the public agenda. The short-term consequences of no action are likely to be a reintroduction of uncertainty for the potentially affected populations and continuing difficulties for the State Government in its metropolitan planning programme.

While the long-term rate of air traffic growth cannot be predicted with any certainty, a decision to reserve a site at this time would be seen in retrospect as a good decision if high traffic growth did occur. If, on the other hand, there were no growth, then deferral or abandonment of site selection at this time would be seen in retrospect as a good decision. Nevertheless, the consequences of being seen in retrospect to have not made the correct decision — of having secured the site prematurely or of having failed to do so when this ultimately proved to be required — are not symmetric for the two choices. This is because the continued growth of Sydney will inevitably make the future acquisition of a site both practically more difficult as well as more costly.

However, a decision now to abandon or defer selection of a site is more likely to give rise to negative effects in the long term. In the short term, deferral or abandonment of site selection is most likely to be followed after a short period by a resurrection of the search for a site for a second airport, with the attendant costs, controversy and uncertainty for the potentially affected populations.

ROLE AND NATURE OF A SECOND AIRPORT

Operational contributions of second airports

Many of the largest metropolitan sources of air traffic in developed countries are served by multi-airport systems. This pattern holds across a wide diversity of economic and regulatory conditions and may reasonably be expected to hold for other regions as they develop into major metropolitan centres. This is because second airports can perform vital functions in increasing airport capacity and efficiency in a major metropolitan area.

Second airports can increase the efficiency of a metropolitan airport system by providing a means of separating traffic using different types of aircraft. Given the variation in separation distances required between aircraft of differing speeds, the separation of slower and faster aircraft enables the number of overall aircraft movements per hour throughout the airport system to be increased. A second airport can also increase the capacity of the primary airport in the metropolitan system by providing for seasonal or daily peak traffic, thus allowing the primary airport to operate at generally higher levels throughout the year, indeed close to its maximum capacity.

Social contributions of second airports

In addition, second airports can make significant social contributions to the operation of air services in metropolitan areas by providing an effective means of distancing some sources of aircraft noise from heavily populated areas without creating access penalties for passengers as a whole. They can achieve this by catering to the range of activities that does not involve regularly scheduled flights, for example training flights, air cargo or express parcel traffic, or traffic that has good reason to operate beyond curfew hours.

Further, second airports can stimulate competition in the air transport system of a metropolitan region by breaking the monopoly on commercial air services and terminal space otherwise held by a single airport facility and by operators established there. In this way, second airports in a multi-airport system can provide opportunities for the development of innovative aviation services directed at market segments not previously catered for. Second airports have proved to be the starting points for many innovative services, particularly those requiring low overheads.

Concentration and specialization

Most multi-airport systems have a dominant airport, which typically may have anywhere from two to five times the number of passengers of the second airport. As a rule, traffic distributes to second airports in proportion to the congestion of the dominant airport. The process of concentration of traffic at primary airports is stimulated by the passengers, who prefer to use the airport that has the best services and greatest possibilities for making flight connections. Commercially, the airlines must follow, as they could not for long afford to offer uncompetitive services elsewhere, even if these were subsidized. Concentration is the inevitable result, and experience elsewhere indicates that government regulation which attempts artificially to distribute traffic between airports in a multi-airport system is unsuccessful. Nevertheless, the success of a second airport should not be judged by whether or not it is as heavily utilized as the primary airport, since a second airport performs a role not comparable to its level of traffic.

Airports in a multi-airport system tend to specialize around particular functions, with each airport typically having distinct characteristics and services. However, this distinction between a primary and secondary airport is unlikely to be a split between 'international' and 'domestic' traffic. In practice, such a split is uncharacteristic; instead, the most common specialization between airports is between 'business' travel on the one hand, and leisure or 'cheap fare' and other special markets on the other. The business airport is typically the larger airport, which provides the services required by business people: high frequency of services; easy flight connections; and a broad range of destinations. Operators providing cheap fare and innovative services locate preferentially at uncongested, and thereby less expensive, sites: factors that help them to provide their services. Other specialized services which may be found at a second airport include air cargo and express cargo, regional destinations, charter operations, and traffic sensitive to curfew restrictions.

Size of a second airport, and distribution of traffic

Experience with multiple airport systems elsewhere in the world suggests that a second airport can become a sizeable enterprise, catering to at least 2 million passengers per annum (or as busy in terms of passenger traffic as Adelaide or Perth airports are today), when the originating traffic in the metropolitan area reaches about 8 million passengers per year (originating traffic is calculated by deducting the number of transit passengers from the total number of passengers at an airport, and dividing this number by two). Under the Department of Aviation's high forecast for air traffic in the Sydney region, this point is likely to be reached at about the year 2000.

The same reasons that make it difficult to forecast passenger levels with any certainty far into the future also make it difficult to predict the responses of airlines and passengers to a condition of severe congestion at Kingsford-Smith Airport and to the opportunity to operate from a second airport. However, based on experience elsewhere, the most plausible future prospect for Kingsford-Smith Airport is that it would remain the dominant business oriented airport, operating much as it does today. It can also be assumed that Kingsford-Smith Airport would probably continue as the focus for much of the extensive network of intrastate commuter traffic, as many of the passengers on these flights are also travelling on business and would wish to make connections with interstate and international flights. Further, it can be expected that the established airlines — Qantas, TAA and Ansett — will retain Kingsford-Smith Airport as their principal airport in the Sydney Region.

A distribution of traffic between Kingsford-Smith Airport and a second airport that envisages 'international' traffic being concentrated at a second airport is not a viable alternative in the Australian context. Because of the multiple number of ports of entry into Australia, alert passengers and travel agents would have no difficulty in subverting the objective of landing Sydney-bound international passengers solely at a second airport. Instead, other ports of entry would be used, with connecting domestic flights providing access to the more convenient Kingsford-Smith Airport. Alternatives involving the division of interstate traffic evenly between Kingsford-Smith Airport and a second airport would fail on similar grounds. While stringent regulations might conceivably force airlines to split their operations for a period, such regulations could not force the passengers to follow suit. Passengers would preferentially use Kingsford-Smith Airport and put great pressure on the airlines to provide fuller services there.

The extent to which a second airport could make a viable contribution to the efficient operation of air services in the Sydney Region would depend very much upon overall growth in traffic. Should such growth occur, then it may also be expected that the conditions under which air services were being offered and operated would be different from those of today. The most plausible future prospect for a second airport operating under such conditions would be to serve peak period, leisure-oriented mass markets, and other special markets such as curfew-sensitive traffic, air cargo and general aviation. The leisure market is distinctly different from business travel in many fundamental respects, each of which makes it possible for this market to distribute to a second Sydney airport. Many of the holiday passengers might not be especially concerned about proximity to the city centre or sensitive to the time taken in travelling to the airport. Their concern would be more for the total cost of the holiday package. Experience elsewhere indicates that airlines serving this market could be charter or charter-like operators offering special schedules or flight programmes to serve mass markets.

These operators might be subsidiaries of existing business oriented airlines or newly establishing innovative operators. Ultimately, if the air traffic to Sydney became sufficiently large, the second airport might develop a broader role, involving more business oriented traffic.

Timing and location of development

Development of a second airport could take several years, and it would need to be opened some time before its traffic could reach a level at which the second airport's contribution was noticeable. If a second airport were to be available when the capacity of Kingsford-Smith Airport was exceeded, then, on the basis of the Department of Aviation's forecasts of demand and capacity, the second airport would be required for initial use between 1988 and the year 2000.

The timing of the growth in traffic at a second airport would depend to a degree on its location. The further away a second airport is located from the Sydney Region origins and destinations of potential passengers, the longer it will be before passengers and airlines choose to use that airport in preference to congested facilities at Kingsford-Smith Airport. Of the two sites that have been short-listed, the time at which development of a second airport at Wilton would become viable would be later than at the closer Badgerys Creek site.

POSSIBLE LOCATIONS FOR A SECOND SYDNEY AIRPORT SITE

Background

Considerable work has been carried out over almost forty years in the search for a suitable site for a second major airport for Sydney. This work has involved the evaluation of a large number of candidate locations, and the subsequent rejection of many, before the list of the ten locations considered in this latest study was defined. The four major studies that preceded this current study were:

- the Report on the Development of an International Airport at Sydney (1946)
- the Major Airport Requirements for Sydney Study (1969-70)
- the Benefit/Cost Study of Alternative Airport Proposals for Sydney (1971-74)
- the Major Airport Needs of Sydney Study (1977-79).

The Second Sydney Airport Site Selection Programme is the fifth attempt by successive governments to select and reserve a site for a second airport. In the course of this and the previous studies, a total of 106 sites have been investigated, nineteen of which have been studied in detail. Of these, twelve were located in the Cumberland Plain and seven in areas to the north and south of Sydney and at Goulburn. Five of these nineteen sites have been common to this and the previous two studies. These are Scheyville, Londonderry, Badgerys Creek, Bringelly and Holsworthy.

The most recent study, the Major Airport Needs of Sydney Study, short-listed two sites: Badgerys Creek and Scheyville. In December 1979, the Commonwealth members of the Major Airport Needs of Sydney Committee submitted their recommendations to the Commonwealth Minister for Transport, although agreement on these recommendations could not be reached with the State members of that Committee.

The Commonwealth members considered that the development of a second major airport could not be preferred to development of a closely spaced parallel runway at Kingsford-Smith Airport; nevertheless, if a second airport were eventually required, they expressed a clear preference for development at Badgerys Creek over the other short-listed site at Scheyville.

Site locations nominated for the current study

Five years have passed since the Major Airport Needs of Sydney Study was undertaken and population increases have occurred at many of the sites in the interim. However, as the effects of these increases are not evenly distributed, it was considered appropriate that the Second Sydney Airport Site Selection Programme should include a re-examination of all four locations that had been analysed in detail for the Major Airport Needs of Sydney Study: Scheyville, Londonderry, Badgerys Creek and Bringelly. It was also proposed to review the decision of that Study to eliminate the Holsworthy military area as a potential site, since it was felt that the population increases at the alternative sites in the meantime may have improved the ranking of Holsworthy. In addition, five other locations had been strongly promoted as suitable airport sites in the press and through personal representation by various interest groups: Somersby, Darkes Forest, Wilton, Goulburn and Warnervale. Although some of these had been examined and rejected in earlier studies, it was considered that the changes in the intervening years and the continued public interest made it desirable for them to be reviewed again.

Five categories of alternative locations, with which the following representative sites (Figure 1) were associated, were thus identified for examination:

. Major Airport Needs of Sydney Study short list:	Badgerys Creek Scheyville
. Other metropolitan locations examined in Major Airport Needs of Sydney Study:	Bringelly Londonderry Holsworthy
. Mid-distance locations (north):	Warnervale Somersby
. Mid-distance locations (south):	Darkes Forest Wilton
. Outlying sites:	Goulburn (as representative of other outlying sites, such as Bathurst-Orange).

SITE SELECTION METHODOLOGY

Site characteristics

As these ten nominated locations have widely differing characteristics, the short-listing process necessarily involved comparisons on a number of characteristics that have no obvious common measure (for example, convenience of access, noise impact, and archaeology). The value that might be attached to any one of these characteristics would vary markedly according to individual perspectives and interests. Thus, airport users could be expected to attach a higher value to convenience of access to the airport, while residents potentially affected by noise at one of the nominated locations could be expected to attach a higher value to minimizing this impact, preferably by locating the airport elsewhere. Compromises between the accessibility, environmental impact, cost and other factors associated with each site therefore had to be considered in short-listing two (or three) sites for detailed comparison in this Draft Environmental Impact Statement.

To facilitate the short-listing process, airport layouts were prepared for each of the ten nominated locations. These layouts were the basis for evaluating 'the worst possible case for the configuration (of airport) adopted', as required by the Government's Guidelines under which the study was conducted. The worst case adopted for the purposes of preparing a short-list of two (or three) sites from the ten nominated locations was a widely spaced parallel runway configuration with an estimated capacity of 25 million annual passenger movements. A specific site was identified at each of the nominated locations, and the operating characteristics of a worst case airport configuration at each site were then described, including the numbers of aircraft movements and passengers, road access requirements, areas affected by noise contours, area of land to be cleared for airport development, number of employees, and so on.

For each of the ten sites, data were then gathered under four main evaluation factors: environment, access, airport operations and cost. Within these four main factors there were twenty-five sub-factors: twelve for environmental considerations, three for access, four for airport operations and six for variable capital costs.

The list of factors and sub-factors used in the short-listing process was as follows:

- **Environment**

  1 Air quality
  2 Water quality
  3 Flood risk
  4 Flora
  5 Fauna
  6 Archaeology
  7 European heritage
  8 Agriculture
  9 Mineral resources
  10 Population displaced
  11 Existing noise-incompatible land use
  12 Future noise-incompatible land use

- **Access**

  13 General aviation market
  14 Private vehicle accessibility
  15 Public transport accessibility

- **Airport operations**

  16 Airspace
  17 Wind coverage
  18 Other meteorological conditions
  19 Site flexibility

- **Variable capital costs**

  20 Site acquisition
  21 Relocation of Commonwealth facilities
  22 Relocation of existing infrastructure
  23 Site preparation
  24 Access
  25 New infrastructure

Grouping of sites

In order to make the evaluation more manageable, the data collected on each of these sub-factors for each of the ten sites were reviewed to identify any pattern that would enable sites to be grouped on the basis of some shared characteristics. From inspection of the data it was found that:

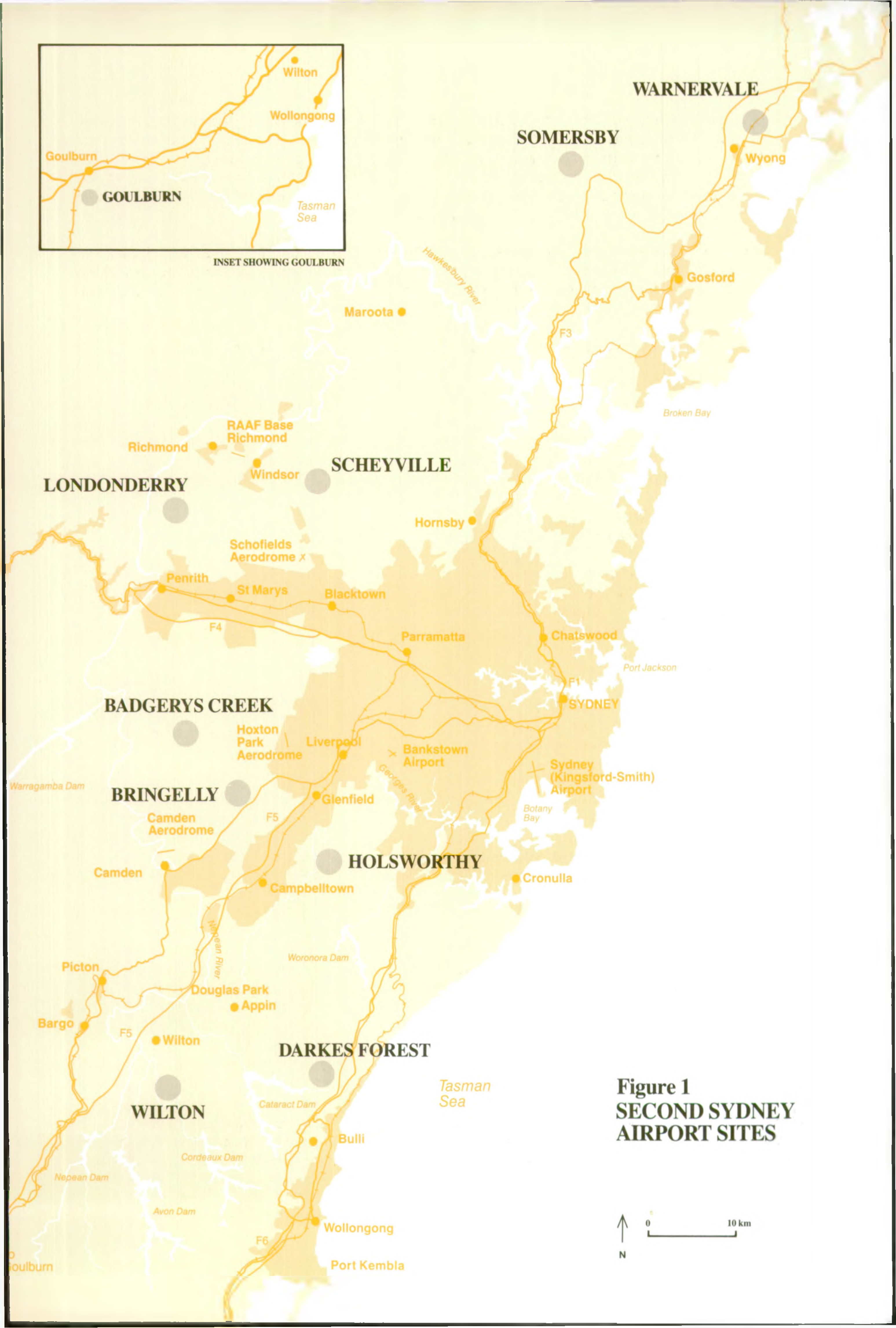


Figure 1
SECOND SYDNEY AIRPORT SITES

- the average distance to the mid-distance sites from the centre of Sydney's population was twice that of the distance to the closer sites;

- the average number of residents who would be displaced by site acquisition at the mid-distance sites was almost one-sixth of the number who would be displaced at the closer sites;

- the average area of existing land use at the mid-distance sites that would be incompatible with noise generated by aircraft operations was less than half that found at the closer sites;

- the average cost of acquiring a mid-distance site was less than one-third of that of the average for the closer sites.

Thus, it was considered that the most useful characteristic by which sites could be grouped was their geographical location in relation to Sydney. Sites that lie closer to the edge of Sydney's urban area are more attractive in terms of accessibility to the airport, but are generally less attractive in terms of their socio-economic impacts and site acquisition cost. On the other hand, sites at a middle distance from Sydney's urban area are less accessible, but their impact would be felt by fewer people and their acquisition costs are generally less.

In view of these distinctions, the ten sites were grouped as follows:

- Closer sites: Badgerys Creek, Bringelly, Holsworthy, Scheyville and Londonderry.

- Mid-distance sites: Darkes Forest, Somersby, Warnervale and Wilton.

- Outlying site: Goulburn.

These groupings enabled comparisons to be made between sites with broadly similar characteristics.

Short-listing

Assessments were then made of which characteristics were likely to be regarded by the widest public as being of critical importance to the selection of an airport site. Of the twenty-five sub-factors identified for evaluation purposes, it was judged that the most important were the number of people relocated as a result of site acquisition, the impact of aircraft noise, the accessibility of the airport, the operational safety of the airport, and the cost of site acquisition.

The data collected for each of the nominated sites were then analysed to identify any site which ranked as consistently weak on the basis of one or more of these critical characteristics. Where this occurred, the merit of continuing to compare this site with the others was reviewed, and a decision taken on whether to recommend its deletion from the short-listing process. At this stage, Darkes Forest, Holsworthy and Goulburn were assessed as having severe liabilities as airport sites, and were deleted from the list of sites warranting further consideration.

Each of the remaining sites was then separately assessed on the basis of all of the sub-factors, and compared with the other sites in its group in order to identify the superior site or sites within each group. This evaluation showed Badgerys Creek to be the superior site within the group of four remaining closer sites, while Wilton was the superior site within the group of three remaining mid-distance sites. A recommendation was then made to the Commonwealth Government to short-list the Badgerys Creek and Wilton sites for more detailed evaluation in this Draft Environmental Impact Statement, and on 18 September 1984 the Minister for Aviation announced the Government's decision to do so.

SELECTION OF THE SHORT-LISTED SITES

Darkes Forest, Goulburn and Holsworthy

As indicated, Darkes Forest, Goulburn and Holsworthy had each displayed one or more severe disadvantages in comparison with the other sites. The question that was addressed in judging whether these three sites should be considered for further intensive investigation was whether such investigation would uncover any information that would alter significantly the poor ranking each of these sites had received. The conclusion reached was that it would not, and these sites were therefore deleted from further consideration. The principal disadvantages of the Darkes Forest, Goulburn and Holsworthy sites were:

- the assessed probability of adverse meteorological conditions (wind shear, fog and turbulence) that would render the Darkes Forest site unsafe for use as an airport;

- the distance of the Goulburn site from Sydney;

- the topographic constraints at Holsworthy which would restrict the primary runway alignment to an orientation that would necessitate the closure of Bankstown airport and that would result in significant site preparation costs.

The remaining closer sites compared

Having deleted these three sites, 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 operations factors.

Given the site and location constraints at Londonderry and Scheyville, it was not readily apparent that some of their respective disadvantages within the closer group of sites could be reduced to a scale that would make either competitive with a site in the area of Badgerys Creek. It was further concluded that, in view of the scale of relocation of people that acquisition of the Bringelly site could occasion, 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 remaining mid-distance sites compared

The three remaining mid-distance sites — Somersby, Warnervale and Wilton — were then compared in terms of the four major factors of environment, access, operations and cost. Wilton emerged from this evaluation as the superior site, closely followed by Somersby. Wilton's advantages over Somersby were in the area of cost and environmental impact, although Somersby's environmental impact disadvantage was possibly marginal, as the Wilton site is located in the catchment area for Sydney's water supply. Wilton and Somersby were comparable in terms of accessibility. However, the principal advantage enjoyed by the Wilton site was the very small number of people who would be affected by site acquisition or noise impacts.

Warnervale offered very few advantages as a second Sydney airport site over these other two mid-distance sites. Warnervale is considered by State Government authorities as an attractive area for current and longer term urban growth and, with the exception of its lesser impacts on flora and on sites of archaeological and Aboriginal interest, Warnervale offered no advantages over Somersby or Wilton on environmental grounds. In terms of access it was clearly inferior to these other two sites. Although it was ranked better on certain cost attributes (the cost of site preparation and new infrastructure), site acquisition costs at Warnervale were higher than at either Wilton or Somersby.

The closer and mid-distance sites compared

The analysis undertaken of the ten nominated sites therefore concluded that Badgerys Creek was clearly the superior closer site, while Wilton was the superior of the mid-distance sites. However, to make a comparison between these two sites would involve a comparison between factors that have no common measure. The closer sites characteristically are more accessible but involve greater socio-economic impacts and cost more to acquire. Conversely, the mid-distance sites are less accessible to potential airport users but involve lower socio-economic impacts and lower acquisition costs. A choice between a site at Badgerys Creek or Wilton will therefore involve, explicitly or implicitly, compromises between issues of accessibility on the one hand and environmental impact and cost on the other, and preference depends on the weighting or value which individuals attach to these factors. In this sense, therefore, there can be no 'best' site.

In preparing a short-list of two (or three) sites from the list of ten nominated locations, there were a number of choices available for comparison in this Draft Environmental Impact Statement. These comparisons could have included:

- two similar sites (two of the closer site group)
- two different sites (one closer and one mid-distance)
- three sites (two closer and one mid-distance)
- three sites (one closer and two mid-distance).

After considering all these possibilities, the Consultant recommended that only two sites be compared in detail in the Draft Environmental Impact Statement, and that these should be from two different site groups (i.e. Badgerys Creek as the superior of the closer sites and Wilton as the superior of the mid-distance sites) in order to enable the necessary compromise between environmental and access characteristics to be more thoroughly addressed. It was judged that this would be more consistent with the basic objective of the Site Selection Programme, which was to contribute to the resolution of Sydney's future airport needs in an environmentally acceptable manner.

Approach to the comparison of the Badgerys Creek and Wilton sites

The detailed comparison of the Badgerys Creek and Wilton sites involved the following steps:

- The assumptions for the worst case used in the short-listing phase were reviewed and the following revised assumptions were adopted:

  - the maximum level of development (or worst case) that could be accommodated within the proposed sites would be for an airport with a capacity of 275,000 annual aircraft movements and 13 million annual passenger movements on a widely spaced parallel runway layout without a cross-wind runway;

  - the second Sydney airport would serve all types of aircraft, ranging from small piston-engined general aviation aircraft to large, wide bodied jet aircraft (including a future generation of larger aircraft which could have wing-spans of up to 95 m);

  - the operational mix of aircraft activity would be similar to that currently experienced at major airports but with a higher proportion of general aviation;

  - the future airport would operate without a night curfew.

- Additional runway orientations were investigated within the broad area within which the notional Badgerys Creek and Wilton sites were situated, and specific site boundaries were defined.

- Preliminary airport master plans were prepared.

- A detailed environmental assessment was then undertaken for each site in accordance with the Draft Environmental Impact Statement Guidelines. This assessment covered the environmental impacts and proposed safeguards at each site for the phases of site acquisition, airport construction and airport operations, under the following headings:

  - effects on the socio-economic environment, covering:

    - land acquisition
    - noise
    - archaeology
    - concerns of Aboriginal people
    - European heritage
    - economic effects
    - agriculture
    - regional planning;

  - effects of the physical environment, covering:

    - geology, soils and physiography
    - water quality
    - air quality
    - road and rail access
    - relocation and provision of other infrastructure
    - landscape;

  - effects on the biological environment, covering:

    - flora
    - fauna.

The environmental effects of the proposals at Badgerys Creek and Wilton are assessed under these categories in Parts B and C of the report which are summarized below.

PART B THE PROPOSAL AT BADGERYS CREEK

LOCATION OF THE PROPOSED SITE AT BADGERYS CREEK

The proposed airport site at Badgerys Creek is located in the Liverpool local government area, between the villages of Luddenham and Badgerys Creek, about 46 km directly west of the centre of Sydney. It is situated on a ridge system at an average elevation of about 80 m above sea-level and drains into South Creek and the Nepean River.

The proposed airport site at Badgerys Creek (Figure 2) comprises about 1,770 ha of flat to undulating land containing a mixture of agricultural and rural residential development and incorporates the village area of Badgerys Creek. Agricultural activities include poultry, grazing for horses, cattle production, dairying and market gardening. About 16.6 km of local roads are within the proposed site boundary as well as a section of an existing 330 kV transmission line.

Much of the surrounding land use is devoted to agriculture, particularly poultry production, dairying, grazing and market gardening. However, there are also a number of specialized facilities nearby, including the Fleurs Radio Observatory, the Overseas Telecommunications Commission (Australia) radio receiving station, various facilities operated by the Department of Defence, the CSIRO's McMaster research station, and the University of Sydney's McGarvie Smith farm.

PRELIMINARY AIRPORT MASTER PLAN

For the short-listing phase of the study, an airport layout for the Badgerys Creek site with a north-west/south-east primary runway orientation was used. Subsequent to the short-listing of Badgerys Creek, two additional orientations were examined. These were a north/south alignment (published in the press-release of 18 September announcing the short-listing of the Badgerys Creek and Wilton sites), and a north-east/south-west alignment. The preliminary master plan (Figure 3) and the proposed site boundary are based on the north-east/south-west alignment, which was selected because of its lesser noise impacts.

The final choice of layout (a widely spaced parallel runway layout) was adopted because it enabled a significant increase in planning flexibility with a minimum increase in land area and cost when compared to either a single runway or a closely spaced parallel runway layout. The need for a cross-wind runway was examined and it was concluded that it was not necessary. This was because a 95% wind coverage was considered reasonable for a second airport where other airports with different runway orientations are within reasonable flying distance.

To ensure that the proposed airport would meet current as well as future aviation needs, the Department of Aviation's layout criteria allow for larger aircraft than are presently in production: aircraft with wing-spans of up to 95 m could ultimately be accommodated. A runway length of 4,000 m was adopted for the long runway after considering the maximum stage lengths for large international aircraft and domestic aircraft, as well as the effects of elevation and temperature. The layout also made provision for a shorter, parallel runway to accommodate aircraft up to 60 m wing-span on shorter stage lengths and to provide separation from the wake vortices of large aircraft.

The area provided for terminal facilities is located between the two parallel runways. It is capable of accommodating a variety of terminal concepts in response to roles that the second airport may develop.

Airspace arrangements

The development of a second Sydney airport at Badgerys Creek would require changes to the existing allocation of airspace in the Sydney Region. A new control zone would have to be established around the airport at Badgerys Creek, and a combined control area created for Kingsford-Smith Airport and the second airport at Badgerys Creek. Arriving traffic would need to be split into flows towards either Kingsford-Smith Airport or the second Sydney airport at some point en route at a distance of perhaps 100 nautical miles from Sydney, while traffic departing from either airport and using a similar route to their destinations would need to join this common route at some distant point from the airports.

In defining the control area for a second Sydney airport at Badgerys Creek, the requirement to preserve access to Bankstown and Camden aerodromes would need to be taken into account. Changes to the control zone of RAAF Base Richmond would be required and there may need to be some increased sharing of what is now military airspace with civil operations. Restricted areas around the Holsworthy Army Base and the Kingswood Defence facility would give rise to some restrictions on civil movements. The Fleurs Radio Observatory would have to cease operations.

In addition, the control zone for a future airport at Badgerys Creek would remove almost all of the present designated flying training areas, and Hoxton Park aerodrome would probably have to be closed. While Bankstown and Camden could continue to operate on the edges of the control zones for Kingsford-Smith Airport and a future airport at Badgerys Creek, it would not be possible for these aerodromes to have adjacent training areas. However, uncontrolled airspace for training could be made available if the airspace restrictions at Richmond and Holsworthy were reduced.

Australian Survey Office – flown 7.10.84

Final delineation of boundary subject to survey

Figure 2
PROPOSED BADGERYS CREEK SITE

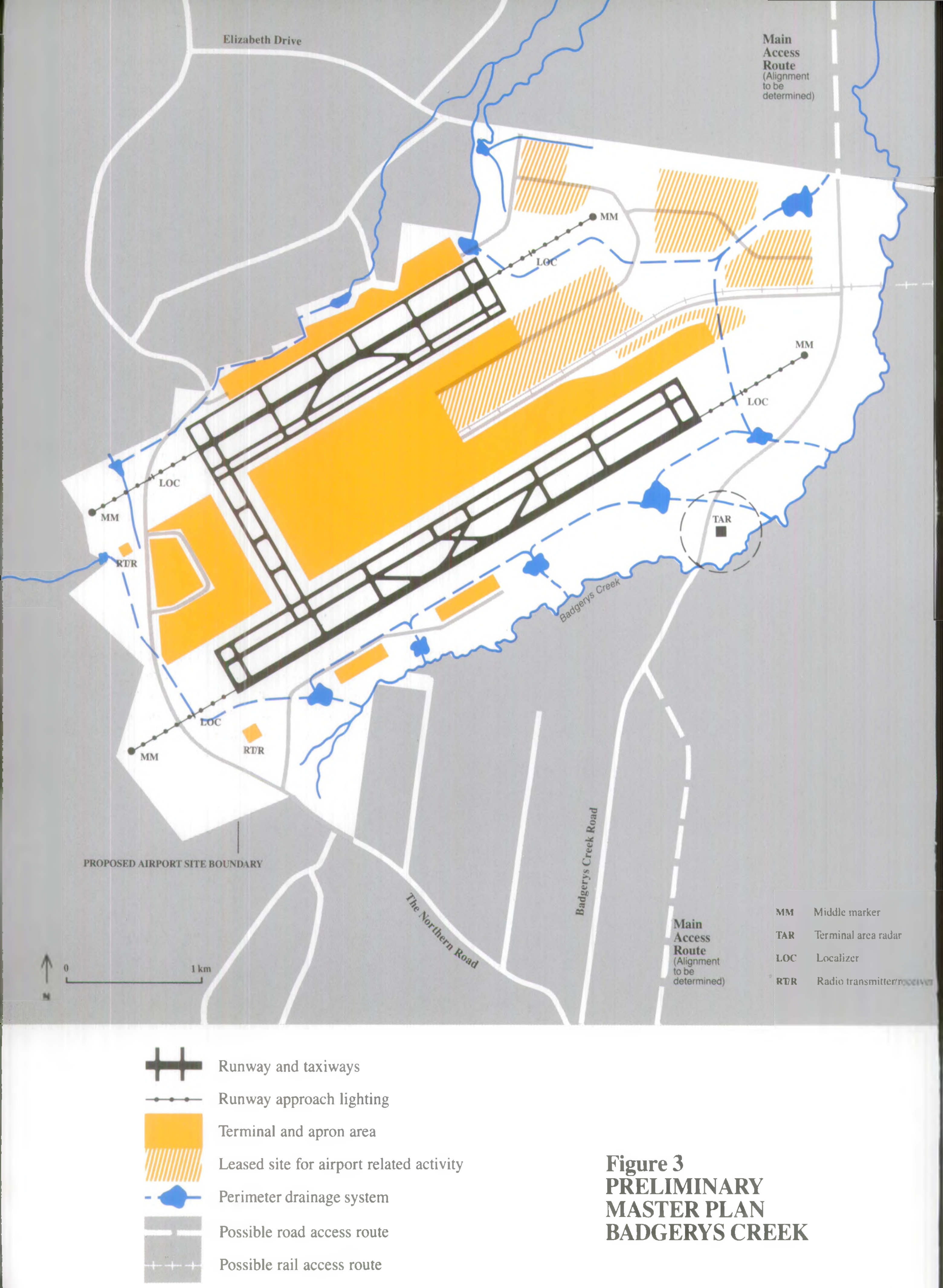


Figure 3
PRELIMINARY MASTER PLAN BADGERYS CREEK

THE SOCIO-ECONOMIC ENVIRONMENT AND EFFECTS OF THE PROPOSAL AT BADGERYS CREEK

Land acquisition

The proposed site at Badgerys Creek covers an area of 1,770 ha (Figure 2). There are 241 separate titles within the boundary, and the market value of privately owned land and improvements within the proposed site is estimated at $31.5 million. The number of houses located within the boundary is estimated at 207 and the total resident population at approximately 750. There are no proposals at this time to acquire land for road or rail access routes, or for airport related land uses outside the boundary of the proposed site shown in Figure 2.

Prior to the announcement of the site finally selected, residents within the proposed acquisition area at Badgerys Creek will be adversely affected by the uncertainty surrounding the selection process. If the Badgerys Creek site were chosen, the effects on existing residents would partly depend on whether the Commonwealth proceeded by compulsory acquisition of all properties or by progressive acquisition through agreement with land owners. In those cases where the original owner requested continued occupation pending construction of the airport, the Commonwealth would lease back acquired land at a fair market rental.

Noise

Assessments of the effects of aircraft noise were carried out for two alternative runway alignments at Badgerys Creek: the 'proposed' north-east/south-west alignment and the 'alternative' north/south alignment. These assessments assumed full development of the airport site to a worst case capacity of approximately 13 million annual passenger movements. Noise contours were plotted for 20, 25, 30 and 40 ANEF. The maximum population capacity of the land within these contours was calculated on the basis of existing residential densities and those permitted under existing zoning. Using the method developed by the National Acoustic Laboratories, the potential number of people within the 20 ANEF contour likely to be 'seriously' or 'moderately' affected by aircraft noise was estimated to be as shown in Table 1.

Table 1 Population moderately or seriously affected by noise - Badgerys Creek

Badgerys Creek alignments	Number of people within 20 ANEF contour		
	Total potential population	Likely to be moderately affected by noise*	Likely to be seriously affected by noise
Proposed (NE/SW) alignment	1,951	1,115	364
Alternative (N/S) alignment	4,380	2,399	726

* Includes those seriously affected.

Archaeology

One Aboriginal archaeological site was located during the field survey of the proposed site. This was found on ploughed and devegetated ground beside Badgerys Creek and consisted of a scatter of five silcrete flakes and flaked pieces. This site, and others which may exist along Badgerys Creek, would not be affected by development of the airport, as the eastern airport boundary fence would be set back from the creek bank.

Concerns of Aboriginal people

The site lies within the Gandangara Local Aboriginal Land Council area. The archaeological site survey indicates that the area that would be cleared is archaeologically insensitive and there would thus be no damage to archaeological sites of potential significance to Aboriginal people. However, Aboriginal people in the Gandangara Local Land Council have expressed strong opposition to the development of this site as an airport, on the grounds that it would adversely affect the quality of their environment and present way of life and has the potential to cause damage to sites of significance to Aboriginal people in the general vicinity.

European heritage

There has been a complex pattern of European settlement at Badgerys Creek, which began in 1813. Originally one major land grant, the area was progressively subdivided throughout the nineteenth and twentieth centuries for small farms, orchards and gardens, as well as some stock farming. More recent twentieth century developments include battery hen farming and horse studs; one vineyard is also known.

Very little physical evidence of the nineteenth century developments survives within the proposed site area. Extant structures predominantly date from the 1920-1940 period and from 1960-1970. No European heritage sites have been registered or recorded within the site or within the 25 ANEF noise contour, although aerial photography does indicate some potential for such sites as does an assessment of the historical literature.

The majority of the standing historical structures are of only local importance and of minimal heritage value, and similar patterns of development could be expected to be found outside the area that would be affected by a future airport. Therefore, although airport construction would remove any extant evidence of earlier occupation, generally this could not be considered a significant impact in historical terms. Vicary's Winery, however, is an exception, as it is a resource of regional importance.

In addition, there is a possibility that there may be some archaeological material under the surface of the site and, if this dated from the first half of the nineteenth century, it would be of national interest and heritage value.

Economic effects

There are unlikely to be any significant economic effects in the area arising from compensation payments for land acquired by the Commonwealth, as land owners may not re-invest such monies in local economic activities, and economic use of the land would continue under lease arrangements until such time as site development commenced. At that time, the negative economic effects of discontinuing the original land use would be outweighed by the positive effects on the local economy of airport associated construction and permanent employment.

Direct employment associated with a second Sydney airport operating at 13 million annual passenger movements could be as high as 10,500 jobs in the sub-region. Airport associated employment and induced employment could add a further 600 to 1,000 jobs, while flow-on employment in the Sydney Region could be up to 10,500 jobs of which up to 2,300 could be within the sub-region. A total of about 22,000 new jobs could be created by the airport operations under the worst case of 13 million annual passenger movements.

Agriculture

It is estimated that about 1,405 ha (or 79%) of the proposed site are presently used for agriculture, and a further 1,890 ha within the 25 ANEF contour are also used for agriculture. The principal agricultural activities within the site and its environs are beef cattle grazing, dairying, horse agistment, trotting horse training and spelling, and thoroughbred horse spelling. Other agricultural activities are pigs, poultry, nurseries and vegetable farming. The area is important for the number of broiler chickens produced, and for the production of tomatoes for the fresh market.

The current annual gross value of agricultural production from within the proposed site is estimated to be $5 million, while the corresponding figure for the area outside the site but within the 25 ANEF contour is estimated to be $3.3 million. The total of $8.3 million represents 17% of the combined value of agricultural production in the cities of Liverpool and Penrith. In the absence of airport development, agricultural production is likely to be maintained in the short term. However, in the longer term the area is likely to be subdivided further for hobby farming and residential development.

Some of the present production from within the airport site would be relocated to other areas, which would partly compensate for the loss of production from this area. Most of the present agricultural activities outside the proposed site area but within the 25 ANEF contour would continue after the airport commenced operations. The effect of aircraft noise on agricultural production is likely to be small, as available evidence suggests that livestock become conditioned to such an environment.

Regional planning and development

A decision on a second airport site would remove the necessity to restrain urban development in areas near other candidate sites. At the sub-regional level, subsequent airport development and land use requirements for activities associated with airport development could be readily accommodated. While some existing uses would be displaced, the principal effect of a future airport in regional planning terms would be to change the sequence in which the potential urban areas already identified were developed rather than to add to the total extent of urban development.

The extent of the effects of electromagnetic interference, noise and certain other airport related activities on various research and technical facilities in the region is uncertain, but it is evident that some facilities would become inoperable if a high level of aircraft operations occurred. These facilities include:

- Fleurs Radio Observatory
- Fleurs airstrip
- Coast Radio Receiving
- Bringelly Remote Receiver Station
- CSIRO Field Station
- McGarvie Smith Animal Husbandry Farm.

However, even in the absence of airport development, future metropolitan growth and technological change may adversely affect the long term viability of these facilities in their present locations.

If the Badgerys Creek site were chosen for acquisition for future airport development, comprehensive land use planning measures would be required to direct development in the potentially noise-affected areas, in order to prohibit inappropriate uses, to identify land for future airport associated uses, and to address the relationship of the airport to other planning issues in the region.

It is proposed that the development of a strategic land use plan for the area in the proximity of the selected airport site would be included in the Macarthur Regional Environmental Plan.

THE PHYSICAL ENVIRONMENT AND EFFECTS OF THE PROPOSAL AT BADGERYS CREEK

Geology, soils and physiography

Both unconsolidated Quaternary sediments and consolidated Triassic rocks (Bringelly Shale) occur within the proposed site. The unconsolidated sediments cover about 5% of the site, mainly along Badgerys Creek. A basalt dyke within the site coincides with the elevated ridge extending south-east from Luddenham.

The site lies within one of a number of areas identified by the NSW Department of Mineral Resources as potential sources of light-firing clay/shale. That Department has recently commenced a drilling and testing programme to identify suitable areas for extraction, but the results of this investigation will not be known for twelve months or more. The site is also underlain by about 40 Mt of coal at a depth of approximately 830 m. However, because of the relative depth of this resource, it is unlikely to be mined within the foreseeable future.

The terrain of the proposed site ranges from flat to gently undulating. Construction of an airport at this location would require a major portion of the site to be reshaped, although most of the cut-and-fill would be less than 10 m deep. Total excavation for the siteworks is estimated at 15.754 million m^3, with fill estimated at 15.823 million m^3. Methods for minimizing erosion and sedimentation would be incorporated in the planning and implementation procedures for all earthworks. A small proportion of the soils within the proposed site are likely to be saline, and special techniques would be used to re-establish vegetation on these areas.

The construction of the proposed airport would require about 2.975 million m^3 of construction material, ranging from sub-base material to concrete. Most of this material could be obtained from site earthworks or from established sources of supply.

Drainage and water quality

The major part of the site drains into South Creek, with a small section draining into the Nepean River at Wallacia. A series of detention basins would be constructed to control run-off from the site, and to separate contaminated from non-contaminated stormwater. Flooding along the creeks is unlikely to be increased, as retarding capacity for the peak flow from a 1:100 year storm would be provided by the major drainage basins.

Discharges of stormwater and treated wastewater from the site could increase forecast nitrogen and phosphorous loads in South Creek by 2.2% and 2.0% respectively by the year 2000.

Air quality

Air emissions related to airport operations could increase the future estimated level of emissions in the Sydney Region by 0.6% for carbon monoxide, 0.5% for hydrocarbons and 2.1% for nitrogen oxides.

Access

If an airport were developed to the worst case traffic level of 13 million annual passenger movements, a number of roads would need to be upgraded, particularly the South Western Freeway east of Liverpool, Bringelly Road, Elizabeth Drive, and The Northern Road. It would also be necessary to relocate Badgerys Creek Road and a section of The Northern Road, while a new road would need to be built from Erskine Park Road to Badgerys Creek Road. The major traffic increases would be restricted to Bringelly Road and the western section of Elizabeth Drive. Other roads would experience increased traffic flows, but these increases would not be out of character with the anticipated role of those roads in the road network as the western and southern suburbs developed. If no rail link were provided, the implications for the road network would be more significant, but not markedly so.

Possible rail connections to the site are via St Marys or via Glenfield. A route via St Marys could connect the Badgerys Creek site to the Parramatta city centre as well as to the Sydney city centre, while a route via Glenfield would be shorter and faster to the Sydney city centre.

Average travel times in peak hour (end-to-end trip duration) for air passengers would be as follows:

- by road: 69 minutes
- by rail via St Marys: 72 minutes
- by rail via Glenfield: 68 minutes.

Infrastructure

The proposed site is outside the area presently serviced by the Metropolitan Water Sewerage and Drainage Board for both water supply and sewage disposal, and the Board has no current plans for extending these services to the site or its environs. Construction of such facilities would have to be programmed to service the airport and surrounding development at the appropriate time.

Other services that would be affected by acquisition and development of the proposed site are the existing local power and telecommunication services, and a 330 kV transmission line that would need to be relocated. This line is also programmed for upgrading to 500 kV and present Electricity Commission plans for this would have to be abandoned in favour of a more expensive and environmentally less acceptable southern route.

Landscape and visual quality

Over 95% of the site is classed as having minimal visual quality, with the only distinctive feature being a partially vegetated ridge system. Most of the site would be cleared of vegetation and existing structures, and earthworks would level much of the high ground. The existing landscape and visual character of the site would thus be irreversibly altered by airport development.

THE BIOLOGICAL ENVIRONMENT AND EFFECTS OF THE PROPOSAL AT BADGERYS CREEK

Flora

The proposed airport site is largely cleared for agricultural use. There are only small scattered stands of vegetation containing native species, and the stands are moderately to heavily disturbed. Only one native plant community is present in the area, Eucalyptus tereticornis—E. moluccana woodland. Examples of this vegetation community are contained within reserves in the Sydney area, and the community at the proposed site is considered of low floristic value.

However, one species of plant found in the study area, Pultenaea parviflora, is not adequately conserved in New South Wales and is regarded as a vulnerable species. This species occurs in a limited area on the site and would be threatened by airport development.

Fauna

The Badgerys Creek site is mainly cleared farming land, with small amounts of remnant shale vegetation, particularly along Badgerys Creek. Field surveys indicate a low diversity of fauna within the site, with sixty-one birds, one native mammal, fourteen reptiles and two amphibian species being recorded. Although there was little difference between habitats, the creek habitat supported the highest number of species. Dams within the site supported a high number of water birds, although dams outside the site had a higher faunal diversity.

There are no species within the site that are regarded as being of high conservation importance, and the site itself is considered to be of low ecological value. Construction of an airport at this site would therefore have little impact on the overall status of the wildlife species.

PART C THE PROPOSAL AT WILTON

LOCATION OF THE PROPOSED SITE AT WILTON

The proposed site at Wilton is located in the Shire of Wollondilly, south of the village of Wilton and about 81 km by road south-west of Sydney. The local government areas of Camden, Liverpool, Wingecarribee, Wollongong and Campbelltown surround the site. The predominant land uses on and adjacent to the site include water catchment area, State forest and rural areas.

The site is 1,440 ha in area and is situated on a knoll, at an average elevation of about 310 m above sea-level (Figure 4). This knoll separates the drainage areas of the Cascade Creek, Wallandoola Creek, Cordeaux River and Allens Creek. About 86% of the proposed site is situated within the Metropolitan Catchment. The balance of the site drains directly into Allens Creek, which eventually flows into the Nepean River.

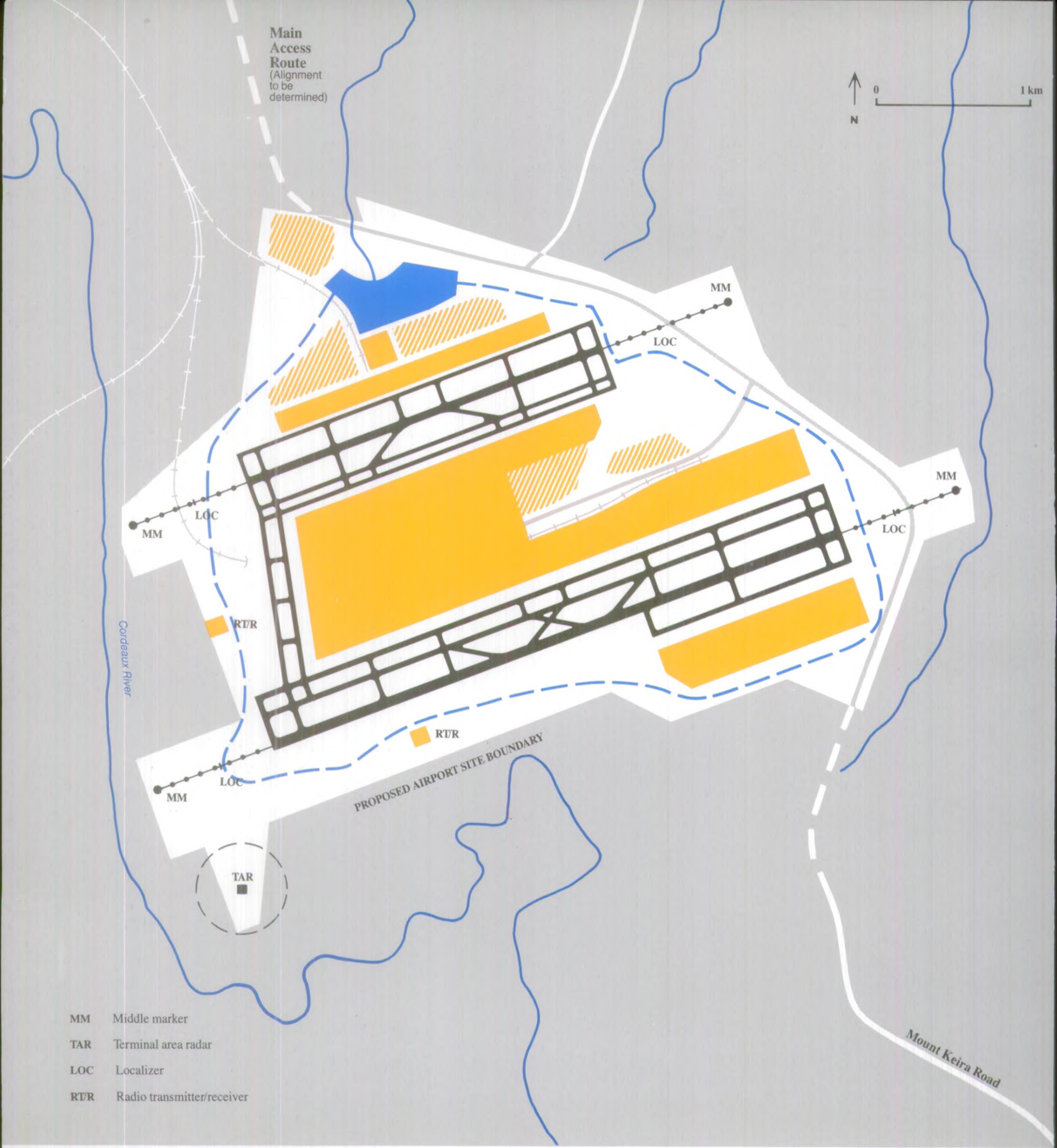
The proposed site includes about 10 km of access tracks used by the Metropolitan Water Sewerage and Drainage Baord, an abandoned airstrip that was built about 1940, about 2 km of 330 kV transmission line forming part of the Sydney South to Dapto supply service, a 4 km section of Mount Keira Road and about 4 km of the Wollongong natural gas pipeline.

PRELIMINARY AIRPORT MASTER PLAN

In determining a location for an airport site at Wilton, significant choices had to be made between a site within the Metropolitan Catchment or one further to the north and over much of the town of Wilton. The latter location was used for the short-listing analysis and was published in the press-release of 18 September announcing the short-listing of the Wilton and Badgerys Creek sites. However, the location now proposed is the one to the south of Wilton within the Metropolitan Catchment, with the runway aligned approximately east/west (Figure 5).

After consultation with officers from the Metropolitan Water Sewerage and Drainage Board, the Department of Aviation concluded that it was feasible to isolate the drainage from the airport site to avoid adversely affecting the quality of water within the catchment. The present site location has considerable benefits in terms of site acquisition cost, noise effects and earthworks, although aspects of the natural environment would be adversely affected.


Figure 4
PROPOSED
WILTON
SITE
Wilton Aerodrome
Hume Highway (South Western Freeway)
Wilton
Wilton Road
Railway Under Construction
Allens Creek
Cordeaux River
Mount Keira Road
Cascade Creek
330 kv Transmission Line
Abandoned Landing Ground
PROPOSED AIRPORT SITE BOUNDARY
0
1 km
N
Australian Survey Office – flown 7.10.84
Final delineation of boundary subject to survey



Runway and taxiways

Runway approach lighting

Terminal and apron area

Leased site for airport related activity

Perimeter drainage system

Possible road access route

Possible rail access route

Figure 5
PRELIMINARY MASTER PLAN WILTON

The final choice of layout (a widely spaced parallel runway layout) was adopted because it enabled a significant increase in planning flexibility and airport capacity with a minimum increase in land area and cost. The need for a cross-wind runway was examined, and it was concluded that it was not necessary. This was because a 95% wind coverage was considered reasonable for a second airport where other airports with different runway orientations are within reasonable flying distance.

To ensure that the proposed airport would meet current as well as future aviation needs, the Department of Aviation's layout criteria allow for larger aircraft than are presently in production: aircraft with wing spans of up to 95 m could ultimately be accommodated.

A runway length of 4,000 m was adopted for the long runway after considering the maximum stage lengths for large international aircraft and domestic aircraft, as well as the effects of elevation and temperature. The layout also made provision for a shorter, parallel runway to accommodate aircraft with up to 60 m wing-span on shorter stage lengths and to provide separation from the wake vortices of large aircraft.

The area provided for terminal facilities is located between the two parallel runways. It is capable of accommodating a variety of terminal concepts in response to roles that the second airport may develop.

Airspace arrangements

A second Sydney airport located at Wilton would not affect military or restricted airspace in the Sydney Region, although the continued existence of the Holsworthy restricted airspace would impose some restrictions on its operations.

General aviation aircraft operating outside controlled airspace are currently denied access to the coast for a distance of 20 nautical miles south of Bankstown because of this Holsworthy restricted area. The Wilton control zone would form another constraint and increase this distance to 40 nautical miles. If Holsworthy firing activities ceased and the airspace restriction were removed, access to the south from Bankstown would be greatly improved.

THE SOCIO-ECONOMIC ENVIRONMENT, AND EFFECTS OF THE PROPOSAL AT WILTON

Land acquisition

The total area of the proposed site is 1,440 ha. Of this, 1,295 ha are in government ownership. The balance, 145 ha, is held by three private companies and would be acquired either by agreement or compulsorily. The market value of land and improvements within the proposed site has been extimated at $1.8 million.

There is one dwelling on the site, and it is estimated that less than ten people would therefore be displaced by site acquisition. For the alternative more northerly site it was estimated that approximately 300 people would be displaced by site acquisition.

Noise

Using the same procedure as described for the proposed Badgerys Creek site, the effects of aircraft noise from operation of an airport at Wilton for the worst case condition were assessed for the proposed east/west alignment and for an alternative north/south alignment. The potential number of people within the 20 ANEF contour likely to be 'seriously' or 'moderately' affected by aircraft noise was estimated to be as shown in Table 2.

Table 2 **Population moderately or seriously affected by noise — Wilton**

Wilton alignments	Number of people within 20 ANEF contour		
	Total potential population	Likely to be moderately affected by noise*	Likely to be seriously affected by noise
Proposed (E/W) alignment	130	68	18
Alternative (N/S) alignment	242	147	54

* Includes those seriously affected.

Archaeology

A survey of the proposed site and its immediate environs was conducted based on the archaeological sensitivity of environmental zones identified during the site ranking investigations. The landscape-based system of sensitivity was further refined while in the field, and areas deemed likely to have the greatest sensitivity were accorded the most thorough examination. In the lower reaches of creeks crossing the study area, several rock shelter sites containing Aboriginal drawings and possible archaeological deposits were located. One of these shelter sites was situated low in the valley of Allens Creek, the floor of the shelter being approximately 1 to 1.5 m above the creek bed. If any permanent increase in the level of water flow in Allens Creek were to occur as a result of airport development, the Aboriginal art could be damaged or destroyed.

Concerns of Aboriginal people

The proposed airport site lies on the boundary between the areas of the Tharawal and Illawarra Local Aboriginal Land Councils. Aboriginal people have given conditional support to the concept of airport development, but have also expressed concern about possible adverse effects on the surrounding country which is of current and traditional importance to them.

European heritage

Wilton has had a relatively short history of European development, due mainly to geographic and environmental factors such as poor agricultural land, difficult access, and unfavourable terrain. These factors inhibited development until late into the nineteenth century and settlement was sparse even at that time. There is no physical historical evidence remaining on the land owned by the Metropolitan Water Sewerage and Drainage Board because of a policy to remove all structures on catchment land. There were no sites noted of heritage value in the remaining privately owned portion of the proposed site nor were any recorded sites identified within the 25 ANEF contour.

Economic effects

In the event of airport development, the negative effect of the loss of 65 ha of grazing land on the proposed site would be outweighed by the positive effects on the local economy of airport construction and permanent employment. Direct employment associated with a second Sydney airport operating at 13 million annual passenger movements could be as high as 10,500 jobs in the sub-region. Airport associated employment and induced employment could add a further 600 to 1,000 jobs, while flow-on employment in the Sydney Region could be up to 10,500 jobs of which up to 2,300 could be within the sub-region. A total of about 22,000 new jobs could be created by the airport operations under the worst case of 13 million annual passenger movements.

Agriculture

There is very little agricultural activity within the proposed site or in the areas that would be affected by aircraft noise, as the majority of the potentially affected area is situated within the Metropolitan Catchment. The gross value of production from the 65 ha of agricultural land within the site has been estimated to be $195,000 per annum, which represents about 0.3% of the annual value of agricultural production in the Wollondilly Shire. In the absence of airport development, this production is likely to be maintained in the short term, but in the longer term the area would probably be subdivided further for hobby farming or for residential development.

Regional planning and development

A decision on a second airport site would remove the necessity to restrain urban development in areas near other candidate sites. At the sub-regional level, subsequent airport development and land use requirements for activities associated with airport development could be readily accommodated. While some existing uses would be displaced, the principal effect of a future airport in regional planning terms would be to change the sequence in which the potential urban areas already identified were developed rather than to add to the total extent of urban development.

In the longer term, if the Wilton site were selected for the second Sydney airport, comprehensive land use planning measures would be required to direct development in the noise-affected areas, in order to prohibit inappropriate uses, to identify land for future airport associated uses and to address the relationship of the airport to other planning issues in the region. It is proposed that a strategic land use plan for the area in the proximity of the selected airport site would be included in the Macarthur Regional Environmental Plan.

THE PHYSICAL ENVIRONMENT AND EFFECTS OF THE PROPOSAL AT WILTON

Geology, soils and physiography

Triassic rocks of the Wianamatta Group (Ashfield Shale), Mittagong Formation and Hawkesbury Sandstone outcrop over the proposed site. The site is located within the Woronora Plateau physiographic sub-region of the Sydney Basin at an average elevation of about 310 m.

The Department of Mineral Resources has indicated that there are no regionally significant identified or potential extractive resources within the proposed airport site at Wilton. However, there are about 50 Mt of in situ coal beneath the site which could be economically mined. The likely effects of the future airport on the sterilization of coal resources beneath the site cannot be determined at this stage, because the timing of both airport development and coal extraction is uncertain.

The terrain of the proposed site incorporates flat land, gently undulating slopes, and steeply dissected gorges. The construction of an airport at this site would require a major portion of the site to be reshaped.

A system incorporating a perimeter drainage canal with integrated detention ponds has been proposed to divert all contaminated site run-off away from the Metropolitan Catchment protection area. This drainage system would be constructed and stabilized prior to any additional earthworks proceeding on the proposed airport site.

Airport development would require about 2.975 million m^3 of construction material ranging from sub-base material to concrete. Most of this material could be obtained from site earthworks or from established sources of supply. Total excavation for the siteworks is estimated at 14.163 million m^3, with fill estimated at 14.035 million m^3.

The site is located in an area of seismic activity between the Modified Mercallie Scale ground intensity contours V and V1 which are expected to be exceeded on average once in 100 years. Vibration arising from seismic activity at this intensity would not be an impediment to airport development.

Drainage and water quality

Approximately 86% of the site drains into the Wallandoola and Cascade Creeks and the Cordeaux River, the waters of which enter Sydney's water supply system via the Nepean and Cataract tunnels. The balance of the site drains into Allens Creek, which is a tributary of the Nepean River.

To avoid airport development or operation contaminating Sydney's water supply, the preliminary master plan for the Wilton site incorporates a perimeter drainage canal which would divert all contaminated site run-off from the Metropolitan Catchment to a retarding basin on Allens Creek. Flows from this basin would be regulated to ensure that the flow in Allens Creek from a 1:100 year storm event would not be increased by the airport development. Smaller retention basins around the site would accept the first flush of stormwater, enabling suspended material to settle before the water was discharged.

Sewage, and process waste from operations such as aircraft maintenance would be treated either on site or at a Metropolitan Water Sewerage and Drainage Board water pollution control plant located off site and serving a wider area. The contribution to the nutrient load in the Nepean River downstream of Camden which would be attributable to airport operations is not expected to exceed 2.2% of the forecast nitrogen load and 1.9% of the forecast phosphorous load in the year 2000.

Air quality

Air emissions related to airport operations would increase the future estimated level of emissions in the Sydney Region by 0.6% for carbon monoxide, 0.5% for hydrocarbons and 2.1% for nitrogen oxides.

Access

If an airport were developed to the worst case air traffic level of 13 million annual passenger movements, upgrading of the South Western Freeway, Wilton Road and Mount Keira Road would be required. With the possible exception of Wilton Road, the environmental implications of increased traffic flows would be relatively minor. If no rail link were provided, the implications for the road network would be more significant, but not markedly so.

Possible rail connections to the proposed site are via Maldon Junction, and via a possible suburban railway from Macarthur south through Appin. This route via Appin would cost more than the Maldon alternative, but would provide additional benefits to the developing Macarthur area.

Average travel times in peak hour (end-to-end trip duration) for air passengers would be as follows:

- by road: 102 minutes
- by rail via Douglas Park: 90 minutes
- by rail via Appin: 84 minutes.

Infrastructure

The proposed site is outside the area presently serviced by the Metropolitan Water Sewerage and Drainage Board for both water supply and sewage disposal, and the Board has no current plans for extending these services to the site. Construction of water and sewerage facilities would have to be programmed to service both the airport and surrounding development at the appropriate time.

Other services likely to be affected by airport development include existing and proposed electrical transmission lines and a small section of the gas pipeline to Wollongong. These would require relocation.

Landscape and visual quality

An assessment of the landscape character of the proposed site indicates that over 80% is of minimal landscape or scenic quality, as it is located on a plateau which is a common feature of the surrounding region. About 5% of the site area has been identified as having a relatively distinctive landscape quality, and about 70% of this would be affected by airport development. However, the loss of this distinctive feature would not be significant when compared to the remaining areas surrounding the site.

THE BIOLOGICAL ENVIRONMENT AND EFFECTS OF THE PROPOSAL AT WILTON

Flora

A large proportion of the site carries native vegetation. This vegetation is relatively undisturbed, as indicated by the large number (more than 350) of native plant species present. Much of this vegetation would be lost if airport development were to proceed. Of particular importance would be the loss of an unusual stand of open forest growing on a shale-capped plateau in the middle of the site. Several rare species of plants would also be affected. The site is regarded as having significant value for the preservation of the flora of the Sydney Region and of the State as a whole. If airport development at this site to proceed, impact on this flora would be unavoidable.

Fauna

There is a high diversity of fauna within the proposed site: ninety-six bird, twelve native mammal, nine reptile and eleven amphibian species have been recorded. The highest diversity of fauna within the site was supported by the native vegetation with the shale vegetation being the most productive. The cleared land provided a variety of faunal habitats (grassland, woodland, orchard, and dams) and the diversity of wildlife was high. Several species of bird and one mammal (the koala) considered of conservation importance were located on the site.

The site is considered of significant ecological value because of its high faunal diversity, and the presence of endangered species and of potential habitat for a wider range of species. The southern part of the site is of greater importance than the northern cleared area. The construction of an airport on the site would result in the loss of a large amount of relatively unmodified native vegetation, and as a consequence the loss of many faunal species from the site. Most would not colonize other areas of similar habitat. Any loss of endangered species from the proposed site may cause changes to their status, although the overall status of other species would not change.

If Wilton were the selected airport site, measures would be implemented to ameliorate as far as possible these predicted impacts on the site's fauna. Any endangered species (such as the koala) would be removed from the site to adjacent areas prior to construction commencing. Also, a management plan and effective soil conservation methods would reduce the effects of airport development upon the water flows and water quality along the creeks in the area, and fauna along Allens Creek would be monitored during operation of the airport. Recolonization of the airport site by native fauna would be encouraged through the planting of native flowering shrubs in appropriate areas.

PART D COMPARISON OF THE BADGERYS CREEK AND WILTON SITES

The proposals and environmental effects at the Badgerys Creek and Wilton sites are summarized in Table 3.

Table 3 Summary of the comparison

Factor	Badgerys Creek	Wilton
Proposed site		
Site area	1,770 ha	1,440 ha
Airport layout		
Preferred runway orientation	North-east/south-west	East/west
Runway configuration	Widely spaced parallel runways	Widely spaced parallel runways
Capacity in annual aircraft movements	275,000	275,000
Capacity in annual passenger movements	13 million	13 million
Airspace consequences	Significant changes required	Minimal changes required
Land acquisition		
Market value of land	$31.5 million	$1.8 million
Population displaced	750 people	<10 people
Noise		
Potential population within the 20 ANEF noise contour	1,951 people	130 people
No. of people 'seriously' affected	364 people	18 people
No. of people 'moderately' and 'seriously' affected by noise	1,115 people	68 people
Effect on agriculture	Some	Negligible
Archaeology	Less sensitive	More sensitive
Concerns of Aboriginal people	Opposition indicated	Conditional support
European heritage	No sites recorded; potential for historic sites	No sites recorded

Table 3 **Summary of the comparison (continued)**

Factor	Badgerys Creek	Wilton
Economic effects		
Construction employment	7,000 person years	7,000 person years
Direct permanent employment	10,500 jobs	10,500 jobs
Flow-on to Sub-Region	2,300 jobs	2,300 jobs
Agriculture		
Area of agricultural land within the site	1,405 ha	65 ha
Area of agricultural land within the 25 ANEF contour	1,898 ha	0
Gross annual value of production within site and 25 ANEF contour	$8.3 million	$0.195 million
Percentage of local production	17%	0.3%
Regional planning and development	Research and technical facilities in the Sub-Region may be adversely affected	Minimal restrictions would arise from airport development
Physiography, geology and soils		
Average elevation above sea-level	80 m	310 m
Balance of cut-and-fill	69,000 m^3 (deficit)	128,000 m^3 (excess)
Sterilization of resources	Potential clay/shale resource present	50 Mt coal
Drainage and water quality		
Major catchment	South Creek	Metropolitan Catchment
Water quality criteria	No classified streams	Class 'S' and 'P' streams
Discharge to:	South Creek	Nepean River via Allens Creek
Contribution to forecast nutrient loads (year 2000) in receiving waters	Nitrogen 2.2%, phosphorous 2.0%	Nitrogen 2.2%, phosphorous 1.9%
Air quality		
Emissions from airport operations as % of forecast Sydney Region emissions	Carbon monoxide 0.6%, hydrocarbons 0.5%, nitrogen oxides 2.1%	Carbon monoxide 0.6%, hydrocarbons 0.5%, nitrogen oxides 2.1%

Table 3 **Summary of the comparison (continued)**

Factor	Badgerys Creek	Wilton
Access		
Average peak hour travel times by road	69 minutes	102 minutes
Average peak hour travel times by rail	72 minutes (via St Marys) 68 minutes (via Glenfield)	88 minutes (via Douglas Park) 84 minutes (via Appin)
Infrastructure		
Water/sewerage	New services required	New services required
Power	Relocation of 2.5 km of 330 kV line	Relocation of 2.0 km of 330 kV line
Gas lines	None affected	Relocation of 4 km of line
Landscape quality	95% of site has minimal quality	80% of site has minimal quality
Flora	floristic value of site is low	floristic value of site is high
Fauna	ecological value of site is low	ecological value of site is high

PART A

SELECTION OF THE SHORT-LISTED SITES

CHAPTER 1

Requirement to Reserve a Site

1.1 OBJECTIVE OF THE PROPOSAL

In 1983 the Department of Aviation was directed by the Commonwealth Government to examine all possible locations for a site suitable for possible future development as a second major airport to serve the Sydney region. Subsequently, the then Minister for Home Affairs and Environment directed that a Draft Environmental Impact Statement be prepared under the terms of the Commonwealth Environment Protection (Impact of Proposals) Act 1974. This Draft Environmental Impact Statement has been prepared in response to that direction.

The objective of the proposal assessed in this Draft Environmental Impact Statement is to acquire a site that would be suitable for possible future development as a second Sydney airport. The document contains a description of the site selection process and of the environmental implications of acquisition and development of the two short-listed sites at Wilton and Badgerys Creek. The scope of its contents has been determined by guidelines jointly developed by the Commonwealth Department of Home Affairs and Environment and the New South Wales Department of Environment and Planning. A copy of these guidelines is provided in Appendix A, together with a description of the arrangements for supervising the preparation of this Draft Environmental Impact Statement. These guidelines call for the Draft Environmental Impact Statement to be based on assumptions relating to a fully operational second Sydney airport under the 'worst case scenario for the configuration [of airport] that has been adopted'.

In the light of this requirement, preliminary master plans have been developed for the two short-listed sites that represent the maximum level of development that could be contemplated in the foreseeable future. This level of development may only be warranted under the most optimistic assumptions of long-term air traffic growth, and it is probable that there would be very much lower levels of development at a second airport. The decision to acquire a site at this time does not imply a commitment to the level of development suggested under the 'worst case scenario', nor to any other level of development. However, the uncertainty associated with the timing and scale of development at a second airport site, and the need to ensure that the maximum effects possible in the very long term are accounted for in long range planning for future metropolitan development in the environs of the site and in the eventual design and construction of the airport, make it necessary to assess environmental effects on the basis of a worst case scenario.

The justification for acquiring a site at this time is established in the following sections of this chapter in terms of:

- forecast growth in the demand for aviation services;
- the capacity of Kingsford-Smith and other airports to accommodate this growth in air traffic;
- the time at which the opportunity to acquire a site for a second airport could be lost;
- the consequences of deciding against acquiring a site at this time.

1.2 GROWTH IN AIR TRAFFIC

In the following sections, growth in aviation activity is discussed in terms of both passenger movements and aircraft movements. Because of differences in the method of collection of statistics between international and domestic passengers movements there are differences in the way these passenger movements are defined. International passenger movements at an airport are defined as the sum of passengers, both revenue and non-revenue, originating and terminating at that airport on both scheduled and non-scheduled flights. Passengers in transit are excluded. Domestic passenger movements at an airport are defined as the sum of revenue passengers, originating and terminating, at that airport on scheduled flights plus passengers transferring between scheduled flights. An aircraft movement is defined as either a take-off or a landing of an aircraft. A landing followed by a take-off of the same aircraft is defined as two aircraft movements.

The relationship between aircraft movements and passenger demand is complex. A given forecast of passenger demand could translate into a range of aircraft movements depending on the assumptions made about the mix of different sized aircraft to be used to carry the passengers and the average level of seat occupancy or loading on each aircraft type.

The level of traffic at Kingsford-Smith Airport in 1984 was approximately 8.6 million passenger movements, of which about 2.6 million were international. Between 1970 and 1984, passenger movements at Kingsford-Smith Airport grew at approximately 4.7% (compound) per annum, while aircraft movements grew at a compound annual rate of 2.6%.

Forecasts of air traffic growth for Sydney

Passenger traffic at Kingsford-Smith Airport is forecast by the Department of Aviation to grow over the long term (to the year 2010) at an average annual rate of 1.6%-3.8%. This would result in passenger traffic levels at Kingsford-Smith Airport, in the absence of any constraints on capacity, ranging between a low of approximately 13.4 million and a high of 24 million annual passenger movements. The corresponding range for annual aircraft movements would be from a low of approximately 216,700 to a high of 382,600 movements. The Department of Aviation's forecasts of air traffic in the Sydney Region are based on the assumption that there will be no change in the present socio-economic or aviation industry environment, and that there will be ample runway capacity available in the region to handle additional growth. These forecasts are shown in Tables 1.1 and 1.2.

These forecasts are a systematic assessment of future growth based on analysis of past patterns and of possible future developments. They represent best estimates and are produced for the purpose of reducing the risk associated with the Department's forward planning responsibilities. However, these forecasts are neither precise nor fixed, and are reviewed and revised where necessary as additional information becomes available.

Table 1.1 Forecast numbers of annual passenger movements at Sydney (Kingsford-Smith) Airport

	1985 ('000)	1990 ('000)	1995 ('000)	2000 ('000)	2005 ('000)	2010 ('000)	Annual increase (%)
Low							
International	2,674	2,762	2,809	3,030	3,262	3,514	1.10
Trunk	4,996	5,541	6,112	6,702	7,399	7,955	1.88
Regional*	1,217	1,246	1,216	1,408	1,635	1,888	1.77
Total	8,887	9,549	10,137	11,140	12,296	13,357	1.64
Median							
International	2,857	3,269	3,616	4,157	4,751	5,417	2.59
Trunk	5,070	5,854	6,691	7,662	8,592	9,537	2.56
Regional*	1,323	1,588	1,754	2,207	2,794	3,453	3.91
Total	9,250	10,711	12,061	14,026	16,137	18,407	2.79
High							
International	3,047	3,751	4,445	5,301	6,275	7,434	3.63
Trunk	5,007	6,353	7,490	8,792	10,093	11,426	3.36
Regional*	1,439	1,940	2,385	3,030	4,383	5,196	5.27
Total	9,493	12,044	14,320	17,123	20,751	24,056	3.79

Note: As a comparison, provisional figures for 1984 are as follows: international 2,645, trunk 4,720, regional 1,208, total 8,573.

* Includes commuter passenger movements.

Source: Department of Aviation.

Table 1.2 Forecast numbers of annual aircraft movements at Sydney (Kingsford-Smith) Airport

	1985	1990	1995	2000	2005	2010	Annual increase (%)
Low							
International	19,470	20,190	19,810	20,800	22,400	23,520	0.76
Trunk	43,470	50,020	54,390	59,070	59,590	59,380	1.26
Regional*	63,330	62,500	61,540	64,000	68,990	74,390	0.65
General Aviation**	46,140	50,620	51,220	53,870	56,610	59,440	1.02
Total	172,410	183,330	186,960	197,740	207,590	216,730	0.92
Median							
International	20,930	24,190	25,870	28,960	33,040	36,550	2.26
Trunk	43,990	51,480	59,590	65,620	66,660	68,430	1.78
Regional*	65,350	70,180	73,490	82,850	95,010	114,270	2.26
General Aviation**	47,390	54,410	57,110	62,820	69,020	74,340	1.82
Total	177,660	200,260	216,060	240,250	263,730	293,590	2.03
High							
International	22,480	27,990	32,070	37,160	43,790	50,010	3.25
Trunk	45,970	54,600	63,860	72,490	74,780	82,370	2.36
Regional*	68,370	80,910	86,780	104,040	126,350	154,440	3.31
General Aviation**	48,810	59,010	64,930	74,600	83,530	95,760	2.73
Total	185,630	222,510	247,640	288,290	328,450	382,580	2.94

Note: As a comparison, provisional figures for 1984 are as follows: international 20,129, trunk 46,114, regional 62,844, general aviation 40,772 total 169,859.

* Includes commuter aircraft movements.
** Includes military and helicopter movements.

Source: Department of Aviation.

Assumptions underlying forecasts
These forecasts depend on a range of assumptions relating to air fares, income levels, gross domestic product, population and other socio-economic factors that affect passenger demand. The major assumptions are set out in Table 1.3, while assumptions made in deriving the level of international, trunk and regional aircraft movements from passenger demand are summarized in Table 1.4. General aviation aircraft movements are also directly derived from similar economic parameters.

Table 1.3 Principal assumptions for annual passenger movement forecasts

Assumption	Low forecast (% per annum)	High forecast (% per annum)
Growth in real income (Australia)	0—2.0	2.0—5.0
Growth in real income (international countries of origin/destination)	0—2.0	2.0—3.6
Population growth (Australia)	1.0	1.3
Change in real level of air fares	0.5—2.0	-1.5—0

Source: Department of Aviation.

Table 1.4 Principal assumptions for annual aircraft movement forecasts

Route	Aircraft load factors (% of seats occupied)	Aircraft types (seating capacity)
International	70% Sydney—overseas direct; 35% Sydney—other Australian port—overseas	From 100-140 seats up to 600 seats, depending on route and forecast year
Trunk	70-75%	96 to 270-280 seats depending on route and forecast year
Regional	60-75% depending on route	52-75 seats for airline service; 8-30 seats for commuter services — depending on route and forecast year

Source: Department of Aviation.

It is possible, therefore, to vary the forecasts by making changes to the underlying assumptions. The arguments for higher or lower forecasts than those prepared by the Department of Aviation are reviewed below.

The possibility of lower than forecast growth
Growth in air traffic between 1981 and 1983 has been either low or negative, and it might thus be considered possible that demand would continue to be stable in terms of passenger and aircraft movements. However, it is a characteristic of air traffic growth that periods of rapid growth alternate with periods of moderate growth or even stagnation. This phenomenon is illustrated in Table 1.5, which shows fluctuations in annual percentage increases in passenger traffic at Kingsford-Smith Airport.

Table 1.5 **Fluctuations in annual percentage increases in passenger traffic at Kingsford-Smith Airport, 1972-84**

Year	Annual % increase in numbers of originating and terminating passengers	
	International (%)	Domestic (%)
1972	14.7	7.5
1973	14.5	15.5
1974	23.0	10.1
1975	4.3	2.6
1976	3.8	-3.1
1977	1.6	4.9
1978	7.3	8.3
1979	15.7	7.7
1980	6.3	3.9
1981	-2.1	-2.6
1982	2.1	-1.7
1983	-7.8	-4.5
1984	4.6	7.6

Source: Department of Aviation.

It is considered highly unlikely that passenger demand will remain stable in the long term unless the Australian economy also enters a period of permanent stagnation. This outcome is not likely, and would not be a sound basis on which to undertake forward planning. Alternatively, it could be considered possible that individual demands for air travel services are now fully satisfied and the propensity to travel will not increase. In that event, however, continued population growth would still stimulate continued growth in passenger traffic.

While an assumption of growth in passenger traffic should therefore be accepted, there is nevertheless an argument that this would not translate into corresponding growth in aircraft movements: this is based on an assumption that increased passenger traffic would be accommodated in larger aircraft and/or higher seat loadings. This possibility is feasible, but the likelihood that it would occur is constrained by the structure of the aviation market in Australia, where the economies that can be achieved by using larger aircraft must be balanced against the requirement to provide at least a minimum frequency of service to all airports served. This tension is illustrated by recent moves towards the use of smaller aircraft in an attempt to service the market better. Qantas has pursued such a path with its purchase of B767 aircraft to service lower density Asian and South Pacific routes.

Therefore, in the absence of severely adverse conditions of a permanent nature (for example, a sustained world-wide depression), it is highly improbable that aviation activity levels, expressed either as passenger or aircraft movements, will fall significantly below the Department of Aviation's low forecasts.

The possiblility of higher than forecast growth

Conversely, there is an argument that growth in aviation activity in Sydney may well exceed the Department of Aviation's high forecast. This argument can be supported by reference to Table 1.6, which sets out indicators of the market penetration of aviation services for major cities with population levels comparable to Sydney's.

Table 1.6 Indices of air traffic levels at selected cities

Metropolitan regions with populations of 2.5-5.0 million, ranked by size	Figures in millions*				Ratio of passengers to metropolitan population (passengers per capita):	
	Metropolitan population (1981)	Total terminal passengers (1983)**	International passengers (1983)	Domestic passengers (1983)	For total terminal passengers	For domestic passengers
San Francisco—Oakland—San Jose	4.6	29.6	2.1	27.5	6.4	6.0
Detroit—Windsor	4.4	9.3	0.3	9.0	2.1	2.0
Boston	3.7	17.8	2.0	15.8	4.8	4.3
SYDNEY+	**3.3**	**7.7**	**2.3**	**5.4**	**2.3**	**1.6**
Washington (DC)	3.2	17.5	0.3	17.2	5.5	5.4
Montreal	2.9	6.9	3.2	3.7	2.4	1.3
Toronto	2.9	13.7	6.1	7.6	4.7	2.6
Dallas—Fort Worth	2.8	31.4	1.9	29.5	11.2	10.5
Melbourne	2.8	5.4	0.9	4.5	1.9	1.6
Houston	2.7	13.0	1.3	11.7	4.8	4.3
Miami—Fort Lauderdale	2.6	25.0	7.1	17.9	9.6	6.9

* For calendar year for all major airports in the metropolitan region.
** A passenger who joins or leaves an aircraft at the referred airport.
\+ Excludes Newcastle and Wollongong.

Source: British Airports Authority Annual Report and Accounts, pp. 109-10; Reader's Digest Atlas of the World, 1982 Edition, pp. 146-74 and 229-41.

The level of air traffic in the Sydney region corresponds to an average of 2.3 trips each year per person in the region. This average is the result of combining the activity of the relative few who travel many times with the substantial number of international travellers, plus the number of trips by the bulk of the population that travels rarely, if ever, by air. While it is recognized that the circumstances of each of the urban centres shown in Table 1.6 differ widely (some cities such as Sydney are ports of entry, while others such as Dallas—Fort Worth are major interchange points where air traffic is concentrated and redistributed), it appears that the Sydney air traffic market is not saturated, and that higher traffic levels are possible. As Table 1.6 shows, the levels of air travel generated by cities of a similar size to Sydney are often higher. The Canadian domestic air traffic pattern may provide a relevant comparison in this regard. There is a trunk route between the two major cities, Toronto and Montreal, and there are four other urban centres distributed across the continent at distances comparable to those found in Australia. It is notable that the number of trips taken within the country per person is 2.6 for Toronto, compared to 1.6 per person for Sydney.

Such comparisons, while of limited validity, could be interpreted as suggesting that there may be scope for an increase in the market penetration of air services in Sydney. The future growth opportunities that might result in such an increase include the following:

- Greater exploitation of the leisure market, which appears less well developed in Australia than in other western countries.

- Potential for a significant increase in international tourist travel from overseas, especially from the United States, Japan and South-East Asia. The Commonwealth Department of Sport, Recreation and Tourism estimates that in 1983-84 the number of US tourists to Australia grew by 32% while those from Japan and the remainder of Asia increased by 25% and 32% respectively. In view of the already large and increasing number of Americans and Japanese who can afford to visit Australia, it would seem probable that this international tourist market could develop substantially over the long term. The growth and development of the ASEAN nations is a further potential source of travellers in the long term. An increasing proportion of this traffic may enter Australia at other recently completed international airports (Adelaide, Cairns, Townsville and Melbourne). However, Sydney will remain a major tourist destination in its own right, and the majority of tourists will still arrive or depart either directly by air (from overseas) or indirectly by air (either on domestic flights from one of the other ports of entry, or on international flights travelling between international terminals within Australia).

- The possibility that some form of deregulation of the aviation industry in Australia will promote a wider range of travel opportunities for the mass market. There is a world-wide trend towards deregulation of air transport that may be difficult to resist since it is perceived as having been successful in reducing fares. Air fares across the North Atlantic are effectively deregulated, as are the holiday markets in Europe. The US domestic market is officially deregulated, leading to widely publicized fare reductions of 50% or more in real terms on many of the most travelled routes. The Canadian Government is partially deregulating some of its domestic air routes.

The potential suggested by these factors is in part counterbalanced by the distribution of the Australian population and their location in predominantly temperate climatic zones, and by an economy based primarily on agriculture and mining (Shaw 1982). These factors tend to lower the generation of air travel compared to that found in cooler climates and in economies that are more dependent on manufacturing. Further, the long travel distances to Australia may yet limit the potential increase in international tourism to Australia from the United States, Japan and South-East Asia.

The Commonwealth Government has commenced a review of domestic aviation regulatory arrangements, the outcome of which cannot be predicted or incorporated into the current preparation of forecasts of aviation activity. However, it is likely that the new arrangements will be directed at stimulating growth and enhancing the opportunity for Australians to travel by air.

These growth possibilities — increased penetration of the leisure market, increased international tourism to Australia, and changes to domestic aviation regulatory arrangements — might thus combine to produce future air traffic levels at Sydney that would be greater than the Department of Aviation's high forecast. Nevertheless the probability of this occurring is assessed as low.

1.3 RUNWAY CAPACITY OF KINGSFORD-SMITH AIRPORT

The runway capacity of an airport is not fixed, as it depends on a number of factors including weather, the mix of aircraft, the profile of daily aircraft movements, and air traffic control procedures, all of which can vary. An airport may thus have surplus capacity in off-peak periods and still be overtaxed during the peaks. However, capacity is widely accepted as reflecting an average hourly aircraft handling rate with a maximum 'tolerable' delay due to congestion. The Department of Aviation uses a standard maximum tolerable average delay of 4 minutes per aircraft throughout the day. At this level of average delay:

- 1.5% of aircraft would be delayed for more than 30 minutes
- 6.0% of aircraft would be delayed for more than 15 minutes.

At an annual traffic level of 200,000 aircraft movements, these delays would represent eight flights per day delayed for over 30 minutes and thirty-three flights per day delayed for 15 minutes or more because of airport congestion.

In 1984 there were approximately 170,000 aircraft movements at Kingsford-Smith Airport. If the profile of daily aircraft movements and aircraft mix remained unchanged, then full capacity under the delay criteria described above would be reached at 203,000 annual aircraft movements. Under the Department of Aviation's forecasts, this could occur as early as 1988 or as late as 2000-2005, as shown in Figure 1.1.

Other estimates of runway capacity are possible, but they depend on assumptions such as:

- improvements in air traffic control equipment and/or procedures
- changes in operating aircraft mix
- changes in the daily profile of aircraft movements.

Increases in runway handling capacity as a result of improvements in air traffic control equipment or revised air traffic control procedures have been advanced as future means by which the capacity of a runway system might be improved. Such improvements are possible, but their contribution to annual capacity is likely to be marginal rather than significant.

Changes in aircraft mix or daily profile of aircraft movements can also potentially contribute to runway capacity improvement. An aircraft mix comprising large and small aircraft, evenly distributed over time, results in a lower runway handling rate than a homogeneous mix of either large or small aircraft. This is because the different speeds of large and small aircraft and the wake turbulence from large aircraft require that large and small aircraft maintain wider separations than are required between aircraft of similar size and speed. If the daily profile of aircraft movements changes so that a higher proportion of aircraft use the runway in off-peak periods, then the average daily, and therefore annual, capacity of the runway system can increase.

However, changes either to the aircraft mix or to the daily profile of movements can only result from some overt regulatory action, such as exclusion of some categories of aircraft either during the peak hour or from the airport completely. For example, the Department of Aviation has estimated that the exclusion of 50% of general aviation and 25% of commuter traffic from Kingsford-Smith Airport could result in an increase in runway capacity from 203,000 to 210,000 annual aircraft movements. If such exclusions were implemented, then attainment of runway capacity could be postponed.

Various alternatives are available to the Commonwealth Government to ensure that airport capacity is available to meet future needs. In seeking to reserve a second airport site at this time, the Commonwealth Government has indicated its belief that the major increase in capacity in the region in the long term should be catered for at a second airport. However, should air traffic growth be at the levels of the Department of Aviation's high forecasts, then other policies would have to be adopted until such time as the second airport could be developed. Possible alternatives are:

- taking no action and allowing congestion to rise;

- regulating the traffic flow through a range of measures such as the pricing of landing rights in peak periods, or by allocation of quotas for landing 'slots'.

'No action' alternative

In the context of strong growth in traffic (along the lines of the Department of Aviation's median or high forecasts), a policy of taking no action and allowing congestion to rise is likely to result in:

- strong but conflicting pressures from different sectors of the aviation industry to immediately regulate traffic;

- increases in air fares to and from Sydney: this may not be sanctioned, but could be achieved indirectly by the expedient of increasing the quantity of first and business class seating at the expense of non-business travellers;

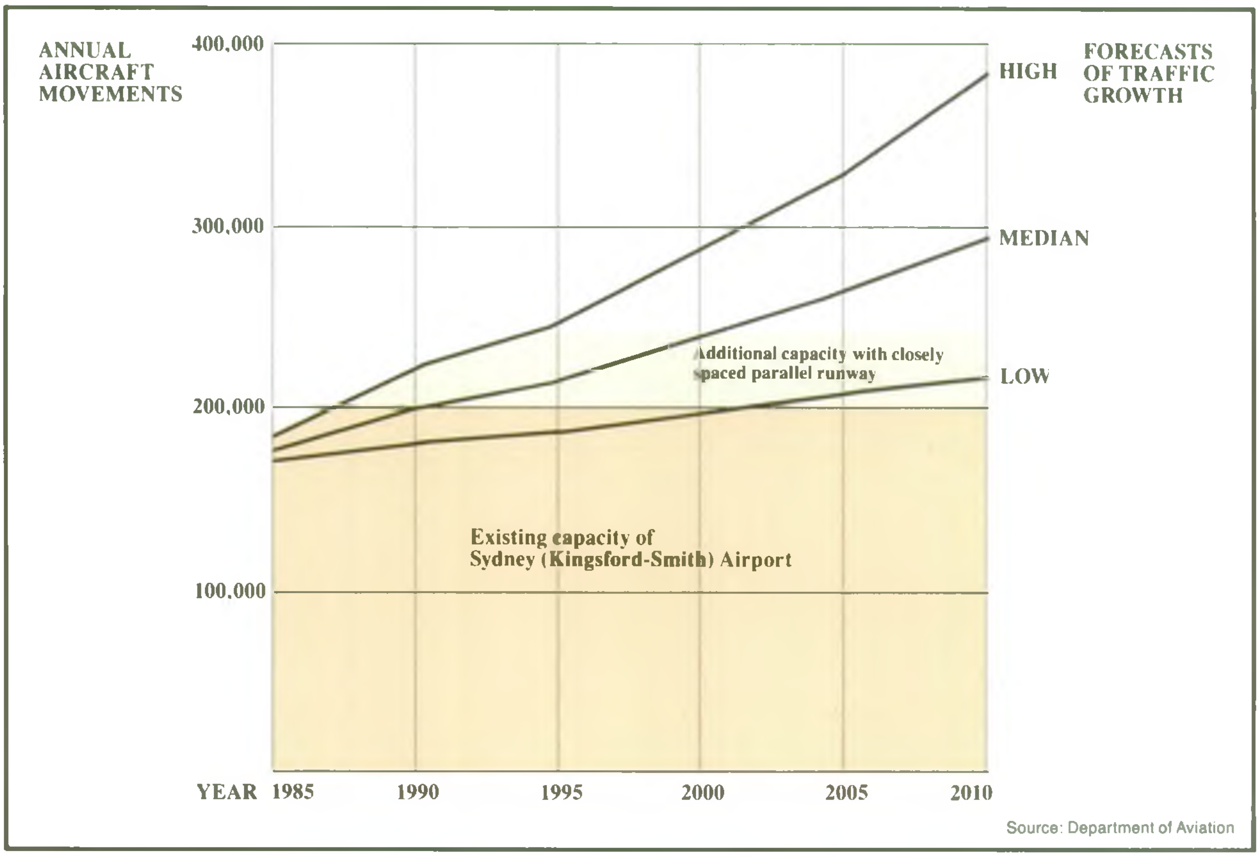


Figure 1.1
FORECAST DEMAND AND CAPACITY (ANNUAL AIRCRAFT MOVEMENTS) AT SYDNEY (KINGSFORD-SMITH) AIRPORT

- suppression of air traffic to and from Sydney: this would lead to a corresponding alteration of perceptions of Sydney's attractiveness as a business centre, and possibly to the loss of Kingsford-Smith Airport's position as the premier Australian airport and port of entry;

- strong and unified pressures from all sectors of the aviation industry and from business for the provision of additional runway capacity either at Kingsford-Smith Airport or at a second airport.

A policy of no action would run counter to the Commonwealth Government's objectives of providing equality of access for Australians to reasonably priced air services. If air traffic grew strongly, such a policy would give rise to severe distortions in the aviation market and would inevitably result in irresistible pressures for immediate solutions to enable airport capacity to be raised quickly.

Regulation of traffic

There is an economic rationale for seeking to transfer aircraft movements away from times of peak traffic by placing a higher price on landing rights for aircraft during peak periods (a 'peak pricing' policy). The effect of this policy would be most felt by private operators and operators of small aircraft, as smaller aircraft have fewer passengers among whom to spread this peak price fee. Later, if growth continued, other classes of air traffic would presumably face similar pressures for economic exclusion from Kingsford-Smith Airport. Eventually, in the absence of an increase in runway capacity either at Kingsford-Smith or a second airport, ability-to-pay would be the principal determinant of access by air to Sydney. This would favour the growth of international and interstate business traffic at the expense of country and leisure travellers.

An alternative to regulation through pricing would be to set limits on total traffic movement levels at peak hours and to allocate landing time slots by quota to each sector of the aviation industry (the quotas being non-transferable between sectors). Such a policy would, to some extent, overcome apparent discrimination between sectors. However, like the no action and peak pricing policies, it would inevitably discriminate against non-business travellers and give rise to the other pressures described above, the principal among these being pressure to increase total regional runway capacity as quickly as possible.

These traffic regulation alternatives could provide relief from traffic congestion and allow for an increase in passengers at Kingsford-Smith Airport. Indeed, if growth in air traffic followed the Department of Aviation's high forecast, such regulations would in all likelihood be implemented at Kingsford-Smith Airport in one form or another until the second airport became operational. However, in view of the consequences of the long-term operation of such regulations and the resultant distortion of the aviation market in Sydney, this option is not seen as an appropriate long term response to Sydney's demand for air services.

Provision of an additional runway at Kingsford-Smith Airport

Previous studies have investigated the possibility of increasing runway capacity at Kingsford-Smith Airport by constructing an additional runway parallel to the existing north/south runway, at either a close spacing or a wide spacing. Most work has focused on the closely spaced parallel runway option, as the widely spaced option has been perceived as being incapable of implementation because of its significantly greater effects on surrounding areas.

In October 1982 the then Minister for Aviation (Mr Fife) announced the Commonwealth Government's intention to prepare a feasibility study for a 2,600 m closely spaced parallel runway east of the existing main north/south runway (Figure 1.2). This was expected to be operational by about 1992. However, following the change of government in March 1983, the then Minister for Aviation (Mr Beazley) directed that planning for a closely spaced parallel runway at Kingsford-Smith Airport cease.

The results of previous studies by the Department of Aviation and of the Major Airport Needs of Sydney Study, although preliminary, indicate that development of a closely spaced parallel runway is physically possible at Kingsford-Smith Airport. However, these studies have not been undertaken in sufficient depth to establish in detail the associated facility requirements and the effects on surrounding communities.

To provide a closely spaced parallel runway at Kingsford-Smith Airport would involve major infill of Botany Bay, restraints on port development, and environmental effects which have not been assessed in detail. The constraints imposed by existing development on the Kingsford-Smith Airport site may also make it difficult to plan an efficient layout capable of making maximum use of the additional runway capacity. Nevertheless, theoretically, a closely spaced runway could be provided at Kingsford-Smith Airport, and this could raise capacity to approximately 240,000 annual aircraft movements. However, as shown in Figure 1.1, under any of the Department's forecasts this would do no more than defer the requirement for an additional major increment in runway capacity, a conclusion reached by all previous studies.

For these reasons, it is the policy of both Commonwealth and New South Wales governments to provide for requirements for any major expansion of future runway capacity by reserving a site for a second airport, rather than through the expansion of Kingsford-Smith Airport.

Figure 1.2
SYDNEY (KINGSFORD-SMITH) AIRPORT (April 1984)

1.4 CAPACITY OF GENERAL AVIATION AERODROMES

In parallel with the Second Sydney Airport Site Selection Programme, a study of Sydney's general aviation requirements was undertaken by the Department of Aviation, assisted by a consultant, Beca Orr Pty Ltd. This study developed a range of forecasts for growth in general aviation activity in the Sydney Region and assessed the capacity of existing airports to accommodate this growth.

General aviation is defined as all aviation activity at civil aerodromes other than regular passenger flights scheduled by international, interstate and intrastate airlines. General aviation thus includes commuter airline services, non-scheduled airline flights, charter services, flying training, private and business flying, test and ferry work, aerial work, search and rescue services, and military aircraft using civil aerodromes for VIP and other purposes. There are at present five government aerodromes in the Cumberland Plain available for general aviation use (Figure 1). These are:

- Kingsford-Smith Airport: Currently, general aviation aircraft movements account for approximately 40% of total airport movements. Much of this activity is attracted to Kingsford-Smith Airport because of the existing passenger and cargo terminal and transfer facilities. Other general aviation aircraft use Kingsford-Smith Airport because of its proximity to the city centre and because it has the longest runways and most comprehensive navigational and approach aids (including instrument landing systems) in the Sydney Region. It is also the only primary airport in the region where familiarization training with instrument landing systems is conducted.

- Bankstown Airport: This airport is 17 km west of Kingsford-Smith Airport and 23 km by road from Sydney's central business district. It is the main general aviation airport in the Sydney Region and has the most aircraft movements of any aerodrome in Australia. Bankstown is also the primary focus for nationwide general aviation sales and servicing in Sydney. Commuter airline services are not operated from Bankstown and no passenger terminal facilities are provided. If significant numbers of commuter services were to be introduced at Bankstown Airport (as was considered for example, in the Major Airport Needs of Sydney Study), this could result in a change to air traffic control procedures that would reduce the capacity of Bankstown Airport. This airport is already operating at moderate congestion levels, and congestion would rise quickly with any growth in traffic. Although there is some potential to increase runway length at Bankstown to accommodate heavy general aviation aircraft (small jets such as the Cessna Citation and Lear), space for associated ground facilities is very limited and moderate congestion already occurs on the ground as well as on the runways.

- Hoxton Park Aerodrome: This airport is a further 13 km west of Bankstown and 39 km by road from Sydney's central business district. A few light aircraft are based there, and it is used extensively for touch-and-go training flights from Bankstown, being outside the jurisdiction of controlled air space. Hoxton Park's potential for expansion is limited by adjacent urban development.

- Camden Aerodrome: This provides an additional general aviation aerodrome in the south to south-west sector of the Sydney Region. It is 59 km by road from the city centre and is used by light general aviation training aircraft and by private aircraft, as well as being the gliding centre for the region.

- Schofields Aerodrome: The only general aviation aerodrome in the northern and western sectors of the Sydney Region is at Schofields, 46 km by road north-west of Sydney's central business district. Schofields' public use is at present restricted to daytime flights at weekends and public holidays.

The proposal to acquire a site for a second airport also recognizes that opportunities for growth that are forgone by insufficient capacity at Kingsford-Smith Airport can only be secured by the provision of capacity elsewhere in the Region, either at existing general aviation aerodromes or at a second Sydney airport. However, the existing general aviation aerodromes have little scope for expansion. For these reasons, the existence of an uncongested second airport may be seen by general aviation interests as an attractive alternative to Kingsford-Smith, Bankstown or the other general aviation aerodromes. General aviation is therefore seen to be an important potential activity at a second Sydney airport.

1.5 LOSS OF THE OPPORTUNITY TO RESERVE A SITE

Sydney, a large city by world standards, has a finite and dwindling reserve of land suitable for further urban development because of the containment of the Cumberland Plain by mountains. Over the past sixteen years, a number of potentially suitable airport sites within the Cumberland Plain have progressively become unavailable as a result of continued urban expansion, and replacement candidate sites are necessarily located further from the city centre. In deciding whether, and when, to reserve a site within reasonable proximity to the city, consideration must be given to identifying the likely time at which the opportunity to reserve such land will be forgone as other urban developments proceed.

Population growth

The population of the Sydney Region is expected to grow from a 1981 level of 3.28 million to between 3.95 and 4.21 million by the year 2001. At the same rate of growth, Sydney's population would reach approximately 4.3 to 4.7 million around 2011.

The NSW Department of Environment and Planning has prepared population projections for the year 2001, this date being compatible with the five-year census intervals. The trends forecast for the period 1981-2001 have been extrapolated to the year 2011 but, understandably, there is less certainty about this latter period than about the period between 1981 and 2001 (Table 1.7).

Table 1.7 Population of Sydney Region (millions): low, medium and high projections to 2001, extrapolated to 2011

Growth projections	1981	2001	2011
Low	3.28	3.95	4.28
Medium	3.28	4.07	4.47
High	3.28	4.21	4.71

Source: For 1981 figures — Australian Bureau of Statistics, 1981 Census of Population and Housing; for 2011 projection — Department of Environment and Planning.

In addition to the population levels forecast for Sydney, an additional population of 1.05 million (low projection) to 1.16 million (high projection) is forecast for 2011 for the Hunter and Illawarra regions, north and south of Sydney. These regions also largely rely upon Kingsford-Smith Airport for interstate and international air services.

The projection for Sydney to the year 2001 is based on a population projection for New South Wales undertaken by the NSW Department of Environment and Planning on the basis of the 1981 Census. The underlying assumptions are set out in Tables 1.8 and 1.9.

Table 1.8 Population forecast assumptions

Population factors	Projection		
	Low	Medium	High
Base population	1981 estimated resident population by sex and five-year age groups.		
Fertility	NRR* = 0.93 for 1981-86, and thereafter 0.9	NRR = 0.93 for 1981-86, and thereafter 0.95	NRR = 0.95 for 1981-86, and thereafter 1.00
Mortality	For 1981-86, age-sex specific annual rates of decline during 1971-81 were applied to 1981 mortality rates (apart from males aged 15-29, where 1977-82 rates of decline were applied). For 1986-2001, age-sex specific annual rates of decline during 1961-81 were applied to 1986 mortality rates (apart from males aged 15-29, where half the female rate of decline was applied). For 2001-2011, the rate of decline for 1986-2001 was halved.		
Overseas migration** 1981-86	25,000 annually to NSW	35,000 annually to NSW	45,000 annually to NSW
Overseas migration** 1986-2011	75,000 annually to Australia; 30,000 to NSW	100,000 annually to Australia; 40,000 to NSW	125,000 annually to Australia; 59,000 to NSW
Interstate migration+ 1981-86	Annual loss from NSW of 15,000	Annual loss from NSW of 15,000	Annual loss from NSW of 15,000
Interstate migration+ 1986-2011	Annual loss from NSW of 10,000	Annual loss from NSW of 7,500	Annual loss from NSW of 5,000

* NRR = net reproduction rate.

** Age-sex distributions based on 1978-82 permanent and long-term gain to NSW.

\+ Age-sex distributions based on trends of the most appropriate period between 1966 and 1981.

The population projections for Sydney also assume that Sydney is likely to retain its present proportion of about 62% of the State's population.

Within Sydney, the pattern of population movements throughout the 1970s has been one of population decline in the inner areas, with very high growth in the outer and peripheral areas. All local government areas in the Central Sydney, Inner West and Southern Sydney subdivisions (except Sutherland) lost population between 1971 and 1981, with Central Sydney losing 70,000. The population of the Western Sydney Subdivision grew by over 180,000 during this period, and the population of the South-Western Subdivision by over 80,000. However, between 1976 and 1981 the rate of decline in the inner areas decreased, although the outer areas continued to grow very rapidly. During this period, Western Sydney alone accommodated 60% of Sydney's growth.

Table 1.9 Combination of assumptions

Component	Projection		
	Low	Medium	High
Fertility	Low	Medium	High
Mortality	Single level	Single level	Single level
Overseas migration	Low	Medium	High
Interstate migration	High	Medium	Low

Urban land requirements

The capacity for urban development of land in the Sydney region has been examined by the Department of Environment and Planning in terms of the following existing or potential constraints:

- Land committed or required for other purposes:
  - existing urban land and land already committed for urban development;
  - national parks and nature reserves, State recreation areas, State forests and statutory environmental protection zones;
  - special-use areas or proposed special-use areas (e.g. utility corridors, water reservoirs, Defence services land, possible airport sites);
  - possible sites for irrigation using reclaimed water;
  - water catchment areas;
  - existing mineral workings.
- Land affected by hazards:
  - land liable to flooding;
  - topographically difficult land;
  - possible airport sites and the areas affected by airport noise;
- Land with valuable natural, scenic or cultural resources:
  - land with geological resources (e.g. construction materials, energy resources);
  - agricultural land categorized as 'prime' or 'good';
  - potential heritage or conservation areas.

Large areas of non-urbanized land in the Sydney Region must be systematically excluded from consideration for urban development on the basis of their topographic unsuitability. However, other areas of non-urbanized land, such as those used for agriculture or for some special purposes (e.g. Defence services land), are subject only to current planning or ownership constraints and may be developed for urban purposes in the future. Also, the constraints imposed at possible second Sydney airport sites and their environs will be removed on all but the finally selected site once a decision has been taken on site selection. Figure 1.3 illustrates the constraints to urban development in the Sydney Region.

The effect on metropolitan planning decisions of the uncertainty that has surrounded the selection of a second airport site can be illustrated by totalling the amount of land potentially affected by airport development. In both the Major Airport Needs of Sydney Study and the Second Sydney Airport Site Selection Programme, four sites were investigated in the Cumberland Plain: Scheyville, Londonderry, Badgerys Creek and Bringelly. For the former study, the area of each site was assumed to be approximately 5,000 ha, while in the current study this has been reduced to approximately 1,800 ha. Thus, the total area affected by the possibility of acquisition ranges between 20,000 ha (200 km^2) for the Major Airport Needs of Sydney Study and 7,200 ha (72 km^2) for the current study. To these areas can be added land within the 25 ANEF contours (within which residential development is not recommended), which amounts to some 2,500 ha for each site, or 100 km^2 for four sites. Some sites are able to accommodate more than one runway alignment, and therefore the total of the areas potentially located within the 25 ANEF contours might amount to 150 km^2.

Thus, with the site areas proposed in the Major Airport Needs of Sydney Study and in this current study, plus areas potentially located within the 25 ANEF contours, a total of some 200-300 km^2 of land within the Cumberland Plain is directly affected by the uncertainty associated with location of the second airport site. This is approximately 8-12% of the total of all land within the Cumberland Plain and some 20-25% of the remaining non-urban land.

The rate at which this remaining undeveloped land will be taken up for urban development will depend upon Sydney's population growth rates, internal migration, household formation and density of development. The Department of Environment and Planning has estimated that existing developed areas and areas suitable for urban development could accommodate about 4.7 million people, assuming:

- densities based on relatively stable population levels in inner areas
- a stable population in existing outer areas
- a development density of ten lots per gross residential hectare in new areas.

Under the high growth projection, a population level of 4.7 million would be reached by 2011. At this time, little or no land would remain available within the Cumberland Plain for airport development (other than at the selected site, if this is located within the Cumberland Plain).

The time at which the opportunity will be forgone to select from a range of airport sites will depend upon the rate of growth of the city. However, the time required in advance of urban development to undertake strategic planning and to install infrastructure is in the order of ten to fifteen years. Opportunities for preservation of development options are thus lost well before land is put to urban use. Within the Department of Environment and Planning's framework for metropolitan planning:

- urban release areas to accommodate land requirements to 1990 are committed;

- medium-term development areas to provide land for requirements beyond the known release areas are now proceeding through the process of public review;

- strategic planning options to accommodate a population of up to 4.5 million are under active and continual review within government.

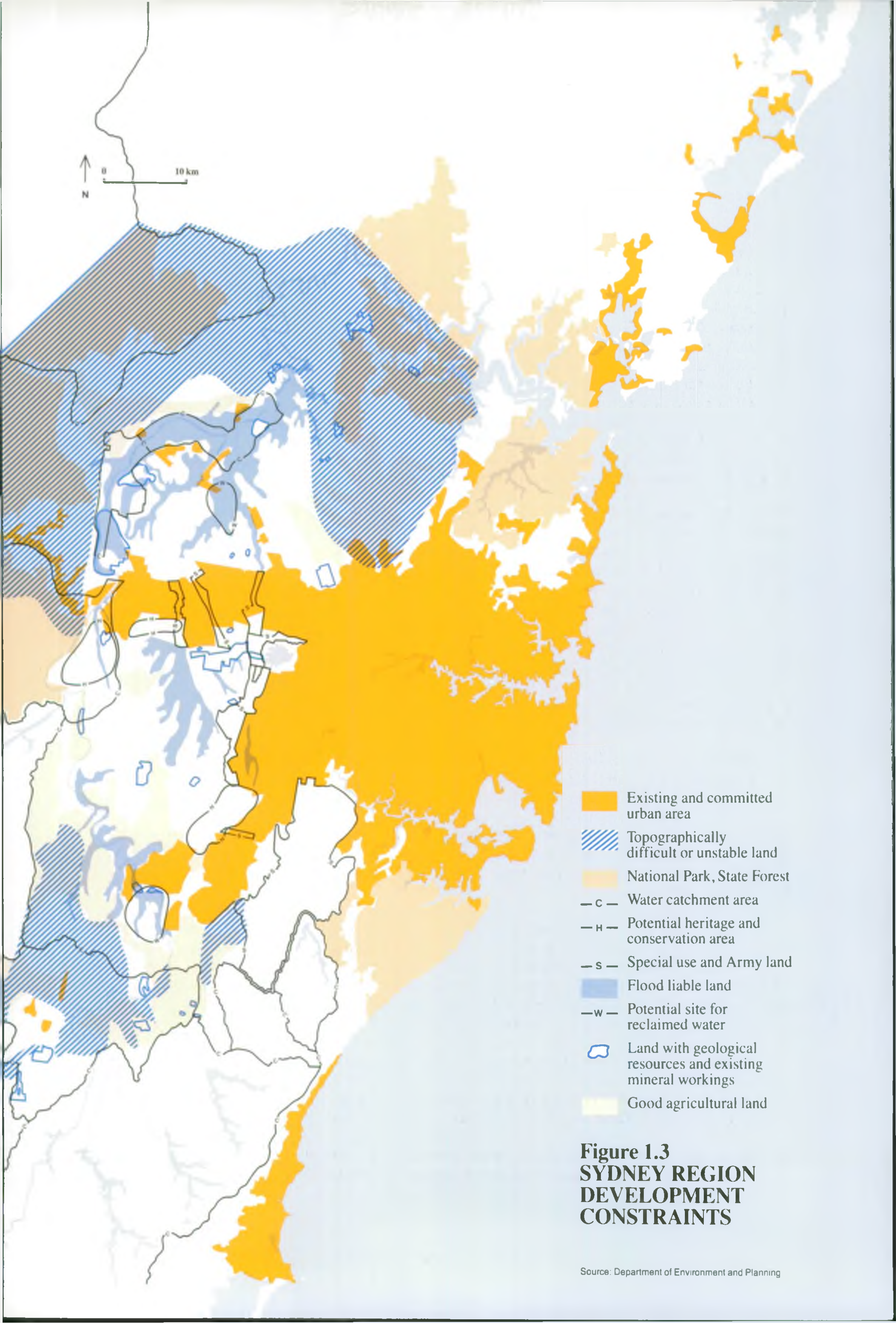


Figure 1.3
SYDNEY REGION DEVELOPMENT CONSTRAINTS

Source: Department of Environment and Planning

Before the 18 September 1984 announcement of the two short-listed sites — Badgerys Creek and Wilton — the lack of a decision on the location of the airport site was seriously affecting the State's urban development programme, particularly for the medium term. Areas identified for urban development after about 1990, for which a considerable amount of investigation and planning was being undertaken, were limited to the land not affected by any future airport options. This was closing off consideration of many areas which may be more suitable for medium-term urban development than those then available for consideration.

In addition, alternative metropolitan plans and strategies were having to be prepared for each of the airport options. In the context of its metropolitan expansion programmes, the State Government considers the need to remove the uncertainty associated with the location of a second airport site to be pressing. The alternative is to risk the loss of all potential metropolitan locations for the proposed airport site.

1.6 CONSEQUENCES OF NO ACTION, DEFERRAL OR ABANDONMENT

A choice made now to take no action, or to defer or to abandon the selection and/or acquisition of a site for a second airport will have both short-term and long-term consequences.

Short-term consequences

The search for a site for a second airport has been pursued by successive governments since the mid 1940s (Chapter 3). In the three most recent studies undertaken since 1971, some nineteen locations have been studied in some detail. The issue of a second airport site is a persistent one and is unlikely to disappear given no decision, deferral or abandonment of the site selection process at this time. The immediate consequences of such decisions are likely to be:

- re-introduction of uncertainty for the populations resident in the environs of all potential second airport sites;

- continuing difficulties for the State Government in its metropolitan planning programme. Should the Commonwealth unilaterally decide not to proceed with, or to defer or abandon reservation of a site, the State Government may still be faced with its own requirement to consider the actions that some future Commonwealth Government may take. The State has been unequivocal in its view of the need for a second major airport site. The 1980 Sydney Region Outline Plan Review states (p.36):

  > The present location of the airport (Kingsford-Smith) is inappropriate for a city the size of Sydney: the site is too small, expansion would adversely affect the bay, the port and the surrounding community, three out of four approach paths to the airport are over dense urban development giving rise to real concern over safety, and the road traffic to serve the airport is causing increasing congestion on the local road system. There is no doubt that a major airport located on a green fields site and connected to inner Sydney by high standard road and rail links is the only solution to catering for Sydney's future airport needs;

- removal of a key alternative in planning for the provision of aviation services in Sydney. The political difficulties associated with expanding existing airports or siting new ones have been amply demonstrated by the experience in Sydney (and elsewhere). In the event of no decision, deferral or abandonment of the current site selection process, the Department of Aviation would retain only one option for planning for the provision of future major airport needs: Kingsford-Smith Airport.

There are significant costs associated with each of the above consequences. These costs include the time and effort of citizens at each potentially affected location who may continue their organized opposition to the siting of a second airport, notwithstanding no decision, deferral or abandonment at this time. The State Government would incur the costs of maintaining several different strategy plans, each assuming a different possible airport location (as has been done since the completion of the Major Airport Needs of Sydney Study).

Should air traffic grow strongly in the short term, the search for a second airport site would almost certainly be resurrected. This is because, in the face of strong air traffic growth, it would be unrealistic and imprudent to place sole reliance on the expansion of Kingsford-Smith Airport as the means of accommodating this growth as, first, it cannot be demonstrated that expansion of Kingsford-Smith Airport is politically feasible and, second, such an expansion would do no more than defer the requirement for additional capacity. The accumulated costs of successive site selection studies to date are already very high, and in current dollars exceed the estimated cost of acquiring some of the ten sites evaluated in this study. Further site selection studies in the future would add to the significant costs already incurred.

Long-term consequences

The long term consequences of a choice made now in terms of no decision, deferral or abandonment of acquisition of a site for a second airport should be assessed in terms of likely government and public opinion in ten to fifteen years' time. This will depend on how traffic grows in the intervening years.

If there is high or median growth in traffic, having reserved a site now will be seen in retrospect as a good decision. Similarly, if there is very low or zero growth, deferral or abandonment of site selection at this time may be seen in retrospect as a good decision. However, the consequences of not being quite right in retrospect — of having secured the site prematurely or of having failed to do so when it ultimately proved to be required — are not symmetric for either of the two choices. This is because the continued growth of Sydney will inevitably make a future acquisition of a site both more expensive and politically more difficult.

To extend this argument, if a site were chosen now and future growth proved to be zero or to follow the Department's low forecast, the consequence would be neutral, as the Commonwealth Government, while having misjudged at an earlier time, would none the less either be left with an asset in the form of 1,770 ha of land with possible urban development potential (in the case of Badgerys Creek), or have incurred minimal acquisition costs (in the case of Wilton).

Conversely, if a site were not chosen, the consequence would be negative if the growth followed the Department's high or median forecasts and Sydney were unable to provide the necessary airport capacity. The consequence would be neutral if there were low growth and a future government had eventually to acquire a site at a premium price or at a greater distance from the city. However, it is to be noted that low growth still implies the need for a second airport eventually.

This combination of choices, possible growth outcomes, and consequences is shown in Table 1.10.

Considerable uncertainty attaches to the forecasting of air traffic growth. However, a decision now to abandon or defer selection of a site is more likely to give rise to negative effects in the long term. In the short term, deferral or abandonment of site selection is most likely to be followed after a short period by a resurrection of the search for a site for a second airport, with the attendant costs, controversy and uncertainty for the potentially affected populations.

Table 1.10 **Consequences of no action**

Action	Outcome, assuming growth follows:		
	High forecast	Median forecast	Low forecast
Select site	Good decision: site available to meet demand	Good decision: site available to meet demand	Neutral decision: temporary sterilization of site; land put to alternative use until required
No action	Poor decision: congestion at Kingsford-Smith Airport; site at higher cost and greater distance subsequently selected	Poor decision: congestion at Kingsford-Smith Airport; site at higher cost or greater distance subsequently selected	Neutral decision: proposed sites put to higher priority use; site at higher cost or greater distance subsequently selected

1.7 Structure of the remainder of Part A

In the remainder of Part A:

- **Chapter 2** discusses possible roles for the second Sydney airport, based on the experience of second airports elsewhere;
- **Chapter 3** describes the history of attempts to select a site for a second Sydney airport and defines the ten sites which are evaluated in this report;
- **Chapter 4** describes the methodology used to select a short list of sites from these ten sites and sets out the criteria used in the short-listing process;
- **Chapter 5** describes the characteristics of the ten sites in relation to the site selection criteria;
- **Chapter 6** compares the ten sites and recommends a short list of two — Badgerys Creek and Wilton — for the more detailed environmental evaluation presented in Parts B and C.

CHAPTER 2

Role and Nature of a Second Airport

Introduction

This chapter sets out a concept for a distribution of traffic between Kingsford-Smith Airport and a second Sydney airport that would accommodate the legitimate requirements of existing airlines and users while securing the long-term ability of Sydney to provide for its aviation traffic. The development of this concept has been based upon two principal considerations:

- the role of second metropolitan airports based on international experience with multi-airport systems;
- the possible future demand, markets and structure of the air transport industry serving Australia.

2.1 ROLE OF SECOND AIRPORTS

Importance to major metropolitan regions

Second airports perform a vital function in the provision of airport capacity in major metropolitan regions. This is indicated by the fact that many of the largest metropolitan sources of air traffic in developed countries are served by multi-airport systems. This pattern holds across a wide diversity of economic and regulatory conditions, and may reasonably be expected to hold for other cities as they develop into major metropolitan regions.

A key concept in this discussion is that of a metropolitan region being a 'source' of traffic, with travellers beginning a journey or 'originating' from there. These originating passengers may be either local residents beginning a trip or visitors resuming their travel after a stay in the area; passengers who pass through an airport when transferring to a connecting flight are considered as 'transit' rather than as originating passengers. The number of originating passengers from any region can be calculated by subtracting the number of transit passengers from the total number of embarking and disembarking passengers and dividing this figure by two.

Major metropolitan sources of air traffic in the world are listed in Table 2.1, ranked on the basis of the number of originating passengers. As can be seen, the number of originating passengers can differ significantly from the total number of passengers at an airport. Atlanta, for example, which is the fifth largest airport listed in terms of the total number of passengers, has a considerably smaller number of originating passengers. This is because Atlanta acts as a massive interchange point for passengers in transit between connecting flights. Approximately three-quarters of the passengers through Atlanta are in transit. Several other mid-continental airports in the United States are similar to Atlanta in this regard: Chicago, Dallas—Fort Worth and Denver, among others. Around the Pacific basin, Singapore and Honolulu similarly function as interchange airports.

Table 2.1 Metropolitan regions ranked by number of originating passengers

Metropolitan region	Millions of passengers (1983)	
	Originating traffic*	Total traffic
New York	23	64
Los Angeles	17	41
London	17	40
Tokyo	14	33
Paris	12.5	30
San Francisco	12	30
Miami	11.5	25
Chicago	10	43
Washington—Baltimore	9.5	22
Dallas—Fort Worth	8	32
Denver	7	25
Houston—Galveston	6	18
Atlanta	5	38

* Total traffic minus transfers, divided by 2.

Source: British Airports Authority Annual Report and Accounts, 1983-84, pp. 109-110, and Kinhill Stearns.

In developed countries, most metropolitan regions now generating 8 million or more originating passengers per annum have a second (and sometimes a third) significant airport. In this regard, a significant second airport is considered to be one catering for 2 million or more passenger movements each year, which is comparable in passenger activity to the size of Adelaide or Perth airports. Facilities that do not serve regularly scheduled commercial flights (such as general aviation or military airfields) or that have fewer than 2 million passengers per annum are not viewed here as significant second airports.

Operational contributions of second airports

Second airports exist in the world's major metropolitan areas because they make vital contributions to the effective, efficient performance of the airport system. The general rule is that the secondary airport, by providing for the needs of particular types of traffic, makes it possible to operate the primary airport with the maximum efficiency.

One way in which a second airport increases the efficiency of the airport system is by providing a means by which traffic using different types of aircraft can be separated. The capacity of any airport is sensitive to the mix of different kinds of aircraft: a runway serving a variety of large and small aircraft can handle fewer operations per hour than a runway serving either large or small aircraft. This is because the separation between aircraft of different sizes must be greater because of differences in airspeeds and the danger to small aircraft of the wake turbulence caused by large aircraft.

The experience at Washington (DC) National Airport illustrates the way in which secondary airports can increase overall airport capacity. In this case, the use of the secondary Washington—Dulles International Airport has a dual effect: first, it provides runways long enough for intercontinental aircraft (which the primary airport, Washington—National, cannot serve) and, second, it caters for general aviation and commuter operations (handling 108,000 general aviation and commuter operations, 57,000 international freights, and 3 million passengers in 1983). The consequent reduction in the proportion of general aviation and commuter operations handled by Washington—National has augmented its capacity to the point where, in contrast to its 'saturated' level many years ago, the number of operations which it now handles has increased.

A second airport also augments the capacity of a primary airport by catering for peaks in traffic, enabling the primary airport to operate at generally higher levels, often close to full utilization, throughout the year. When there is only one facility to handle the traffic, it must necessarily be under-utilized a great deal if it is sized to handle the peak. Where there are two facilities, one handling the peak and the other the base load, the utilization of the primary airport can become very high. Indeed, the secondary airport makes it possible for the primary airport to be fully utilized most of the time. This is the situation that typically prevails in multi-airport systems. Primary airports, such as Washington—National, London—Heathrow and New York—La Guardia, operate at maximum capacity during most of the hours they are open. Meanwhile, their secondary airports, Washington—Dulles, London—Gatwick and New York—Newark are typically busy in peak periods or at peak hours, and relatively quiet at other times.

It should be noted in this context that it is never possible to completely flatten out the peaks in traffic for a metropolitan region, as these are largely generated by reasons beyond an airport management's control. Seasonal peaks in holiday traffic, for example, are determined by school holiday periods and the season, while daily peaks in international traffic depend on the requirement to leave or arrive in different time zones at sensible hours and within any curfew limitations. The amount of flexibility to reschedule traffic from peak to off-peak periods is thus limited.

Social contributions of second airports

Second airports provide an effective means of distancing some significant sources of noise from heavily populated areas without access penalties for air travellers as a whole. Second airports can do this by catering for the range of aviation activities that do not involve commercial traffic (for example, training flights and maintenance activities) and by providing capacity for traffic that has good reason to operate beyond curfew hours (for example, air cargo and express parcel traffic).

The second airport for Paris, Paris—de Gaulle, fulfils such a role. In contrast to Paris—Orly, it is situated outside the built-up areas and serves as the principal cargo centre and maintenance base for the Paris region. San Francisco—Oakland and Los Angeles—Ontario are similarly important centres for express cargo for their regions.

Second airports also inherently stimulate competition in the air transport system of a metropolitan region: the second airport breaks the monopoly on commercial air services previously held by the single airport facility, and can provide opportunities for the development of innovative services directed towards market segments not previously well catered for. Table 2.2 lists examples of such innovative services associated with second airports.

Innovative operators seeking to establish themselves are attracted to second airports for several reasons. A prime consideration is that, by being at a much smaller, less central facility, they distance themselves from the attention and dominance of the established carriers, and thus have a good chance of using the best facilities and terminal locations, as well as avoiding, to some extent, competitive retaliation from the more powerful, established companies. Additionally, there is necessarily less congestion and associated costs at a second airport.

Table 2.2 Some innovative airlines associated with second airports

Metropolitan region	Secondary airports	Innovative services
New York	Newark	People Express Federal Express World Airways
Los Angeles	Ontario Burbank	United Parcel Service Pacific Southwest Air California
London	Gatwick Luton	British Caledonia Tour operators
San Francisco	San Jose Oakland	Pacific Southwest World Airways Federal Express
Chicago	Midway	Midway Airlines Air One
Washington	Baltimore	World Airways
Dallas	Love Field	Southwest Airlines Muse Air
Houston	Hobby	Southwest Airlines Muse Air

Another factor favouring innovative services at second airports is that the airport authorities will often go to considerable effort to assist the innovative operators in promoting their services, and therefore the second airport itself. Services that may often be seen as something of a nuisance at the major airport may be viewed as desirable at the second airport. This has been the experience in Britain and the United States, where the national authorities have permitted innovative services: the British Airports Authority, for example, has been active in attracting new services to London—Gatwick that it does not want to accommodate at London—Heathrow.

A second major airport is thus not typically a duplication (or a splitting) of a primary airport and its functions, but a significant contributor to the rationalization and efficient operation of a regional air traffic system.

2.2 SIZE OF A SECOND AIRPORT

Although each airport in a multi-airport system will be a focus for a specialized set of services, there will be a dominant airport in every system. This primary airport will attract many more passengers, generally anywhere from two times to five times more than the second airport. Experience has shown that the second airports are smallest in their level of passenger activity in those regions that generate the fewest originating passengers. This is because traffic distributes to secondary sites in proportion to the congestion at the dominant airport, and therefore the busier the principal facility the larger the share at the smaller airport. The expectation that traffic can be evenly distributed between two airports in the same system is not borne out by the experience in existing multi-airport systems. Table 2.3 illustrates this situation.

Table 2.3 Relative sizes of airports in a multi-airport system (1983)

Metropolitan region ranked in order of number of originating passengers	Major airports serving region	Ratio of air traffic among airports
New York	3 (Kennedy: La Guardia: Newark)	100 : 67 : 62
Los Angeles	3 (International: Burbank: Ontario)	100 : 10 : 7
London	3 (Heathrow: Gatwick: Luton)	100 : 46 : 6
Tokyo	2 (Haneda: Narita)	100 : 42
Paris	2 (Orly: de Gaulle)	100 : 84
San Francisco	3 (International: San Jose: Oakland)	100 : 14 : 10
Miami	2 (International: Fort Lauderdale)	100 : 30
Washington	3 (National: Baltimore: Dulles)	100 : 31 : 21
Montreal	2 (Dorval: Mirabel)	100 : 22

This situation of traffic concentration at primary airports exists despite repeated efforts by many governments to distribute traffic more evenly. The minimization of costs — in terms of the environment, air traffic congestion, and access — have been the principal governmental objectives in trying to redistribute this traffic. Thus, in an attempt to reduce the environmental costs (represented by noise) to airport neighbours, the United States Federal Aviation Administration has attempted to shift traffic from the centrally located Washington—National Airport. Similarly, in order to ameliorate the problems of congestion incurred by airlines, both the Port Authority of New York and New Jersey and the British Airport Authority have been trying to shift traffic from the most congested airports at New York and London. There have also been sustained efforts in Paris and San Francisco to shift traffic to airports that are more accessible to the population of the region, in order to alleviate the costs of access incurred by the travellers themselves.

However, these attempts have generally not met their planners' expectations. In Washington, for example, it was expected that 50% of all passengers for the city would pass through the new Washington—Dulles International terminal by 1967, five years after its opening. However, more than twenty years after its opening it has 10% of the total traffic of the two airports. Washington—National, located close to the city centre and with flight paths over some of the most sensitive residential areas in the United States, is busier than ever. Similarly, efforts to induce greater traffic to the convenient San Francisco—Oakland airport have failed, and this facility now receives only a quarter of the market share it was supposed to attain a decade ago. In Paris, traffic at the new airport, Paris—de Gaulle, is not yet at the planned level and it is still clearly the secondary airport in the region.

The distribution of traffic between airports results from a powerful interaction between the needs of the airlines and their passengers. The process of concentration at primary airports is stimulated by the passengers, an important factor because their preferences are effectively beyond a government's control. The majority of travellers concentrate at the airport with the best services and the greatest possibilities for making flight connections. The airlines must follow, as they could not afford to continue to offer services at a secondary airport that were out of proportion to the demand there, even if subsidized or subject to regulatory constraints. Ultimately, therefore, most of the airline services tend to centre upon the busier airport, reinforcing the passengers' desires to be there. Traffic concentration is thus the inevitable result, and planned allocations of traffic which have not recognized this tendency towards concentration of traffic have not been successful.

2.3 TRAFFIC SPECIALIZATION

In a multi-airport system, airports will tend to specialize around particular functions, with each airport typically having a quite distinct set of characteristics and services. Table 2.4 illustrates some examples.

Table 2.4 Specializations of airports in multi-airport systems

Metropolitan region	Airports listed by size	Specialities
New York	Kennedy	Transcontinental, bulk cargo
	La Guardia	Medium, short haul
	Newark	Cheap fares, express cargo
Los Angeles	International	Domestic, international business
	Ontario	California, express cargo
	Burbank	California
London	Heathrow	Domestic, international business
	Gatwick	Southern traffic
	Luton	Charters
Tokyo	Haneda	Domestic
	Narita	International
Paris	Orly	Southern, cheap fares
	de Gaulle	Northern and East/West traffic
Miami	Dade	Business, international
	Fort Lauderdale	Holiday
San Francisco	International	Business, international
	San Jose	California, commuter
	Oakland	Cheap fares
Washington	National	Short haul, business
	Baltimore	Long haul, cheap fares
	Dulles	Long haul
Dallas	Dallas—Fort Worth	Interchange operation
	Love Field	Short haul
Houston	International	Interchange operation
	Hobby	Short haul

The popular notion is that airports tend to specialize in either 'international' or 'domestic' traffic. This was the case in the Major Airport Needs of Sydney Study proposals for a second Sydney airport, where the options were seen as being to place all international traffic at the second airport and most domestic traffic at Kingsford-Smith Airport, or vice versa. Elsewhere, this image is reinforced by the names that have been applied to particular airports. However, despite their names, Los Angeles and San Francisco International airports primarily serve domestic traffic. In the San Francisco region, Oakland also has a high proportion of international traffic. Similarly, in the Washington area, although Washington—Dulles is the 'international' airport, such services are also provided at both Baltimore and the centrally located Washington—National Airport via connections through other airports.

The most common specialization between airports is between 'business' travel on the one hand and 'cheap fare' and other special markets on the other. The 'business' airport is often the larger airport and typically provides the services required by those travelling on business: high frequency of service, easy connections, and a broad range of destinations. The cheap fare and innovative services locate by preference at uncongested and therefore less expensive sites, as such savings assist them in providing their services.

The business airport is generally the older, established facility. Business services are most easily provided from this site because it starts with an established network of routes and is endowed with major investments in terminals which tie the existing airlines to that site. The cheap fare airport typically evolves around charter and similar services, whose operators, lacking major investments at the established airport, feel free to locate at a secondary airport.

The specialization of airports around particular services is an extension of the tendency towards concentration. In this case, similar kinds of services congregate together, propelled by their clients' desires for intensive operations in one place. Such a situation has its counterpart in the concentration of specialized services found in distinct districts within a city (for example, the clustering of department stores in shopping centres).

Examination of international experience as far as traffic specialization in a multi-airport system is concerned therefore leads to the following conclusions:

- It is impossible, over any appreciable period, to impose a distribution pattern that is not economically and socially acceptable to the airlines and air travellers.

- Business oriented passengers and airlines naturally coalesce around a single major facility.

- This major, business oriented airport will dominate the other airports in the region in terms of passenger traffic, and to a lesser extent also in terms of airline operations.

- Secondary airports will cater to traffic that does not require the convenience of the frequent flights provided at the major airport and that concurrently may wish to reduce expenses by operating in an uncongested environment. This traffic in large part tends to be holiday traffic.

- Secondary airports become sizeable enterprises, catering to at least 2 million passengers per annum, when the originating traffic in the metropolitan region reaches about 8 million passengers per annum.

2.4 DISTRIBUTION OF TRAFFIC BETWEEN TWO MAJOR AIRPORTS IN THE SYDNEY REGION

The projected distribution of air traffic within the Sydney Region rests upon the following assumptions:

- Kingsford-Smith Airport will be maintained at least at its present level of runway capacity.

- The second Sydney airport will be accessible by car or bus within one to two hours from anywhere in the Sydney region.

- The second Sydney airport will be built to accommodate long-distance international aircraft. (This presupposes sufficient runway length, customs and immigration facilities, but not necessarily full repair or catering facilities such as currently exist at Kingsford-Smith Airport.)

It is also assumed that prudent planning must accept the possibility, although not the certainty, that growth in air traffic in the Sydney Region could be as strong as indicated by the Department of Aviation's high forecast (Chapter 1). Much of the growth under this forecast would necessarily have been based on the development of a mass, consumer oriented market, principally consisting of leisure and holiday travel, which may be served in part by specialized services provided by charter airlines or charter-like subsidiaries of established airlines.

As a corollary, such high levels of air traffic could also imply that the structure of the air transport industry may be different from what it is today, and therefore the estimated distribution of traffic to a second Sydney airport needs to envisage the possibility of a larger set of services and companies than now exist.

Nature of the distribution

The most plausible future for Kingsford-Smith Airport is that it will remain the dominant, business oriented airport providing much the same services as it does today. This airport will always be much more attractive to the business person travelling for only one or two days and wanting easy access between the airport and the city centre. These passengers will be both able and prepared to pay a premium in order to use Kingsford-Smith Airport. As discussed in Chapter 1, in conditions of congestion, airlines would respond by charging higher fares for travel to Kingsford-Smith Airport either explicitly or by the simple device of limiting the number of economy and discount seats available on aircraft serving it. Holiday and other passengers more interested in cheap fares than in access to the city centre would correspondingly find greater opportunities at the second Sydney airport. This pattern of concentration of business traffic at the more central, established airport is the one that has repeatedly emerged elsewhere: for example at Washington, Miami and San Francisco, which are comparable in size to Sydney, as well as at London.

It may also be presumed that Kingsford-Smith Airport would continue to be the focus for much of the extensive network of intrastate commuter traffic. These passengers are also largely travelling on business and interested in making connections with interstate and international flights. Once again, this is similar to patterns elsewhere: even at the busiest airports in the world, such as New York—Kennedy and Chicago—O'Hare, there is intense activity by commuter airways serving the business market.

Further, it could be expected that the established major airlines — Qantas, TAA and Ansett — will all retain Kingsford-Smith Airport as their principal airport in the Sydney Region. There are two reasons for this. The first is that each has substantial investments in facilities there, although as these terminals, hangars and workshops eventually become obsolete or inadequate this reason loses much of its force over the long term. However, the second and more fundamental reason is that the alternative option for these airlines of relocating to a second airport is not realistic in the face of their established markets and competitive relationships.

A distribution that envisages all international traffic concentrated at a second Sydney airport is not a viable alternative in the Australian context. While international airlines might be persuaded to relocate to a more distant airport, passengers could not be coerced to follow suit when they had the possibility of organizing their international travel through the more central airport. Alert travellers and their travel agents would soon discover that flights to Europe or Asia could be arranged via a domestic flight to Perth, Darwin or Brisbane, for example, where they could transfer to an international flight. Passengers bound for the United States or the Pacific could similarly route their travel through Melbourne or Brisbane. Domestic airlines would profit from this opportunity to obtain a significant share of what is now international traffic. In ways such as this, a policy of placing all the international traffic at a second Sydney airport would inevitably be subverted.

Such a subversion of official policy has occurred at Montreal and Washington, where large airports were planned as focal points for international traffic. While the stance of these international airports serving as the gateway to the city still remains, the reality is now otherwise. Washington National Airport, which is comparable in location to Kingsford-Smith Airport (although more limited, as it is unable to handle inter-continental aircraft), processes many more flights to London than the more remote Dulles International Airport. This is achieved by the simple expedient of airlines effecting connections at intermediate cities such as New York. Similarly, European and North American passengers to Sao Paulo routinely avoid its distant international airport by first landing in Rio de Janeiro and connecting with interstate flights to Sao Paulo's convenient downtown airport. International travellers to and from Sydney could be expected to adopt similar strategies.

Alternatives involving the division of interstate traffic evenly between Kingsford-Smith Airport and a second Sydney airport would fail on similar grounds. While stringent regulation might conceivably force airlines to split their operations for a period, such regulations could not force the passengers to follow suit. Passengers would preferentially use the more convenient Kingsford-Smith Airport and put great pressure on the airlines to provide fuller services there. Experience elsewhere indicates that, in a democratically responsive society, these pressures are eventually accommodated and the traffic allowed to concentrate where it will. This was the experience at Paris, in particular, where the French Government attempted to divide the Paris—London traffic evenly between the two Paris airports. The policy was cancelled within only two years of its implementation.

Specialization of a second Sydney airport

The essential role of a second Sydney airport would be to provide the additional runway capacity that would enable Sydney to deal with future demand for mass air transportation and growth in air freight and general aviation. The creation of such additional capacity would benefit the entire air transport system and hence all travellers to and from Sydney. Without the facility to quickly develop additional runway capacity, it would be extremely difficult to provide adequate service when it was required.

However, given that all travellers would benefit from the additional capacity, consideration needs to be given to who might use the facility. Since a second Sydney airport would necessarily be more distant from the city centre, and thus less attractive to business users, it is economically rational for business travellers to use it as little as possible, and for it to be patronized by the travellers who would be least sensitive to the inconvenience of a more distant site. These are peak period leisure and holiday travellers. A plausible future for a second Sydney airport would be to serve this peak period, leisure oriented mass market.

This holiday market is distinct from the business travel market in many fundamental respects, each of which makes it reasonable for these types of holiday travellers to use a second Sydney airport. Proximity to the city centre is not a prime concern, as originating holiday passengers generally travel to the airport from their homes in the suburbs, a significant proportion of which may be as close in terms of travel time to a second Sydney airport as they are to Kingsford-Smith Airport. Even where access trips are longer, holiday travellers embarking on a long trip are in practice less sensitive to additional travel time than business people travelling on day trips would be.

Experience elsewhere indicates that the airlines serving this market would be charter or charter-type operators offering special schedules or flight programmes. These operators may be subsidiaries of business oriented airlines, and as such could be similar to British Air Tours, Air Vacances or Air Condor which are subsidiaries of British Airways, Air France and Lufthansa respectively. There may also be explicit charters or even national airlines specializing in particular tourist destinations, for example Fiji or Bali. As a rule, such cheap fare operators often prefer to operate out of uncongested airports, to avoid the extra air and ground costs.

The major centres for general aviation activity in Sydney are at Kingsford-Smith and Bankstown airports. However, the future prospect is for increasing constraint on the growth of general aviation at these airports. The potential for the expansion of other general aviation aerodromes at Camden, Hoxton Park and Schofields is also limited. In circumstances where congestion at Kingsford-Smith and Bankstown airports is high, the availability of a second airport is likely to result in a redistribution of some general aviation activities to this uncongested second airport. Activities such as air cargo, which may be restricted by the curfew at Kingsford-Smith, may also be attracted to a second airport.

While international experience shows that second airports have typically fulfilled the role of catering to the mass holiday market and other specialized services, ultimately a second Sydney airport might develop a broader role involving more business oriented traffic if the level of Sydney regional air traffic became sufficiently large. Such a situation has occurred at London's Gatwick Airport. However, this distribution would almost certainly not develop until some time well beyond the next twenty years.

Size of a second Sydney airport

On the basic premise that the runway capacity at Kingsford-Smith Airport will not be significantly enlarged, it also follows that the number of aircraft operations during any peak hour will not be much greater than at present. Although slight variations may arise from changes in the proportion of various types of aircraft using the airport or from the evolution of procedures, these would not change the overall maximum capacity in terms of aircraft operations per hour in any fundamental way. On an annual basis, the runway capacity of Kingsford-Smith Airport has been estimated to be 203,000 aircraft movements. The total potential passenger traffic at Kingsford-Smith Airport may therefore rise to 11-12 million annual passenger movements.

In comparison with the projected maximum level of traffic at Kingsford-Smith Airport of 11-12 million annual passenger movements, the level of traffic at a second Sydney airport would probably initially be relatively low: possibly about 2 to 5 million annual passenger movements. However, in absolute terms this would be significant, as the lower end of this range is equal to the current passenger traffic at, for example, Adelaide or Perth airports. The difference in the relative levels of traffic stems directly from the role of a second airport in providing for the peaks, in terms of runway capacity and aircraft operations. Although it would provide a substantial proportion of the runway capacity required in peak periods, these would only occur during a few hours of the day. The importance of a second airport to the Sydney area — in terms of providing the necessary capacity for aircraft when required — would thus not be reflected in the overall intensity of use.

These suggested relative levels of traffic that could apply initially between Kingsford-Smith Airport and a second Sydney airport are similar to those at other secondary airports: generally, such airports have 10-20% of the total traffic for the region in their first years of operation. However, these figures depend substantially on the type of aircraft being used, the runways available, the relative accessibility of the airports within the particular metropolitan region, and other factors. Significantly higher levels of traffic have been assumed for the purposes of evaluating the environmental effects of the worst case; the basis for these higher levels is discussed in Chapter 4.

2.5 TIMING AND LOCATION OF DEVELOPMENT OF A SECOND SYDNEY AIRPORT

Development of a second airport could take several years, and it would need to be opened some time before its traffic could reach a level at which the contribution of the second airport was noticeable. If a second airport were to be available when the capacity of Kingsford-Smith Airport was exceeded, then, on the basis of the Department of Aviation's forecasts of demand and capacity, the second airport would be required for initial use between 1988 and the year 2000.

The timing of the growth of traffic at a second airport would depend to a degree on its location. The further a second airport was located from the potential passengers, the longer it would be before the users and the airlines chose to use that airport in preference to the congested facilities at Kingsford-Smith Airport. It thus follows that a closer site would be more effective in providing early relief to the problems of congestion at Kingsford-Smith Airport.

The relationship between the ability of a second airport to attract traffic and its distance from the population does not follow any strict rule. On the one hand, it may be assumed that the clientele using a more distant airport would be relatively insensitive to the difficulty of access, or at least would be prepared to accept this inconvenience in order to obtain the cheap fare or special services of the second airport. On the other hand, it is certain that, of two possible airport sites, the one which is thirty minutes or more further away is bound to be much less attractive.

CHAPTER 3

Possible Site Locations

3.1 PREVIOUS STUDIES

Considerable work has been carried out over almost 40 years in the search for a suitable site for a second major airport for Sydney. This work has involved the evaluation of a large number of candidate locations, and the subsequent rejection of many, before the list of the ten locations considered in this latest study has been able to be defined. The four major studies which preceded this current study were:

- the Report on the Development of an International Airport at Sydney (1946)
- the Major Airport Requirements for Sydney Study (1969-70)
- the Benefit/Cost Study of Alternative Airport Proposals for Sydney (1971-74)
- the Major Airport Needs of Sydney Study (1977-79).

The second airport locations, sites or zones referred to in the following sections are shown in Figure 3.1.

3.2 REPORT ON THE DEVELOPMENT OF AN INTERNATIONAL AIRPORT AT SYDNEY (1946)

In the 1940s, Kingsford-Smith Airport came under considerable pressures for expansion, and several acquisitions of land surrounding the airport were made. Studies were also commenced in 1946 to determine the best location at which to develop a modern international airport for Sydney.

Three sites were under consideration: Towra Point, and the two existing airports at Bankstown and Mascot. The disadvantages of expanding Bankstown aerodrome were many. Towra Point, a flat sandy area surrounded by shallows on the southern side of Botany Bay, had more advantages than Bankstown but was not without its problems. The Mascot site, on the other hand, had the decided advantage of being an established aerodrome close to the city centre. The Towra Point site was not rejected, however, and was viewed as a good site for Sydney's future second airport, notwithstanding what was then considered its relative inaccessibility and the environmental difficulties foreseen with site development.

From 1946 to 1968, there were extensive negotiations between the Commonwealth, State and local governments over the Towra Point site, with the result that this site was included for possible airport development in the 1969 Sydney Region Outline Plan.

However, in 1969, the Commonwealth Government decided that the environmental difficulties involved in developing the long discussed Towra Point site as a second Sydney airport were insurmountable.

3.3 MAJOR AIRPORT REQUIREMENTS FOR SYDNEY STUDY (1969-70)

Following the conclusion of the lengthy period of investigation and negotiation over the Towra Point site, a Commonwealth Interdepartmental Committee undertook the Major Airport Requirements for Sydney Study. The major conclusions and recommendations of this study were that:

- Sydney would need additional airport facilities within a few years;
- a second major airport would be required, but its timing would be dependent on development at Kingsford-Smith Airport;
- further investigations were required in relation to:
  - future development at Kingsford-Smith Airport
  - the selection of a second Sydney airport site.

These recommendations led to:

- the 1970-71 review of further development at Kingsford-Smith Airport;
- the Benefit/Cost Study of Alternative Airport Proposals for Sydney (1971-74).

3.4 BENEFIT/COST STUDY OF ALTERNATIVE AIRPORT PROPOSALS FOR SYDNEY (1971-74)

This study prepared and evaluated long, medium and short lists of potential sites for a second Sydney airport. For the selection of an initial long list of sites, a map of the Sydney Region within 104 km of the GPO was overlaid with a grid of squares, each with 9 km sides, and each square was then examined for its airport potential. The figure of 104 km was arrived at through a rough trade-off between distance from Sydney and the cost of earthworks: the further away a site lay, the lower its justified level of fill. It was calculated that, beyond 104 km, access costs would render a 'perfect' site (i.e. one with no site preparation cost) non-competitive. The criteria used for selection of the long list from the grid of squares were the number of houses on and adjacent to the site, the terrain, and the flight clearance surfaces.

A number of offshore and sheltered water areas were examined as well as all the land squares in the grid. Consideration was also given to possible locations which overlapped one or more adjacent squares. As a result of this work, a long list of possible sites was drawn up and designated as List A. This contained ninety-eight sites on land and eight offshore sites.

In addition, two other lists (B and C) were compiled by the Department of Aviation. List B was based on suggestions from the Commonwealth and State governments, and List C on suggestions from the public. List B contained twenty-one sites on land and three offshore sites; all of these, with the exception of Bathurst-Orange, were also included in List A. The Bathurst-Orange site was the subject of a separate study and was eliminated on the grounds of its high access cost. It was concluded that the provision of satisfactory access to Sydney from this site would have required the construction of a 200 km/h railway incorporating over 60 km of two-track tunnel. List C contained sixteen sites on land in the Sydney region (all but one of which were included in List A), five offshore sites in the Sydney region (of which three were included in List A), and five sites outside the Sydney region. The eight sites on List C that were not on List A were eliminated for the following reasons:

Figure 3.1
CANDIDATE SECOND SYDNEY AIRPORT SITES: 1946-1985

- Albion Park did not have adequate approach surfaces (even though it already had a general aviation airport);

- the two offshore sites (one in Broken Bay and one off Wollongong) both had too great a depth of water;

- the five sites outside the Sydney region -- Alice Springs, Goulburn, Melbourne (Tullamarine), Moruya and Narromine — were too distant.

By this process of elimination, List A therefore became the final long list of sites for further consideration.

The purpose of medium listing was to reduce this long list of 106 sites to a medium list of about twenty sites which would then receive more detailed evaluation for short-listing.

As part of the evaluation of these sites for the medium-listing, six variations of airport layout were tested and in some instances more than one layout type was applied to a particular site. This produced a total of 147 site/layout combinations. Thirty-six of the sites were found to be capable of accommodating two widely spaced parallel runways and, of these, twelve could accept a four-runway layout consisting of two pairs of closely spaced parallel runways.

Nine cost areas were identified. However, in the first elimination stage of medium-listing, sites with layouts of the same type were ranked using crude cost estimates for site preparation and surface access. In the second elimination stage, the costs of noise disturbance and land acquisition were included in addition to those of site preparation and access. The final elimination stage involved consideration of additional information supplied by the NSW State Planning Authority and others. Much of this information related to uncosted intangible items such as land use planning, flooding, effect on recreation areas, airspace conflict, and possible air turbulence.

As a result of this medium-listing process, thirty-three site/layouts were selected at fifteen different sites. These medium-listed sites are shown on Figure 3.1. Subsequently, an additional fifteen site/layouts were included for sites already on the list, to provide cross-runway and three-runway variants. The medium list therefore contained forty-eight site/layouts at fifteen discrete sites.

The short-listing evaluation was then undertaken. First, the layout requiring the least net cost was selected for each site. Second, three sites were eliminated on environmental grounds. Some revisions were then made to the basis of costing, sensitivity tests were carried out, and the remaining sites were reduced to nine by a process of pair-wise comparisons. Four overlapping site/layouts were amalgamated to produce two new site/layouts. The resulting seven sites were known as the 'select list'. The Prospect and Galston sites were eliminated from this list, largely on environmental, planning and airspace grounds, leaving a short list of five sites. These were:

- Towra Point
- Nelson
- Long Point
- Marsden Park
- Bringelly.

For each of these sites, the layout with the lowest net cost proved to be a pair of closely spaced parallel runways.

However, the study recommended development of a parallel runway at Kingsford-Smith Airport as the first step in expanding Sydney's airport capacity, and no selection was made from the short list of second airport sites. This was because the study was terminated in March 1974 when the Commonwealth Government decided that Galston should be the site for a second airport — a decision that was not implemented following strenuous public opposition and an unfavourable report by the Department of Transport. Consideration was also given to a site in the Canberra—Goulburn area, but the persuasive element against selecting this site was the associated high capital and user costs of travel to and from Sydney.

3.5 THE MAJOR AIRPORT NEEDS OF SYDNEY STUDY (1977-79)

In 1976, the Commonwealth and State governments agreed to a further evaluation of possible sites as part of a comprehensive review of Sydney's future airport needs. The Major Airport Needs of Sydney Study was commenced under the direction of a joint Commonwealth—State committee. Among its tasks, the Committee was asked to recommend a site for a second airport. In February 1977 the Major Airport Needs of Sydney Commonwealth—State Committee reviewed the Benefit/Cost Study of Alternative Airport Proposals for Sydney and expressed satisfaction with the methodology used and the sites selected in the medium list. However, it noted that:

> The selection of a short list by the previous committee had involved weighted judgements based on considerable economic analysis and limited environmental and planning information. As some of the sites previously preferred by inclusion in a short list were no longer so clearly available and recognising the need for broader based analysis, the Committee took the previous medium list as the starting point in its own site selection process.

The Committee also noted that:

> Since 1973 when the original medium list was compiled, there has been considerable development in the vicinity of some sites. Because of these changes and the likelihood that further changes in site/layouts may become necessary as the study progresses, the Commonwealth—State Committee has concluded that for the Major Airport Needs of Sydney Study it should work with zones in its investigations rather than specific locations.

The following four zones were selected for consideration:

- northern: in the Scheyville—Nelson—Galston area
- north-western: in the Richmond—Londonderry area
- south-western: in the Badgerys Creek—Bringelly area
- southern: within the Holsworthy Military Area.

These zones contained seven of the fifteen sites from the previous medium list. Those not included, and the main reasons for their exclusion, were as follows:

- Towra Point: listed as a Nature Reserve in the interim
- Wattamolla: within a national park
- Duffys Forest: adjacent to a national park, and increased urbanization
- Prospect: increased urbanization
- Marsden Park: increased urbanization
- St Marys: increased urbanization
- Somersby: terrain and distance from Sydney
- Wyong: distance from Sydney.

In assessing the suitability of areas for consideration, the Major Airport Needs of Sydney Committee adopted more limiting criteria than those of the Benefit/Cost Study of Alternative Airport Proposals for Sydney. Where this study had included sites capable of accommodating no more than one or two runways, the Major Airport Needs of Sydney Committee required that any area considered must be capable of accommodating six runways: two pairs of widely spaced parallels in the primary direction, plus a pair of closely spaced parallels in the cross-direction. This requirement was relaxed in the case of the southern zone, where 'V' layouts were considered. The effect of this ruling was that eight site/layouts, considerably larger than those of the earlier study, were identified within the Major Airport Needs of Sydney Study zones. The size of these site areas was each approximately 5,000 ha (compared to the 1,440-1,770 ha now proposed for Wilton and Badgerys Creek).

A number of problems associated with the southern zone were identified early in the study and this zone was quickly eliminated from further consideration. These problems related to site costs, airspace conflicts and the difficulty of clearing unexploded ordnance from the Holsworthy firing range.

A detailed economic and environmental analysis of the remaining six site/layouts for the remaining four sites (Londonderry, Scheyville, Badgerys Creek and Bringelly) culminated in a site ranking based on both economic and environmental merit. Two sites were short-listed:

- Badgerys Creek
- Scheyville.

In December 1979, and prior to completion of the Major Airport Needs of Sydney Study, the Commonwealth members of the Committee submitted their recommendations to the Minister for Transport. Agreement on these recommendations could not be reached with the State members of the Committee. However, the principal recommendations by the Commonwealth members were as follows:

- A decision in principle should be taken to develop Kingsford-Smith Airport by constructing a closely spaced parallel runway and associated facilities east of the existing north-south runway (Recommendation 2).

- As part of the review of the Sydney Region Outline Plan (which was being conducted at that time), a contingent site for a curfew-free second major airport, together with potential noise affected areas, should be protected through at least retention of existing land use planning controls and with consideration being given to acquisition in cases of hardship. Badgerys Creek was the preferred site, largely on operational and environmental grounds (Recommendation 6).

- A separate strategic planning study of general aviation needs in the Sydney Region should be commenced and should include consideration of the use of part of the contingent site for a second major airport as one of the options for a possible additional general aviation aerodrome (Recommendation 7).

There were six other recommendations concerning:

- traffic management at Kingsford-Smith Airport;

- master planning for Kingsford-Smith Airport;

- airport management measures which might enable airport construction to be deferred;

- contingency planning in the event that no decision were taken on a preferred major airport development measure;

- availability of reports for public comment;

- the timing of further investigations arising from the Commonwealth members' recommendations.

Thus the Commonwealth members considered that development of a second major airport could not be preferred to developing a closely spaced parallel runway at Kingsford-Smith Airport. However, in the event that a second airport were eventually required, the Commonwealth members believed that there was a clear preference for a development at the Badgerys Creek site over the other short-listed site at Scheyville.

The reasons for the Major Airport Needs of Sydney Study reducing the possible sites for a second major airport to Scheyville and Badgerys Creek were as follows:

- Southern zone: Airport development in this zone would have serious environmental effects, higher capital costs, and only limited potential for expansion. The presence of unexploded ordnance would also have to be overcome.

- South-western zone: Badgerys Creek was clearly the preferred site on economic, financial and environmental grounds.

- North-western zone: Londonderry had significant economic and financial penalties and more serious adverse environmental impacts than either Scheyville or Badgerys Creek.

The Major Airport Needs of Sydney Study identified the following principal disadvantages of a 5,000 ha site at Scheyville when compared with a 5,000 ha site at Badgerys Creek:

- The general incidence of fogs in the Scheyville area is high, and may be unacceptable for a major airport because of the potential disruption to scheduled services.

- Long Neck Lagoon and other areas adjacent to the Scheyville site attract substantial numbers of large birds such as pelicans and ibis and may therefore have to be modified to reduce a potentially serious hazard to aircraft movements.

- Twice as many dwellings would need to be acquired and demolished at the Scheyville site as at Badgerys Creek.

- Airport operations at Scheyville would be incompatible with military aircraft movements at the nearby RAAF Richmond Base. A military runway would therefore have to be constructed at Scheyville and some RAAF activities would need to be relocated.

- Pitt Town may be degraded as a functional historic area due to noise impacts.

In turn, the following principal disadvantages of a 5,000 ha site at Badgerys Creek when compared with a similar sized site at Scheyville were identified:

- Several historic buildings would be destroyed.

- Several scientific installations would need to be relocated (e.g. Fleurs radiotelescope, CSIRO animal research farm).

- A large brickworks would probably need to be relocated.

- Clay and coal resources may be sterilized.

In 1982 the then Minister for Aviation, Mr Fife, announced his government's intention to construct a closely spaced parallel runway and associated facilities at Kingsford-Smith Airport. However, in a policy statement made prior to the 1983 Federal Election, the then Leader of the Opposition, Mr Hawke, announced that, if elected to office, his government would not proceed with Mr Fife's proposal, but proceed instead with the work necessary to select a site for a second major airport for Sydney.

3.6 SECOND SYDNEY AIRPORT SITE SELECTION PROGRAMME (1983-85)

Five years have passed since the Major Airport Needs of Sydney Study's recommendations were published, and further rural subdivision at all the sites has occurred in the interim. As the effects of this development are not evenly distributed, it is possible that the relative rankings of the sites by the Study may have been altered. It was therefore considered appropriate that the Second Sydney Airport Site Selection Programme should include a re-examination of all candidate locations in the Sydney Region. This examination covered an area within an 80 km radius from the Sydney GPO. This area was divided into the same grid of squares of 9 km sides that was used in previous studies, and the squares were given the same designations as previously to facilitate comparison with earlier work. Each grid square was subjected to examination using maps of 1:25,000 scale.

The criteria used for selection of possible airport locations were:

- Population: heavily poulated areas were eliminated, as were areas in which it was not possible to avoid the imposition of significant noise nuisance over populated areas.

- National parks: national parks were excluded from the search area.

- Topography: it was considered necessary for a site to be able to accommodate a main runway of 4,250 m and a cross runway of 3,000 m approximately at right angles, with the average longitudinal gradient not to exceed 1%. Cut-and-fill was not to exceed 10 m except for small areas such as gully crossings.

- Terrain clearance: an obstacle limitation surface of 1.6% from each end of each runway was preferred, although where this was not possible a 2% slope was considered acceptable.

The results of this examination are shown in Figure 3.2. From the areas within which possible sites existed, it was proposed to include all four sites which were analysed in detail in the Major Airport Needs of Sydney Study — Scheyville, Londonderry, Badgerys Creek and Bringelly. It was also proposed to review the decision of that Study to eliminate the southern zone (the Holsworthy Military Area) from contention, as the increased urbanization of the alternative sites might have improved the ranking of this area.

In addition, five sites which were strongly promoted in the press and by personal representation by various interest groups were included in the investigation. These were Somersby, Darkes Forest, Wilton, Goulburn and Warnervale. Although all these sites had previously been examined and rejected, it was considered that the changes in the intervening years and the continuing public interest made it desirable that they be reviewed again.

A further consideration in the reintroduction of sites discarded in earlier studies was that the Second Sydney Airport Site Selection Programme was to be conducted within the framework of the Commonwealth Environment Protection (Impact of Proposals) Act 1974 and the guidelines prepared pursuant to this Act which require that alternative sites be considered.

To permit an evaluation which took account of these considerations, five categories of alternative locations were identified, with which the following representative sites were associated:

- Major Airport Needs of Sydney Study short list: Badgerys Creek
Scheyville

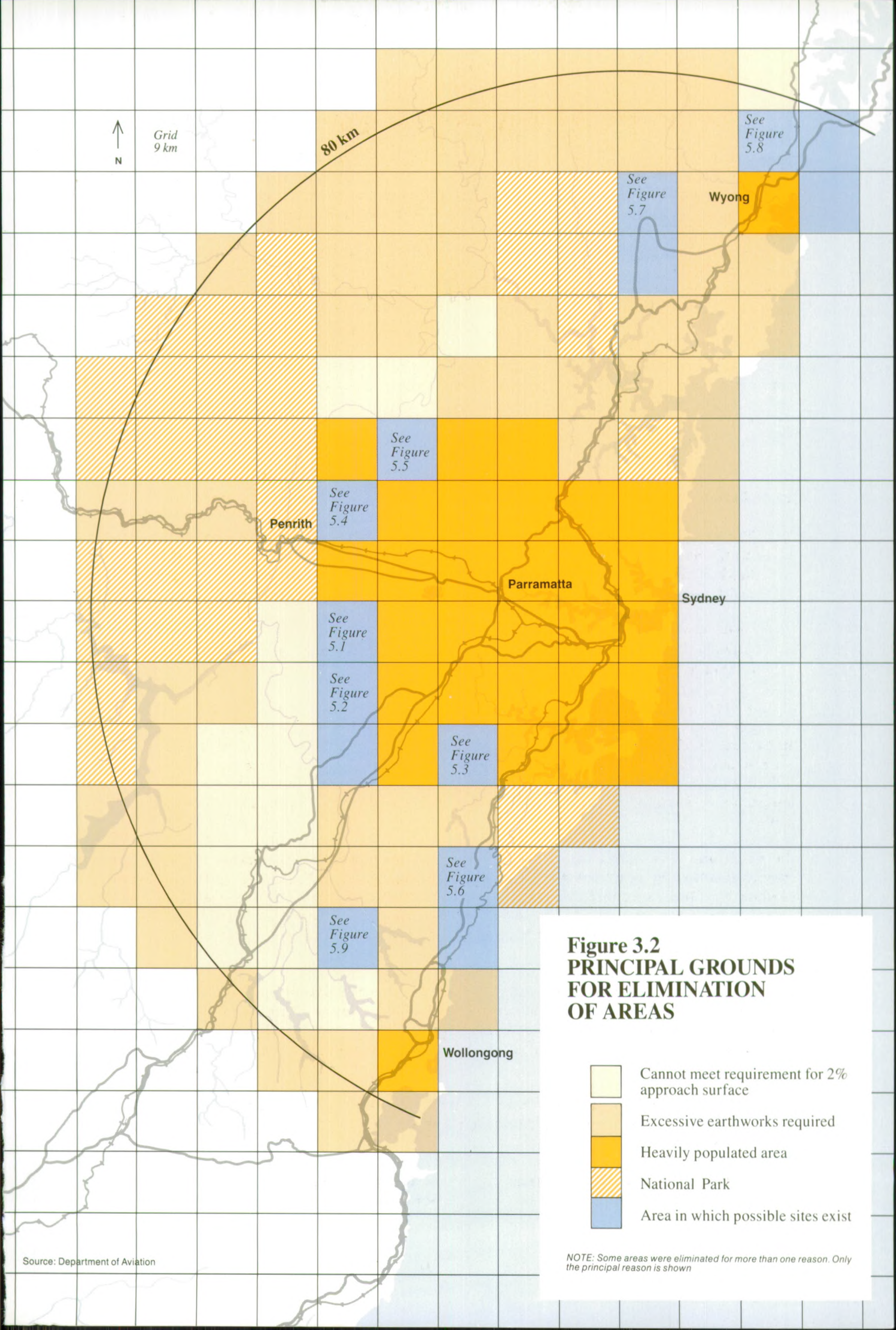


Figure 3.2
PRINCIPAL GROUNDS FOR ELIMINATION OF AREAS

- Other metropolitan Major Airport Needs of Sydney Study locations: Bringelly, Londonderry, Holsworthy
- Mid-distance locations (north): Warnervale, Somersby
- Mid-distance locations (south): Darkes Forest, Wilton
- Outlying sites: Goulburn (as representative of other outlying sites, e.g. Bathurst-Orange).

With the exception of other potential outlying sites, this listing exhausted the available and potentially feasible sites in and around Sydney.

3.7 PROGRESSIVE LOSS OF POTENTIAL SECOND AIRPORT SITES

Table 3.1 lists all medium and short-listed sites that have been considered in the three most recent second Sydney airport studies. Over the past sixteen years, sites which were closer to the city centre have been progressively lost to urban expansion or to the intensification of residential development in the urban/rural fringe of Sydney.

Table 3.1 Candidate second Sydney airport sites: 1971-85

	Benefit/Cost Study of Alternative Airport Proposals for Sydney (1971-74)			Major Airport Needs of Sydney Study (1977-79)			Second Sydney Airport Site Selection Programme (1983-85)	
	Medium list	Select list	Short list	Zones	Sites/layouts	Short list	Nominated locations	Short list
	Wyong*						Warnervale	
	Somersby						Somersby	
	Richmond**			NW: Londonderry	Londonderry		Londonderry	
	St Marys			NW: Richmond				
North and west of city centre	Blue Gum Ck+	Blue Gum Ck	Blue Gum Ck	N: Scheyville	Scheyville	Scheyville	Scheyville	
	Marsden Pk	Marsden Pk	Marsden Pk	N				
	Rouse Hill							
	Galston	Galston		N: Galston				
	Prospect	Prospect				Sites forgone		
	Duffys Fst							
	Towra Pt	Towra Pt	Towra Pt					
	Wattamolla							
	Long Point++	Long Pt	Long Pt	S: Holsworthy			Holsworthy	
South and west of city centre	Bringelly	Bringelly	Bringelly	SW: Bringelly	Bringelly		Bringelly	
	Badgerys Ck			SW: Badgerys Ck	Badgerys Ck	Badgerys Ck	Badgerys Ck	Badgerys Ck
							Darkes Forest	
							Wilton	Wilton
	Canberra—Goulburn						Goulburn	

* Later called Warnervale.
** East of the Londonderry site.
\+ Later called Scheyville.
\++ Later called Holsworthy.

The loss of more central sites is further illustrated by a comparison of the average straight line distance from the city centre of the short-listed sites, which has increased by approximately 20 km since 1971 as shown in Table 3.2.

Table 3.2 Average straight line distance of sites from Sydney GPO

Site listing	Average distance (km) from Sydney GPO	
	SACB Study (1971)*	SSA Study (1985)**
Medium list/nominated locations+	41	52
Short list	36	55

* Benefit/Cost Study of Alternative Airport Proposals for Sydney.
** The present Second Sydney Airport Site Selection Programme.
\+ Excludes Goulburn

There has also been a shift in the availability of candidate sites from areas north and north-west of Sydney to areas in the south and south-west, reflecting a more rapid intensification of development in the rural/urban fringe on the north and north-west of the city.

The functional contribution of a second airport to problems of air traffic congestion in the Sydney Region will be largely dependent upon its geographical relationship to the population and to other markets to be served. As Tables 3.1 and 3.2 show, sites within 30-40 km of the city centre are now forgone, and replacement sites are progressively further out. However, Sydney's centre of population is also shifting progressively westward, thus offsetting to some extent the relative decline in accessibility of candidate sites.

By comparison with the primary airports of other cities of comparable size to Sydney, Kingsford-Smith Airport has better than average proximity to the city centre, as shown in Table 3.3. In contrast, Sydney's short-listed second airport sites are, on average, further from the city centre when compared with second airports at other major metropolitan areas.

There are a number of possible explanations for these differences. One is that the existing secondary airports shown in Table 3.3 were sited under conditions and at times when less consideration was given to environmental factors. Another, and perhaps more plausible, explanation can be found in Sydney's very low urban density when compared with other cities of comparable size. Such comparisons are difficult to make, as metropolitan boundaries, topography and other factors render the calculation of densities on the same basis for each city most difficult. However, an analysis of the populations and areas of the cities listed in Table 3.3 indicates that the gross density of the Sydney metropolitan area may be approximately half the gross density of the average of the seventeen cities listed in the table. In other words, Sydney appears to have used about twice the amount of land per capita than the average of the other major cities in the same size range listed in Table 3.3. On this basis, it was calculated that, without consideration of any unique opportunities afforded by topography or local patterns of development, candidate new airport sites in Sydney would have to be located at least 7-10 km further from the city centre than for the other cases listed in Table 3.3.

Table 3.3 Distance of airports from city centres

Selected metropolitan areas with populations of 2.5–5.0 million	Approximate distance from city centre by road			
	Primary or most central airport	(km)	Secondary or other airport	(km)
Hong Kong	Kaitak	3		
Boston	Logan	5		
Washington (DC)	National	8	Dulles	42
Singapore	Changi	10		
Dallas—Fort Worth	Love Field	10	Dallas—Fort Worth	27
Sydney	**Kingsford-Smith**	**11**		
Madrid	Barajas	13		
Athens	Hellenikon	14		
Rome	Ciampino	15	Leonardo da Vinci	35
Milan	Linate	16	Malpensa	56
Melbourne	Tullamarine	19	Essendon	12
San Francisco	San Francisco	22	Oakland	27
Montreal	Dorval	23	Mirabel	55
Toronto	International	24		
Johannesburg	Jan Smuts	24		
Detroit	Metropolitan	40		
Average distance		16		36
Short-listed second Sydney airport sites			Badgerys Creek	48
			Wilton	81

Source: Kinhill Stearns

CHAPTER 4

Site Selection Methodology

4.1 APPROACH TO THE SITE SELECTION TASK

The preceding chapters have described the need to reserve a second airport site at this time, a possible role for a second Sydney airport, the history of attempts to reserve a second airport site, and the development of the list of ten nominated locations that form the subject of this current study. From this list of ten locations, two sites were selected for detailed evaluation in Parts B and C of this Draft Environmental Impact Statement. This chapter describes the methodology used in short-listing these two sites.

The approach that was adopted involved the following steps:

- examination of the ten nominated locations for potentially suitable airport sites;
- preparation of four conceptual airport layouts for each of these airport sites;
- adoption of an airport layout and worst case for site selection purposes;
- identification of a list of factors against which the ten sites and layouts could be assessed;
- assembly of the necessary data relevant to each factor for each site;
- evaluation of the data using several different methods;
- consideration of the strategic choices involved when short-listing sites for further evaluation in a Draft Environmental Impact Statement.

4.2 AIRCRAFT TYPE AND MIX, AND AIRPORT LAYOUT

For each of the ten sites, the following four conceptual airport layouts were developed:

- a single runway (SR) with a cross-wind runway;
- two closely spaced parallel runways (CSPR) with a cross-wind runway;

- two widely spaced parallel runways (WSPR) with a cross-wind runway;
- two double widely spaced parallel runways (DWSPR) with a pair of cross-wind runways.

These layouts are shown in diagrammatic form in Figure 4.1. Each layout was applied to each of the ten sites, taking into account local meteorological conditions, airspace constraints, obstructions, local topography and effects on adjacent areas.

For each layout, a hypothetical mix of frequencies of use by different aircraft type was developed, as shown in Table 4.1.

Table 4.1 Assumed aircraft mix for each layout

Aircraft type*	Layout			
	SR (%)	CSPR (%)	WSPR (%)	DWSPR (%)
Wide bodied	10	20	30	30
Narrow bodied	20	40	40	40
Commuter	30	20	20	20
General aviation	40	20	10	10

* Examples of the types of aircraft in each of these categories are as follows:

- wide bodied: B747, DC10, L1011, B767, A300
- narrow bodied: B727, B737, DC9, B757
- commuter: F27, Metroliner, Short Skyvan
- general aviation: business jet, twin and single piston-engined aircraft.

This aircraft mix was designed to reflect the probable use that would be made of a given layout type (for example, a DWSPR configuration would be likely to have a majority of movements by wide and narrow bodied jet aircraft), as well as to provide a broad range of options for aircraft mixes — from predominantly general aviation and commuter (SR) to predominantly commercial jet aircraft (DWSPR).

From this aircraft mix hypothesized for each layout it was then possible, taking into account runway capacities, aircraft type and load factors, to broadly calculate the range of total passenger movements (originating, terminating and in-transit) that each layout type could accommodate annually. These ranges are set out in Table 4.2.

Table 4.2 Passenger movement capacity and land requirements

Layout type	Approximate annual passenger movements (millions per annum)	Approximate land area (ha)
SR	0 -11	1,000
CSPR	5 -14	1,300
WSPR	13 -28	1,750
DWSPR	25 -45	2,650

The ranges shown in Table 4.2 are necessarily broad, as they reflect thresholds at which traffic levels could justify investment in a given layout type.

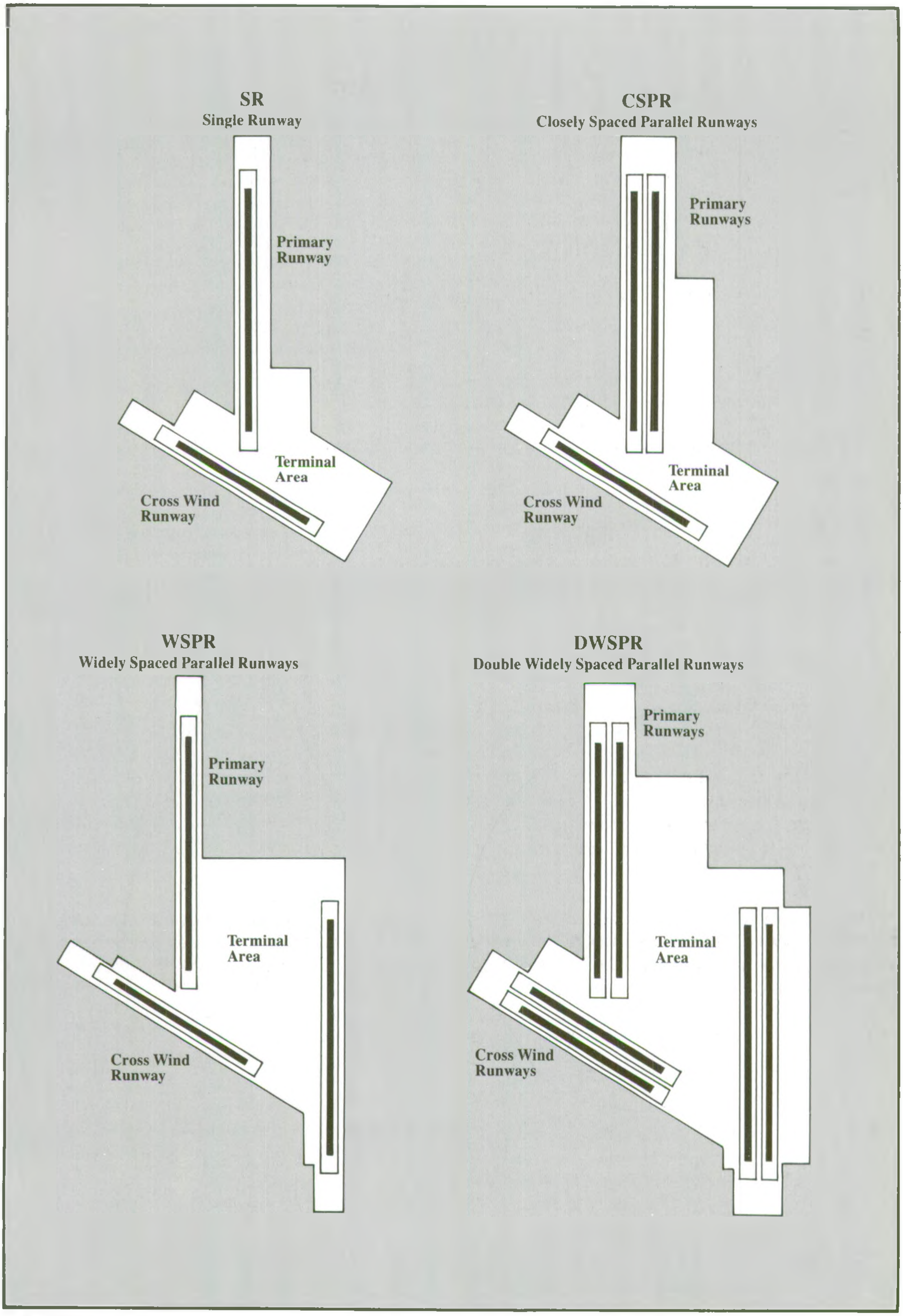


Figure 4.1
SCHEMATIC ALTERNATIVE AIRPORT LAYOUTS

4.3 SELECTION OF AN AIRPORT LAYOUT AND OF A WORST CASE

All ten sites were found to be physically capable of accommodating the four airport layouts described above, although with varying degrees of difficulty. At some sites several runway orientations were possible (for example at Badgerys Creek), while at others the topography and other constraints reduced the flexibility of airport layout to one runway orientation (for example at Holsworthy).

A minimum of forty site/layout combinations was possible when all four layouts were applied to all ten sites. However, as it was not considered practicable to attempt to evaluate forty or more site/layouts, two airport layouts on which to base technical information for site selection purposes were adopted for each site. This choice of airport layouts involved the resolution of two conflicting requirements:

- the requirement under the guidelines for preparation of this Draft Environmental Impact Statement (Appendix A) that the environmental assessment be based on the 'worst possible case' for each site under consideration;
- the necessity, in terms of the Department of Aviation's forward planning, for a feasible or realistic scale of airport development to be assessed.

Worst case for short-listing

The programme for the conduct of the study required that two (or three) sites first be short-listed and then evaluated in further detail. The level of detail in the data gathered for the evaluation of the ten sites was necessarily less than in that gathered for the evaluation of the two short-listed sites. In selecting a worst case for the purposes of short-listing, it was therefore necessary to consider the risk that the worst case selected would not result in the development of parameters sufficiently broad to accommmodate the range of specific site boundaries and noise contours that might need to be prepared for the short-listed sites. As it was the Government's intention to announce the selection of the short-listed sites before detailed environmental evaluation of them began, it was important to ensure that these short-listed sites did not subsequently emerge as unfeasible on one ground or another because the basic assumptions used for short-listing had been too narrowly drawn. With this risk in mind, it was judged prudent to conduct the short-listing analysis for a worst case of 25 million annual passenger movements at a second airport (or approximately the total of the forecast Sydney Region air traffic in the year 2010).

From Table 4.2 it can be seen that a worst case of 25 million annual passenger movements corresponds broadly to the upper limit in capacity of a WSPR layout and the lower limit of a DWSPR layout. The former was adopted (with a cross-wind runway) as the worst case for the short-listing task. The aircraft mix shown in Table 4.1 for the WSPR layout assumes 70% of aircraft movements by wide and narrow bodied jet aircraft, which can be contrasted to the present mix at Kingsford-Smith Airport where approximately 37% of all movements are by wide and narrow bodied jet aircraft. For the short-listing analysis, the mix assumptions in Table 4.1 were used to generate aircraft noise contours. The conservatism of these assumptions was further increased by assuming that 20% of flights would be at night.

Sensitivity of short-listing to a lower level of development

The above approach to evaluation of the ten sites on a worst case basis carried with it the possibility that sites better suited to a smaller scale of development could be prejudiced in the short-listing process. For this reason, a second set of assumptions was prepared to test the sensitivity of the worst case short-list to a much lower level of development. Chapter 2 discusses a range of lower levels of development at a second airport during the next fifteen to twenty years based on a range of annual passenger movements of 2-5 million. For sensitivity testing for a lower level of development, an option involving an SR layout and 5 million passenger movements annually was used.

Having made a judgement that these two contrasting activity levels of 5 million and 25 million annual passenger movements represented appropriate bounds for short-listing purposes, the consequent assumptions flowing from each activity level were developed (Table 4.3). These assumptions were then used for calculating such factors as noise contours and access traffic volumes and for assessing impacts associated with these factors.

Table 4.3 Assumptions for different levels of activity for site selection

Factor	Lower activity level	Higher activity level (worst case)
Number of annual passenger movements	5 million	25 million
Airfield configuration	SR, with cross-wind runway	WSPR, with cross-wind runway
Mix of aircraft type — wide bodied/narrow bodied/ commuter/general aviation (%)	10/20/30/40	30/40/20/10
Daily aircraft operations	300	750
Proportion of night flights (%)	20	20
Proportion of flights using cross-wind runway (%)	20	20

Worst case for evaluation of the two short-listed sites

At the conclusion of the short-listing process, the assumptions set out in Table 4.3 were reviewed for their appropriateness as a basis for the more detailed evaluation of the short-listed sites at Badgerys Creek and Wilton. It was concluded that the worst case for the evaluation of the Badgerys Creek and Wilton sites should be an airport with a capacity of 275,000 annual aircraft movements and 13 million annual passenger movements on a WSPR layout without a cross-wind runway (further detail on these assumptions is given in Chapters 8 and 13). The reasons for adopting this set of assumptions in place of the assumptions used in the short-listing process were:

- the Department of Aviation's advice that a cross-wind runway would not be required at a second airport at either the Wilton or Badgerys Creek sites as both of these proposed layouts have high usabilities and as, in the circumstances in which a second airport would be operating, there would also be another major airport (Kingsford-Smith) and several general aviation airports in the region with a different set of runway orientations;

- the fact that the earlier assumption that the second airport be required to take all of the region's traffic over the forecast period to 2010 was not a realistic basis for master planning and all subsequent actions flowing therefrom. With Kingsford-Smith Airport presently estimated to have a capacity of 203,000 annual aircraft movements (Figure 1.1), which corresponds to approximately 11-12 million annual passenger movements, the balance of the 24 million annual passenger movements forecast to 2010 — say 12-13 million annual passenger movements — was adopted for the capacity of a second airport.

Table 4.2 shows that 13 million annual passenger movements could be accommodated on a CSPR layout. However, for the preliminary master planning of the short-listed sites at Badgerys Creek and Wilton, the WSPR layout was maintained. This decision reflected the likelihood that the future aircraft mix at a second airport would contain a high proportion of smaller aircraft and that the ability to operate large and small aircraft on separate runways (and thus avoid problems of wake turbulence separation) would be desirable.

A further important consideration is the need to maintain planning flexibility. Acquisition of a second airport site represents the last opportunity to provide for any significant increases in aviation traffic. A site able to accommodate a WSPR layout involves a relatively moderate increase in land area over that required for a CSPR layout, yet provides much greater planning flexibility.

4.4 SITE SELECTION FACTORS

In evaluating alternative airport sites, choices must be confronted between quite different characteristics (such as convenience of access, noise impact and construction cost) which have no obvious common measure. Airport site comparison studies often involve the evaluation of each site against other alternatives based on twenty to thirty such factors. There is no standard or commonly accepted list of appropriate factors to be considered in airport site evaluation and, while some factors are common to a number of studies, local conditions and perceptions of issues are the principal basis for determining relevant factors. However, the evaluation process is aided if the factors selected:

- form a comprehensive listing
- are mutually exclusive (to avoid double counting)
- can be measured in objective terms
- demonstrate an appropriate response to public concerns.

A review was made of international airport site selection standards and studies, as well as of the results of the Department of Aviation's surveys of attitudes of Sydney residents to airport related issues. From this review it was concluded that the ten sites should be evaluated against each of the following four factors:

- environment (the external impacts of the project)
- access (efficiency of access to the airport site)
- operations (efficiency and safety of airport operations)
- cost (of acquisition, construction and servicing).

These four factors correspond generally with the probable concerns of the major groups likely to have an interest in the site selection. These concerns are set out below:

- 'Environment', broadly defined, would be a primary concern of all those individuals, businesses, institutions or groups who could be either adversely or beneficially affected by the siting and operation of a second airport.

- 'Access' would be a primary concern of air travellers and other potential consumers of services at a second airport — and of the airlines and other businesses supplying those services.

- 'Operations' would be a primary concern of the airline industry and of the Department of Aviation.

- 'Cost' would be a major concern of government, which has the responsibility for funding the proposed acquisition and any subsequent development.

However, all contributors to, participants in, or parties affected by, the site selection decision could be expected to have views or preferences concerning the priority accorded to each of the factors used in the evaluation of alternative sites.

Within these four broad factors, twenty-five sub-factors were identified. To the extent that was possible, this list was constructed to be comprehensive and the sub-factors to be mutually exclusive and capable of measurement. In addition, the sub-factors had to represent one or more of the following conditions:

- a unique or important environmental resource which could be adversely affected by airport development;
- a critical determinant of airport location;
- a constraint of sufficient magnitude either to preclude or to severely restrict airport development;
- an issue likely to arouse public controversy;
- a legal or statutory obligation of the proponent.

Table 4.4 lists these twenty-five sub-factors, gives the reasons for their inclusion, summarizes the measurement criteria and, where applicable, indicates the measurement units. Some additional explanatory comments on data collection methods follow.

Environment

There are twelve environmental sub-factors listed in Table 4.4: five are concerned with aspects of the natural environment and seven with aspects of the social and economic environment. For the first three natural environment sub-factors listed in Table 4.4 — air and water quality and flood potential — the ranking of sites was based on a qualitative assessment.

The total quantity of air emissions from airport development is unlikely to exceed 1% of the total pollutant load in the Sydney Region. The airport would thus be a contributor to the total pollutant load, but not a substantial one. Airport air emissions were assumed to be concentrated in the vicinity of the airport owing to the convergence there of road and air traffic. The regional effects of these emissions were assumed to depend primarily on the location of the site within (or outside) the Cumberland Plain.

The ranking of sites for the effect of airport development on the quality of water in any receiving waters was based on the classification of the receiving waters by the State Pollution Control Commission and any restrictions that might be imposed on discharges from a site. The flooding assessment was based on site topography and known flooding problems in the vicinity of each site.

The rankings for the other two natural environment sub-factors (flora and fauna) were quantitatively based. The method used to rank sites for the likely impact of airport development on plant communities or species of conservation significance was based on a score for each site that took account of:

- the percentage of the site occupied by each community or species
- the ratio of this occurrence to all known occurrences
- the vulnerability of each species
- the condition of the species represented
- whether the pattern of site development could enable plant species to be conserved.

A similar method was used for the assessment of the relative impact of airport development on fauna and was based on a score for each site which took into account the proportion, condition and status of different habitats within a site, the habitat preferences of different species, and the diversity and status of species at each site.

Table 4.4 Site selection factors

Factor	Reason for inclusion	Measurement criteria	Units
ENVIRONMENT			
1. Air quality Local and regional effects of emissions due to airport related activity	Controversial public issue (ranks relatively highly in public opinion surveys dealing with perceived adverse effects of airports and issues influencing health)	Combination of regional and local effects. Regional — location in relation to Sydney air pollution basin; local — proximity of residential development	Qualitative ranking of regional effects weighted for proximity to residential development
2. Water quality Potential effect on quality of receiving waters	Controversial public issue Potential impact of site drainage on Sydney water supply	Indicative measure of the ability of receiving waters to assimilate discharges from the airport site based on quality of discharges required and receiving water classification	Qualitative ranking based on State Pollution Control Commission classification of waters in NSW.
3. Flood potential Contribution to downstream flooding or likelihood of site flooding	Statutory requirement Severe restriction on airport development	A measure of the degree to which the site is flood-liable or is likely to exacerbate downstream flooding	Qualitative ranking
4. Flora Potential loss or destruction of rare or endangered communities or species	Potential loss of unique resource Severe restriction on airport development Controversial public issue	Occurrence of rare or endangered communities or species	Weighted score for the status and condition of species by proportion of site occupied
5. Fauna Potential loss or destruction of habitat of rare or endangered species	Potential loss of unique resource Severe restriction on airport development Controversial public issue	Occurrence of habitat of rare or endangered species	Weighted score for faunal status and diversity and habitat status and diversity, by proportion of site occupied by given habitat type
6. Archaeology Potential loss or destruction of sites or land of archaeological value	Controversial public issue Statutory requirement Severe restriction on airport development	Predictive assessment of archaeological sites combined with actual known sites	Weighted score for the frequency of occurrence, condition, and heritage and scientific significance of archaeological sites
7. European heritage Potential loss or destruction of sites or features of heritage significance	Controversial public issue Statutory requirement	Number of listed or potential sites of heritage value; ranking based on condition, conservation status and importance	Weighted score for the frequency of occurrence and significance of sites
8. Agriculture Loss of productive agricultural land	Potential sterilization of a prime resource Controversial public issue of political importance	Rural land capability based on Soil Conservation Service classification system	Weighted score based on the area, class, versatility and degree of development of agricultural land at each site

Table 4.4 Site selection factors (continued)

Factor	Reason for inclusion	Measurement criteria	Units
ENVIRONMENT (continued)			
9. Mineral resources Sterilization of valuable mineral resources	Potential sterilization of a prime resource Severe restriction on airport development	Occurrence of known mineral resources and potential for extraction	Ranking based on tonnes of resource, and likely timing of extraction
10. Disruption Residents displaced by site acquisition	Controversial public issue	Estimate of the number of people likely to be displaced by site acquisition (from 1981 Census)	Number of people
11. Existing/committed noise-incompatible land use Noise-incompatible land uses within the 25 ANEF* contour	Severe restriction on operation of an airport Controversial public issue Statutory requirement	Measurement of noise-incompatible land use within 25 ANEF* contour	Hectares of noise-incompatible land use
12. Possible future noise-incompatible land use Potential future additions to noise-incompatible land uses within the 25 ANEF* contour	Potential loss of resource Severe restriction on airport development if in conflict with future plans for urban development	A measure of potential future noise-incompatible land use within the 25 ANEF* contour	Hectares of noise-incompatible land use
ACCESSIBILITY			
13. Market share potential (general aviation) Accessibility to general aviation facility	Need to consider demand/supply of general aviation services	Population within 20 km of site and not already within 20 km of a general aviation aerodrome	Population
14. Private vehicle accessibility	Commonly used factor	A year 2015 forecast of the number of likely air travellers in each of 79 zones in Sydney multiplied by the road travel time from each zone to each site. The lower the aggregated value, the more accessible the site	Person-hours x 10^3
15. Public transport accessibility	Commonly used factor	A year 2015 forecast of the total population in each of 79 zones in Sydney multiplied by the public transport travel time from each zone to each site. The lower the aggregated value, the more accessible the site	Person-hours x 10^3

* See Section 9.2 or 14.2 for a decription of the ANEF contour.

Table 4.4 Site selection factors (continued)

Factor	Reason for inclusion	Measurement criteria	Units
OPERATIONS			
16. Airspace Compatibility with existing airspace arrangements and scope for adjustments	Safety Effect on capacity of existing and proposed airports	Professional opinion	Ranking based on major, moderate, minor and no interaction with existing airspace arrangements
17. Wind coverage Runway usability within cross-wind tolerance	Effect on capacity and safety	Measure of runway usability for the runway orientations adopted for ranking	Ranking based on percentage of time that runways are usable.
18. Other meteorological conditions Degree to which other meteorological phenomena may affect airport usability and operations	Safety Effect on capacity	Availability of airport for safe operation under Instrument Meteorological Conditions	Ranking based on estimate of occurrence of adverse meteorological phenomena (e.g., incidence of fog)
19. Site flexibility Degree to which runway alignment can be altered within topographic and obstruction clearance limitations	Inappropriateness of fixed role definition Ensuring potential for long-term staged development	Range of possible major runway orientations	Ranking based on assessment of range of alternative layouts within the notional site boundary
VARIABLE CAPITAL COSTS			
20. Site acquisition	Commonly used factor	1984 capital cost	$ (1984 prices)
21. Relocation of Commonwealth facilities	Significant Commonwealth Government consideration	1984 capital cost	$ (1984 prices)
22. Relocation of existing major infrastructure Cost of relocation of major power transmission lines	Significant State Government consideration	1984 capital cost	$ (1984 prices)
23. Site preparation Cost of site clearing and levelling	Commonly used factor	Cost of cut-and-fill	$ (1984 prices)
24. Access works Cost of connecting the airport site to existing transport infrastructure and of any required upgrading of existing routes	Commonly used factor	1984 capital cost	$ (1984 prices)
25. New infrastructure Cost of water/sewerage works	Significant State Government consideration	1984 capital cost	$ (1984 prices)

Seven socio-economic sub-factors are listed in Table 4.4. For three of these — archaeology, agriculture and European heritage — scores based upon the extent and status of the sub-factor at each site were used to rank the sites, using techniques similar to those described above for flora and fauna.

The ranking of sites for the relative impact of airport development on sites of Aboriginal archaeological significance was based on the definition of zones within each site that were deemed likely to contain different types of archaeological sites. Known archaeological sites were tabulated by type and number for each zone and a score developed for each candidate airport site based on:

- dominant archaeological site types as a proportion of each candidate site
- frequency of occurrence of archaeological sites
- physical condition of sites
- long-term survival of sites
- heritage and/or scientific significance of sites.

For agriculture, the ranking was based on a measurement of different classes of land within each site, their versatility, and degree of development or intensity of use.

The ranking of sites for their European heritage significance took into account patterns of historical and economic development, the number and significance of sites already known, and the potential frequency of sites and their heritage or scientific significance.

The rankings for potential sterilization of mineral resources, the fourth socio-economic sub-factor, were based on information provided by the NSW Department of Mineral Resources which enabled the resource at each site to be assessed in terms of coal type, seam thickness, average depth of cover, estimated size of resource, and likely timing of extraction. These scores were combined with those for the extent of surface extractive resources (clay, sand, gravel and stone).

For the fifth socio-economic sub-factor (disruption) the population resident on each site was estimated from the 1981 Census, to allow an assessment of the number of people who would be disrupted by site acquisition.

The methodology used for developing noise contours (the ANEF contours) for the sixth and seventh socio-economic sub-factors (existing and future noise-incompatible land use) is described in Sections 9.2 and 14.2. For each of the ten sites, a worst case noise contour was plotted based on the operational assumptions set out in Table 4.3. This contour was then overlaid on maps that were prepared for each site showing existing land use zonings and urban release areas nominated by the NSW Department of Environment and Planning. The zonings were correlated with the Department of Aviation's land use compatibility advice and the area of noise-incompatible land use within the 25 ANEF contour was then measured at each site. The areas of rural/residential and agricultural land within the 25 ANEF contour on which residential development could possibly intensify were also quantified, to take account of the possibility that these areas might develop as urban residential areas in the future.

Accessibility

There are three accessibility sub-factors. Two of these — private and public transport accessibility — relate to the transport of people to or from a second airport. General aviation was assessed as a separate market, with the main criterion being the level of contribution of a second airport to the efficient distribution of general aviation facilities throughout the Sydney Region.

Travel times and distances used in the comparison of the ten sites were supplied by the NSW State Transport Study Group. The figures supplied were for the year 2015 and related to 'weighted average' travel times and distances between various parts of the metropolitan area on the road and rail network assumed for that date. These travel times and distances were calculated by estimating the average travel time by each available route between each site and each of seventy-nine metropolitan travel districts and then weighting those averages by the number of people using each route. This calculation gives an aggregate travel time for each travel mode (in person-hours). The State Transport Study Group figures included an allowance for 'terminal time' which includes parking time and walking to the final destination. Where necessary, travel times and distances to non-metropolitan sites from the edge of the metropolitan area were added to the times and distances to the edge of the metropolitan area to give total travel times and distances to the sites. For the ranking of sites for their accessibility by private vehicle or public transport, these aggregates of travel time (person-hours) were used.

In addition to ranking sites by their accessibility to the city as a whole, a separate measure was included to account for the distribution of general aviation facilities. This was done by calculating the population within 20 km of each site and not already within 20 km of a general aviation aerodrome.

Airport operations

The four airport operations sub-factors are concerned with the effects of a second airport on regional airspace users, the capacity of the runway system as limited by wind coverage, the level of safety under adverse meteorological conditions, and the flexibility offered by each location for alternative runway layouts. Although the site ranking was based on only one alignment, this last operational sub-factor was nevertheless included for those sites where more than one alignment was feasible, in case an amended alignment were required for the more detailed analysis of the short-listed sites.

Variable capital costs

The six capital cost sub-factors were those likely to vary between sites. The costs of runway and taxiway pavements and buildings were therefore not assessed, as it is unlikely that these would constitute a significant cost variation between sites. These variable capital cost figures were amalgamated into a single measure — the present value of savings relative to the most expensive site — which took account of a speculative schedule for acquisition, relocation of facilities and infrastructure, and completion of earthworks. Appendix B describes the method used for calculating the present value of savings.

4.5 DATA EVALUATION METHODS

For each sub-factor listed in Table 4.4, information was gathered at each site for the two different activity levels selected for comparison: the 5 million annual passenger movement case and the 25 million annual passenger movement worst case. The combination of the data for the twenty-five sub-factors for each site results in a formidable array of information and one from which conclusions are not immediately apparent. Thus, effort has been directed to presenting an analysis of all this data in a manageable form that is at the same time also responsive to the information requirements of the wide spectrum of interests. To achieve such an analysis, the factors and groups of sub-factors were considered in a number of different ways:

- First, the data was reviewed to identify any pattern that would enable sites to be grouped on the basis of some shared characteristics — as a way of rendering the evaluation more manageable. In this context, it was considered that the most useful characteristic by which sites could be grouped was their geographic location in relation to Sydney. Sites that lie closer to the edge of Sydney's urban area are, on the whole, more attractive in terms of access but less attractive in environmental and cost terms; sites at a middle distance from Sydney's urban area are, on the other hand, generally less accessible, but their impact would be felt by fewer people and their site acquisition costs would be less. This grouping allowed comparisons and rankings to be made initially between similar sites and subsequently between different types of sites.

- Assessments were then made of which characteristics were likely to be regarded by the widest public as being of critical importance to the selection of an airport site. Such characteristics, it was judged, included the extent of population displaced by site acquisition, the effects of aircraft noise, the accessibility of the airport, operational efficiency and safety, and the cost involved in site acquisition.

- The data were then analysed to identify any sites that ranked as consistently weak on the basis of one or more of these critical characteristics. Where this occurred, the merit of continuing to compare this site with the other sites was reviewed, and a decision taken on whether to recommend its deletion from the list of sites warranting more detailed evaluation.

- Having deleted any sites with severe liabilities (relative to the other sites), each group of remaining sites was separately assessed to identify the superior site (or sites) within each group. This assessment was carried out for the critical factors listed above and for all other sub-factors.

- The superior sites from each group were then compared, and a recommendation made regarding the basis for short-listing sites for more detailed evaluation in the Draft Environmental Impact Statement.

To supplement this approach and as a means of testing its sensitivity, use was made of a 'site ranking matrix', consisting of the list of sub-factors shown in Table 4.4. For each site, each sub-factor was measured or quantified on a common scale. The sites were then scored for each sub-factor on a ratio scale, which was designed to measure a range of situations for each site from the 'best' through to the 'worst' situation. Following this, each sub-factor was assigned a relative value or weight when compared with the other factors influencing site selection. The matrix was thus used as a format where the effects of each factor at each of the sites could be weighed and ranked, with the total rank for any one site being determined by aggregating the weighted scores.

However, because of the subjective nature of factor weights, there are severe limitations on the use of such a matrix as a strong tool in site ranking, as choice between alternative sites with different characteristics implies a value judgement that one set of characteristics is, on balance, more important than the others. The use of relative weights can be justified for only a narrow set of factors: generally those that are economic, where weights correspond to values such as the price of land or the cost of construction. More generally, because there cannot exist a common unit value, factor weights cannot be fully justified for the majority of characteristics associated with an important urban development such as an airport. There is no agreement, for example, on values for noise, travel time, environmental quality and other important factors under consideration when comparing sites.

Nevertheless, factor weights can be used speculatively to explore the nature of the alternative sites by testing the implications of different weights. In such sensitivity analyses, factor weights can give an indication of how a choice would rank different assumptions or values, and how robust the choice is when subjected to a range of factor weights.

In summary, therefore, the main steps in the short-listing process were:

- analysis and grouping of sites with similar characteristics;

- identification of sites with severe liabilities;

- identification of the superior site(s) within each group;
- examination of the differences between the superior sites from each group;
- sensitivity testing using the ranking matrix;
- recommendation of two (or three) sites for comparison in this Draft Environmental Impact Statement.

CHAPTER 5

Site Characteristics

5.1 DESIGN PARAMETERS AND DATA COLLECTION

In this chapter, the characteristics of each of the ten nominated locations identified in Chapter 3 are summarized. To ensure that the site selection process treated each location on equal terms, the following design and data collection work was completed for each location:

- The general environs of each location as defined in Figure 3.2 were investigated to identify a specific and practicable site for airport development. This investigation concentrated on major determinants of site development: reasonable topography; obstruction-free approach surfaces; feasibility of runway orientation for wind direction; and avoidance of effects on major environmental assets or on residential areas.

- In the process of selecting a specific site within each location, four concept plans for the four generic runway layouts described in Chapter 4 (SR, CSPR, WSPR and DWSPR) were applied to each location, having regard to:

  - orientation for wind direction;
  - practicable site development to minimize cut-and-fill and to take account of drainage;
  - known adverse meteorological conditions;
  - potential flight path obstructions;
  - potential airspace conflicts;
  - minimizing acquisition of housing;
  - minimizing the extent of noise impact.

  As far as it was possible at a concept planning level, it was established that each of the four layouts could be accommodated at each of the ten locations taking into account the practical problems of airport development.

- A notional site boundary was then identified at each location and a concept plan prepared using the WSPR layout as representing the worst case. These concept plans, which are illustrated in Figures 5.1 to 5.10, show:

  - a notional site boundary (the 'site');

  - the area within this boundary that could be expected to be cleared, levelled and drained for runway and terminal development (the 'development area');

  - the area within the 25 ANEF contour.

  Subsequent development of preliminary master plans for the two short-listed sites at Badgerys Creek and Wilton involved departures from the original concept plans as further information was introduced - see Chapters 8 and 13 for discussion of these variations.

- An SR variant of the WSPR layout was also developed for each site; it comprised one of the main runways, the cross-wind runway and a reduced notional site boundary.

- Using these concept plans, the notional site boundaries, and the runway and airport terminal activity level assumptions set out in Table 4.3 as a basis, data for each of the site ranking factors were assembled for the 5 million and 25 million passenger activity levels.

This design and data collection task involved the assembly of some 500 different items of information (10 sites x 25 sub-factors x 2 concept plans for each site). The results of this work are summarized in the following sections in the form of a general description of the characteristics of each site. The order of presentation of sites is alphabetical within each group of sites as follows:

- closer sites:

  - Badgerys Creek
  - Bringelly
  - Holsworthy
  - Londonderry
  - Scheyville

- mid-distance sites:

  - Darkes Forest
  - Somersby
  - Warnervale
  - Wilton

- outlying site:

  - Goulburn.

The information and assumptions presented for the Badgerys Creek and Wilton sites were based on that which was available at the time when the short-listing was being undertaken (April to September 1984). On the basis of more detailed recent information, some of the data and assumptions have been varied in some respects for the evaluation of the two short-listed sites presented in Parts B and C; the variations in assumptions are discussed in Chapters 4, 8 and 13; the data presented in Chapters 9-11 and 14-16 are the more recent and detailed.

5.2 CLOSER SITES

5.2.1 Badgerys Creek

Figure 5.1 shows the nominated 9 x 9 km location (reproduced on an enlarged scale from Figure 3.2) and the notional boundary of the Badgerys Creek site that was used for short-listing purposes. Although the village of Luddenham is included within the site shown in this figure, it was found to be possible when developing the preliminary master plan (illustrated in Chapter 8) to define a site boundary to exclude this village. The site area used for short-listing purposes is bounded to the north by the pipelines from Warragamba Dam to Prospect Reservoir and to the south by Badgerys Creek. The land slopes gently from the ridge line at The Northern Road in the west to South Creek in the east, with a maximum change of elevation of about 70 m.

The conceptual runway system shown in Figure 5.1 is aligned along the ridge line on an approximately north-west/south-east orientation. However, this is only one of several alignments possible at Badgerys Creek. Two other alignments — north/south and north-east/south-west — were subsequently investigated (Chapter 8), and the north-east/south-west alignment was selected for the detailed environmental studies that were undertaken (Chapters 9-11).

Environment

Within the notional site boundary shown in Figure 5.1 there are some 4,020 ha of agricultural land comprising 3,770 ha of prime agricultural land and 250 ha of good grazing land. The principal land use is rural residential and small farms pasturing cattle and horses. There is also one large dairy, some irrigated vegetable production, and some battery chicken sheds. While there is a lower proportion of prime agricultural land on this site than at Bringelly to the east, economic pressures would eventually lead, in the absence of zoning restrictions, to the area being utilized mainly for rural residential and hobby farm purposes.

The soils are predominantly clay loams of the Cumberland association. However, there is an area of Menangle association at the centre of the site, and an area of Mulgoa association alluvium on the site's western border. The dominant geological unit is the Wianamatta Shale, with the Bringelly Shale sub-group outcropping throughout the area. Coal underlies the area at a depth of approximately 830 m. However, the location and depth of cover of this resource make it unlikely that it would ever be mined. A proportion of the site is also likely to contain economically significant deposits of light-firing clay/shale used for brickmaking, although the potential of this resource will not be determined until the NSW Department of Mineral Resources completes investigations over the next twelve months.

Some disturbed remnants of native vegetation remain on the ridge and along the creeks in the site. While these areas may provide habitat for fauna, most of the site consists of cleared land and therefore does not support a high diversity of species.

One Aboriginal archaeological site is known to exist at the boundary of the notional site area. European settlement commenced in the early years of the nineteenth century (c. 1809), when agricultural production, which had been concentrated around Sydney and Parramatta, was extended to the Badgerys Creek area in order to utilize the fresher soils there. Initially, small farms were built on small blocks of land, but these were consolidated into larger estates during the 1830s and 1840s. Extensive deposits of good clay in the area were also exploited for brick manufacturing at this time. However, during the 1860s, disease and competition severely affected agricultural development, and large pastoral runs were established. These in turn were badly affected by the 1890s depression and began to be subdivided into farmlets and housing in the 1920s. There are no recorded sites within the notional site; however, early local plans show the names of a further seventeen properties also within the notional site, some of which appear to have historical connections.

Because the Badgerys Creek site is located within the Cumberland Plain, it was judged to rank seventh out of the ten sites in its potential to contribute to regional air quality problems. Only Bringelly (which is similar in location to Badgerys Creek, but in a more populated area), and Londonderry and Scheyville (both of which are in areas with very poor dispersion characteristics) were ranked as worse on this factor.

The site drains into South, Badgerys, Cosgroves, Duncans and Mulgoa creeks, and thence into the Nepean River. None of these creeks is classified by the State Pollution Control Commmission, but Duncans Creek discharges into the Nepean, which is classified as Class 'S' (Specially Protected Waters) upstream of Wallacia. Given this classification and the location of the site at the headwaters of five creeks, one of which (South Creek) is extensive, development of this site was judged as having the potential to give rise to more water quality problems than the other sites except for Bringelly (also located on South Creek), Darkes Forest and Wilton. Development of the site could also contribute to the risk of flooding along South Creek.

Some 1,350 people (1981 Census) were estimated to reside within the notional site boundary shown in Figure 5.1. The area of noise-incompatible land use within the 25 ANEF contour is approximately 2,518 ha, and a further 5,007 ha were assessed as being capable of more intensive development which could render these areas noise-incompatible also.

There are a number of significant institutional land uses to the north and east of the site, including the CSIRO McMaster Research Station, the University of Sydney's McGarvie Smith farm, an RAAF receiving station, the Fleurs Radio Observatory and the Overseas Telecommunications Radio Centre. The site is crossed by two 330 kV transmission lines and there is a proposal for a new 500 kV line that would also cross the site.

Accessibility

Access to Badgerys Creek by road would be via:

- The Northern Road, north to the Western Freeway;
- Elizabeth Drive, east to the Hume Highway;
- Bringelly Road, south and east to the Hume Highway.

The road traffic load generated by a second airport would be spread over a number of access routes, and upgrading of the Western Freeway or Hume Highway may not be required. It would be necessary to construct a new road around the site, and to relocate The Northern Road to link it with Elizabeth Drive and Silverdale Road.

In planning for rail access, the following two alternatives are available for an electrified double-track rail spur from the existing network to the site:

- from west of St Marys;
- from south of Glenfield.

Under the road network and travel conditions assumed for the year 2015, the site would be approximately 48 km from Sydney, and morning peak hour travel time by road would be approximately 74 minutes. Of the ten sites, only Holsworthy would have a lesser aggregate road travel time measure. The rail distance to the city centre on the assumed year 2015 network would be 68 km (given a suitable connection to the network), with a morning peak hour travel time estimated at 65 minutes (in the discussion of access distance and times for the remaining nine sites, the times are as estimated for the morning peak hour and the distances are estimated from the network assumed to be in place in the year 2015).

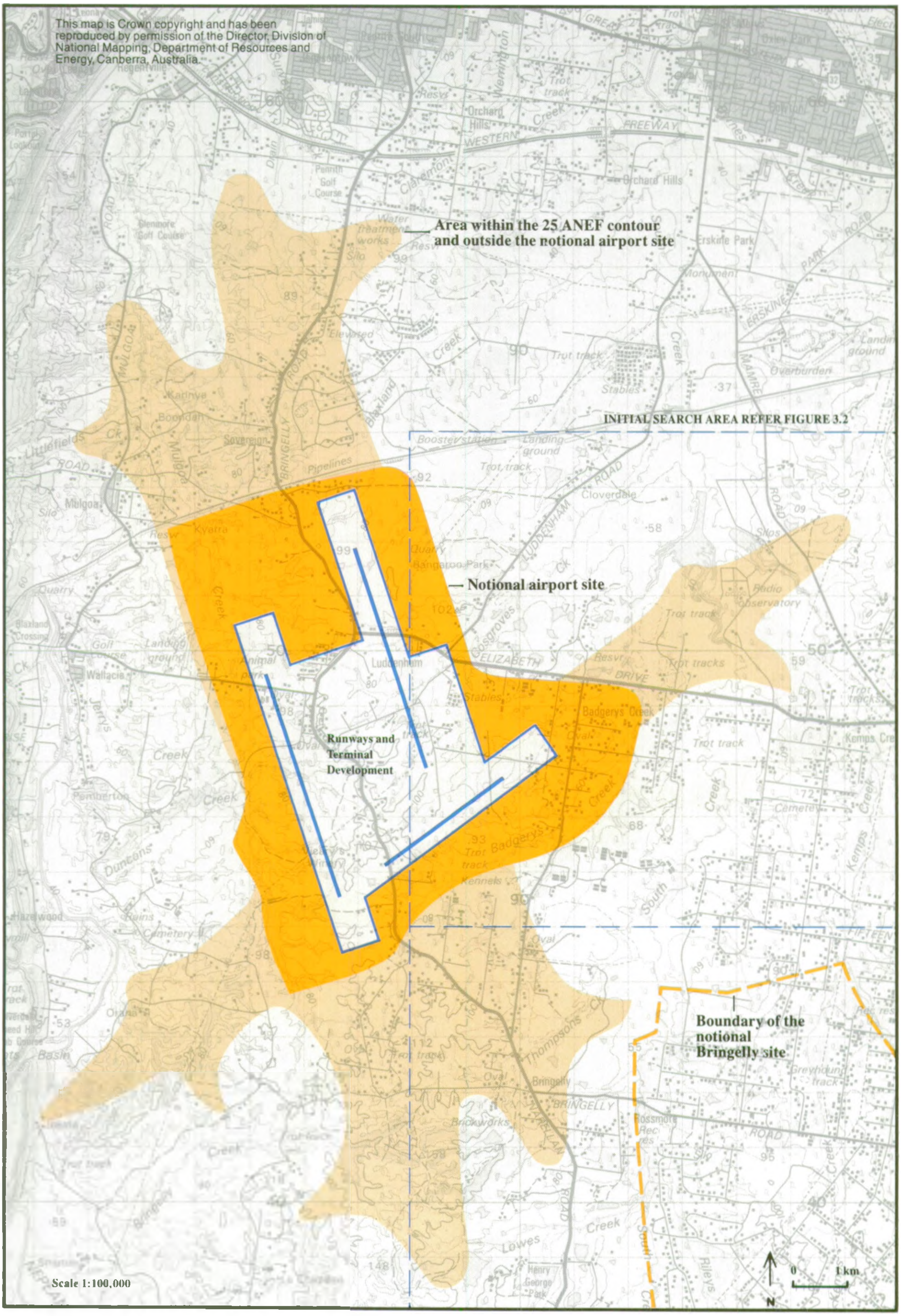


Figure 5.1
BADGERYS CREEK SITE AND WSPR LAYOUT

NOTE: This layout was used for the short-listing analysis only; see figure 8.3 for the proposed layout at Badgerys Creek.

The region in which the proposed Badgerys Creek site is located is already well served in terms of general aviation, as there are three general aviation aerodromes in the area: Bankstown, Hoxton Park and Camden.

Airport operations

The average incidence of fog in the area has been estimated to vary from twelve days per year on the Luddenham ridge to twenty-five days for the South Creek area. Occasional thunderstorms might restrict operations at a future airport on the proposed site for brief periods, but no more so than at the existing aerodromes in the region. Wind coverage for the runway system would be 99.8% or greater.

Existing airspace arrangements in the western region would be affected by the operations of a second Sydney airport at Badgerys Creek, but the extent of this would depend on the final alignment adopted. Hoxton Park would be the aerodrome most affected, although provision could be made for its continued operation. There would be severe restriction on the flight training now carried out in the area and some interference with other activities at Bankstown and Camden aerodromes.

Cost

The Badgerys Creek site has the third highest acquisition cost, after Scheyville and Bringelly. Nevertheless, the overall acquisition and development costs for the Badgerys Creek site would allow savings of approximately $90 million over these costs associated with the most expensive site, which is Scheyville. This assessment took into account broad cost estimates for site acquisition, relocation of infrastructure and of Commonwealth facilities, site preparation, and the provision of access and new infrastructure, as well as a speculative schedule for acquisition and development over fifteen years.

5.2.2 Bringelly

Figure 5.2 shows the nominated location and notional boundary of the Bringelly site used for short-listing. The site is bounded by the Hume Highway on the south and east and by South Creek on the west, and extends some 2.5 km north of Bringelly Road. The terrain consists of moderately to gently rolling hills on Wianamatta Shale and some alluvium, with a maximum fall of about 60 m from south to north.

Several runway orientations are possible. The alignment shown in Figure 5.2 used for the short-listing analysis took advantage of the north/south sloping terrain and of the drainage pattern toward South Creek in the west and Kemps Creek in the east.

Environment

Much of the land within the notional site boundary is prime agricultural land. The principal land uses are rural residential and small farms running cattle and horses, some small areas of horticulture, intensive vegetable production, and chicken production (an important activity in the local area) as well as some extensive cattle grazing enterprises. The total area of prime agricultural land within the site is estimated at approximately 4,100 ha — the largest of the ten sites.

The dominant geological unit is the Wianamatta Shale, with the Bringelly Shale sub-group outcropping throughout the area. The latter is a brickmaking resource. Coal underlies the Bringelly Shale at a depth of 830 m but the depth of cover and location make it unlikely that this resource would ever be mined.

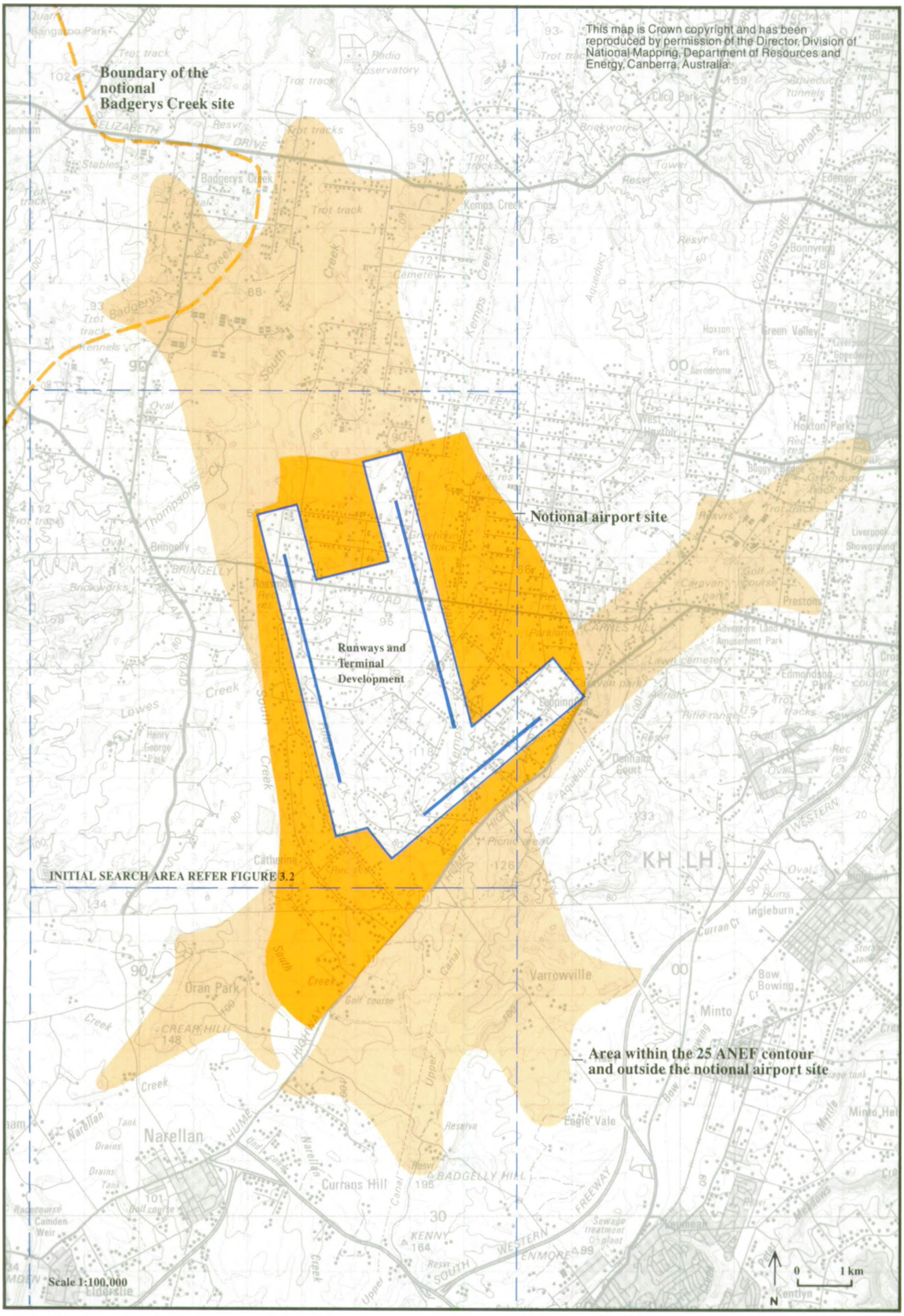


Figure 5.2
BRINGELLY SITE AND WSPR LAYOUT

There are small disturbed remnants of native vegetation on the site. No rare or endangered plant species are known to be present; however, there is a proposal for a nature reserve on Kemps Creek downstream from the site. The creeks within the site serve as wildlife corridors, and a small proportion of the site (5%) would be a suitable habitat for three sensitive bird species — the satin flycatcher, the collared sparrowhawk and the cuckoo-shrike.

There are no Aboriginal archaeological sites known to exist within the site. Settlement of the area by Europeans followed a similar pattern to that at Badgerys Creek. There are two recorded historic sites, the Church of the Holy Innocents and Bellfield Farm at Rossmore. In addition, early local maps show the names of at least thirteen properties within the notional site which appear to have historical connections.

The site is located within the Cumberland Plain and is adjacent to populated areas. For this reason, it was poorly ranked on air quality grounds — only the Londonderry and Scheyville sites received a worse ranking.

The site drains into South Creek and Kemps Creek and thence into the Hawkesbury River at Windsor. South Creek is an unclassified stream. Bringelly was ranked as comparable to Badgerys Creek on the potential for airport development to affect water quality in these streams. Development at Bringelly could also contribute to the risk of flooding along South Creek.

Approximately 4,250 people (1981 Census) were estimated to reside within the notional site boundary shown on Figure 5.2. The area of noise-incompatible land use within the 25 ANEF contour is approximately 2,729 ha, and a further 4,014 ha were assessed as being capable of more intensive development that could render these areas noise-incompatible also.

The site is traversed by a number of power transmission lines which converge on the Kemps Creek high voltage switching station. The Moomba—Sydney natural gas pipeline and a Telecom radio link from Cecil Park also cross the site.

Accessibility

On the basis of the layout shown in Figure 5.2, it was assumed that road access would be via Bringelly Road east to the Hume Highway and that Devonshire Road and Mamre Road would be upgraded to the north to connect to the Western Freeway. The section of Bringelly Road between Cowpasture Road and the Northern Road would have to be relocated. Rail access would be provided by the construction of an electrified double-track spur from Glenfield.

The site would be approximately 47 km from Sydney on the road network assumed for the year 2015. Travel time by road under those conditions would be approximately 71 minutes. Of the ten sites, Bringelly is ranked third in terms of the aggregate road travel time measure (with Badgerys Creek and Holsworthy being more accessible). The rail distance to the city centre would be 47 km and rail travel time 52 minutes.

The region in which the Bringelly site is located is already well served in terms of general aviation by the Bankstown, Hoxton Park and Camden aerodromes.

Airport operations

The frequency of fog has been estimated at an average of twenty-five days per year for South Creek but could be expected to be less on the higher ridges. Occasional thunderstorms may briefly restrict operations, but no more so than at existing aerodromes in the region. Wind coverage for the runway system shown in Figure 5.2 would be 99.8% or greater.

A second Sydney airport at the Bringelly site would severely restrict the use of Camden aerodrome or require its closure and would require the closure of Hoxton Park. Modifications to airspace arrangements at Bankstown and Kingsford-Smith airports would be required; Schofields aerodrome would be largely unaffected.

Cost

Of the ten sites, Bringelly was estimated to have the second highest acquisition cost (Scheyville having the highest). This reflects the existing density of development on the Bringelly site. Overall, it was estimated that it would be the fourth most expensive site to acquire and develop.

5.2.3 Holsworthy

Figure 5.3 shows the nominated location and notional boundary of the Holsworthy site used for short-listing purposes. The site is south of Liverpool and east of Campbelltown and is approximately 13 x 4 km, bounded on the west by the Georges River and on the east by Williams Creek. The site consists largely of a deeply dissected sandstone plateau rising at an average gradient of about 1% to the south. The north-flowing streams are approximately 60 m below the level of the plateau.

The conceptual runway system shown in Figure 5.3 is aligned approximately north/south along the ridges, and there is little scope for optimization of runway alignment for wind direction. The most favourable alignment as far as the site's topography is concerned requires substantial earthworks: the creation of a terminal area would require filling one of the creek gullies to a depth of approximately 60 m. A suitable source for the quantities of fill required has not been identified.

Environment

The area has been used since the turn of the century as a military firing and bombing range. As up to 5% of shells and 8% of aerial bombs do not explode as intended on impact, the site is contaminated by unexploded ordnance, and current technology is inadequate to ensure the detection of all of it. The site contains no prime agricultural land although there are some 980 ha of grazing land. The Bulli coal seam is at a depth of 800 m and the site has some potential for the production of a hard coking coal, although the depth of cover makes this uneconomic at this time.

The site is located on the periphery of the Cumberland Plain and is elevated. Air dispersion characteristics are assumed to be slightly better than those at Bringelly or Badgerys Creek, although there are populated areas immediately north of the site.

The site drains into the Georges River and Kalibucca, Harris, Williams and Complete creeks, all of which discharge into the Georges River. Harris and Williams creeks and the Georges River are Class C (controlled waters); discharges to these waters are permitted subject to approved treatment and to the availability of sufficient water for adequate dilution in the receiving waters. The site terrain offers opportunities to regulate stormwater run-off to avoid contributing to flooding problems on the Georges River.

For reasons related to its military use, there is little information available on the botanical significance of the site. However, in the north of the site there is now rare vegetation on Tertiary alluvium and Wianamatta Shale. The site has an extensive cover and greater variety of natural vegetation and therefore a greater variety of faunal habitats than are found at many of the nominated sites. Although much degraded by military use, the site may nonetheless form an important environmental buffer between the Royal National Park and the urban development to the north and west.

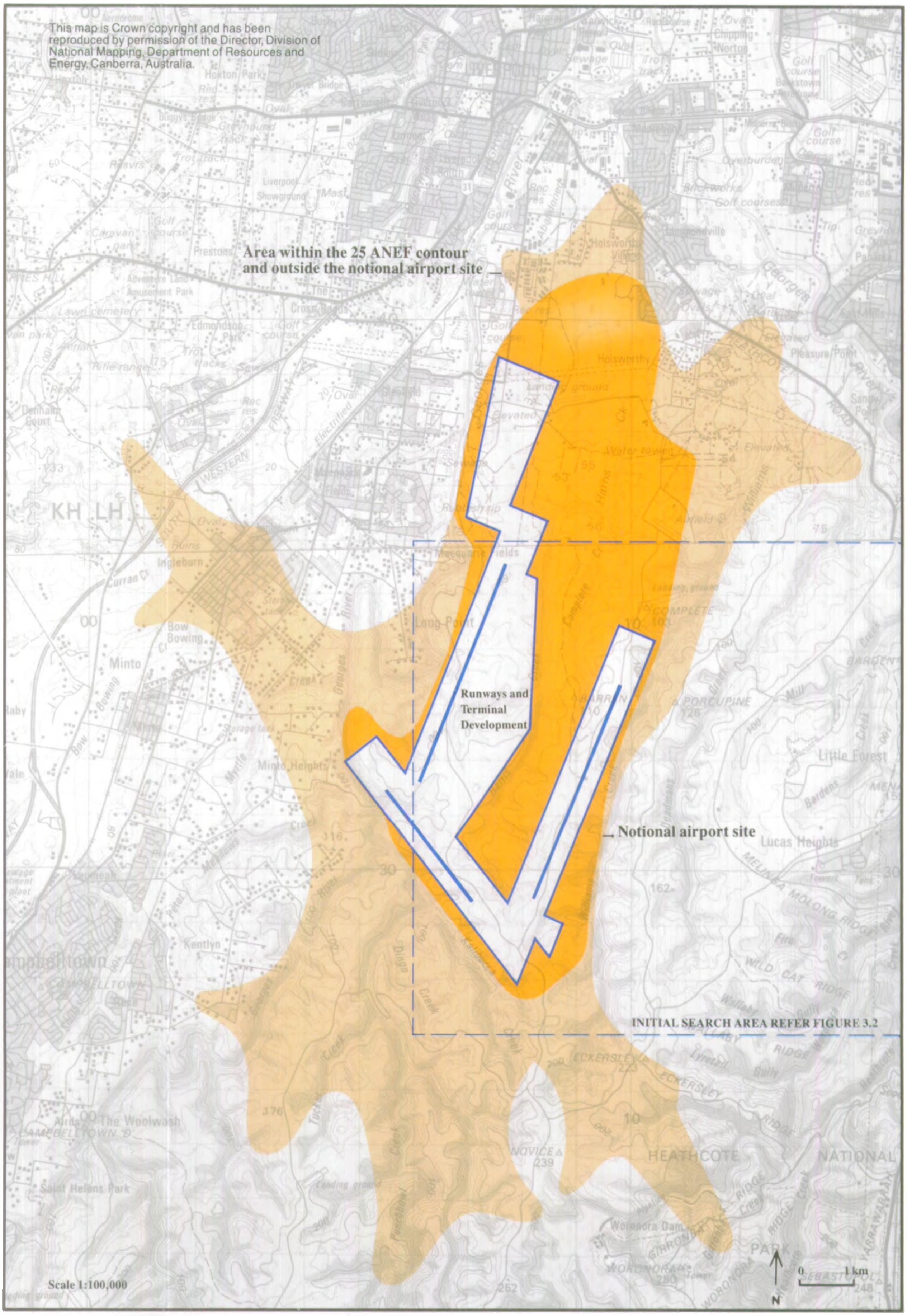


Figure 5.3
HOLSWORTHY SITE AND WSPR LAYOUT

Within the notional site boundary, some twenty-three Aboriginal archaeological sites have been identified, but there are no known or recorded European heritage sites.

It is estimated that approximately 1,230 people (1981 Census) live within the notional site boundary shown in Figure 5.3. The area of noise-incompatible land use amounts to approximately 1,424 ha within the 25 ANEF contour. In addition, 671 ha within this noise contour were assessed as being capable of more intensive development which could render these areas noise-incompatible also.

Development of a second Sydney airport at Holsworthy would require relocation of the Army units stationed there. The cost of relocation is estimated by the Department of Defence at $360 million.

Accessibility

Road access to an airport at Holsworthy would be direct from the Hume Highway north of the site. However, this freeway would require upgrading. While provision of direct rail access to Holsworthy would be difficult, it was assumed for the purposes of short-listing that some form of moving footway and escalator system could be provided to link a new station on the East Hills—Glenfield Line with an airport terminal on the plateau at Holsworthy.

Holsworthy is the most accessible of the ten sites by road, being 33 km from Sydney and, on the assumed 2015 road network, requiring 48 minutes in travel time. The distance by rail would be 32 km, with a travel time of 47 minutes.

The region within which the Holsworthy site is located is already well served by three general aviation aerodromes (Bankstown, Camden and Hoxton Park).

Airport operations

The runway system illustrated in Figure 5.3 provides 98.7% runway usability for wind direction. Because of the topographic constraints of the site, it is doubtful that this could be improved.

A second Sydney airport at Holsworthy would be approximately 24 km from Kingsford-Smith Airport, and operations at both airports would therefore have to be completely co-ordinated. Bankstown Airport would have to be closed, since the approach paths for Holsworthy would pass overhead and would be in conflict with Bankstown operations. Also, some limitations might need to be imposed on the use of Hoxton Park. Current airspace restrictions around the Atomic Energy Commission's Lucas Heights establishment would have a significant effect on operations at a second Sydney airport at Holsworthy.

Cost

The estimated costs associated with site preparation ($375 million) and relocation of Defence facilities ($360 million) make this site overall the second most expensive to acquire and develop (after Scheyville).

5.2.4 Londonderry

Figure 5.4 shows the nominated location and notional boundary for the Londonderry site used for short-listing. This site is located between Penrith and Richmond, and is bounded approximately on the east and west by Londonderry and Castlereagh roads respectively. The land is gently undulating, with a maximum difference in elevation of about 40 m.

The primary runway alignment shown in Figure 5.4 is north-north-east/south-south-west. The major constraints on the location and alignment of runways at this site are the escarpment of the Blue Mountains to the west and the nearby urbanized areas. To the north are the towns of Richmond and Windsor, Riverstone is to the east, while to the south are Penrith and St Marys. Considerations of terrain clearance preclude the location of an east/west runway closer than about 10 km to the escarpment.

Environment

Much of the site is covered with scrub, except where this has been cleared to the east of Londonderry Road on the periphery of the site. The soils are mainly Mulgoa association, and tend to be badly drained clays. There is no prime agricultural land on the site, although there is 3,410 ha of Class II and IV land.

The little development that has occurred is mainly rural residential or small poultry farms. There are sand and gravel resources within the site that would be sterilized by airport development unless they were extracted beforehand. There is also coal, at a depth of 860 m, although its location and the depth of cover make it unlikely that this resource would ever be mined.

The site contains some of the most significant remaining examples of several Cumberland Plain plant communities, including all occurrences of the Eucalyptus sclerophylla—Angophora bakeri—Banksia serrata community (Benson 1980). Several rare plant species also occur on the site, and a small nature reserve has been gazetted. In addition, there are several sensitive species of fauna in or near the site whose habitat could require conservation protection.

There are six known Aboriginal archaeological sites within the notional site boundary. One of the earliest European settlement drives occurred in the region when grants of 50-200 acres were made (c. 1800), and the site is bordered by major areas shown in Governor Macquarie's settlement plans. However, the site itself had limited early settlement owing to the poor soil. One slab cottage of the 1850-60 period stands on Ricketts Road. The only recorded site is the Londonderry cemetery. However, the site also incorporates the only remaining section of Ham Common, the original Macquarie grant for the Richmond area.

The site is in the Hawkesbury Basin, an area with notably poor air dispersion characteristics. There are also populated areas immediately north of the site. For these reasons airport development at Londonderry was assessed as more likely to adversely affect air quality locally than at all other sites except Scheyville.

The site drains into Rickabys Creek and then into the Hawkesbury River at Windsor. Both are unclassified receiving waters. Parts of the site are low-lying and fall within the floodplain of Rickabys Creek. Site filling and/or the provision of levee banks to keep the site flood-free could reduce the available area for flood storage and aggravate local flooding problems.

Approximately 1,700 people (1981 Census) were estimated to reside within the notional site boundary shown in Figure 5.4. The area of noise-incompatible land use within the 25 ANEF contour is approximately 2,956 ha. In addition, 1,833 ha within the 25 ANEF contour were assessed as being capable of more intensive development which could render these areas noise-incompatible also. The Hawkesbury Agricultural College and the town of Richmond are located immediately north of the primary runways for the layout adopted for short-listing purposes.

No major power lines would require relocation.

Accessibility

Road access to the Londonderry site would be via direct connections into the proposed Castlereagh Freeway, which would have to be upgraded and extended to Castlereagh

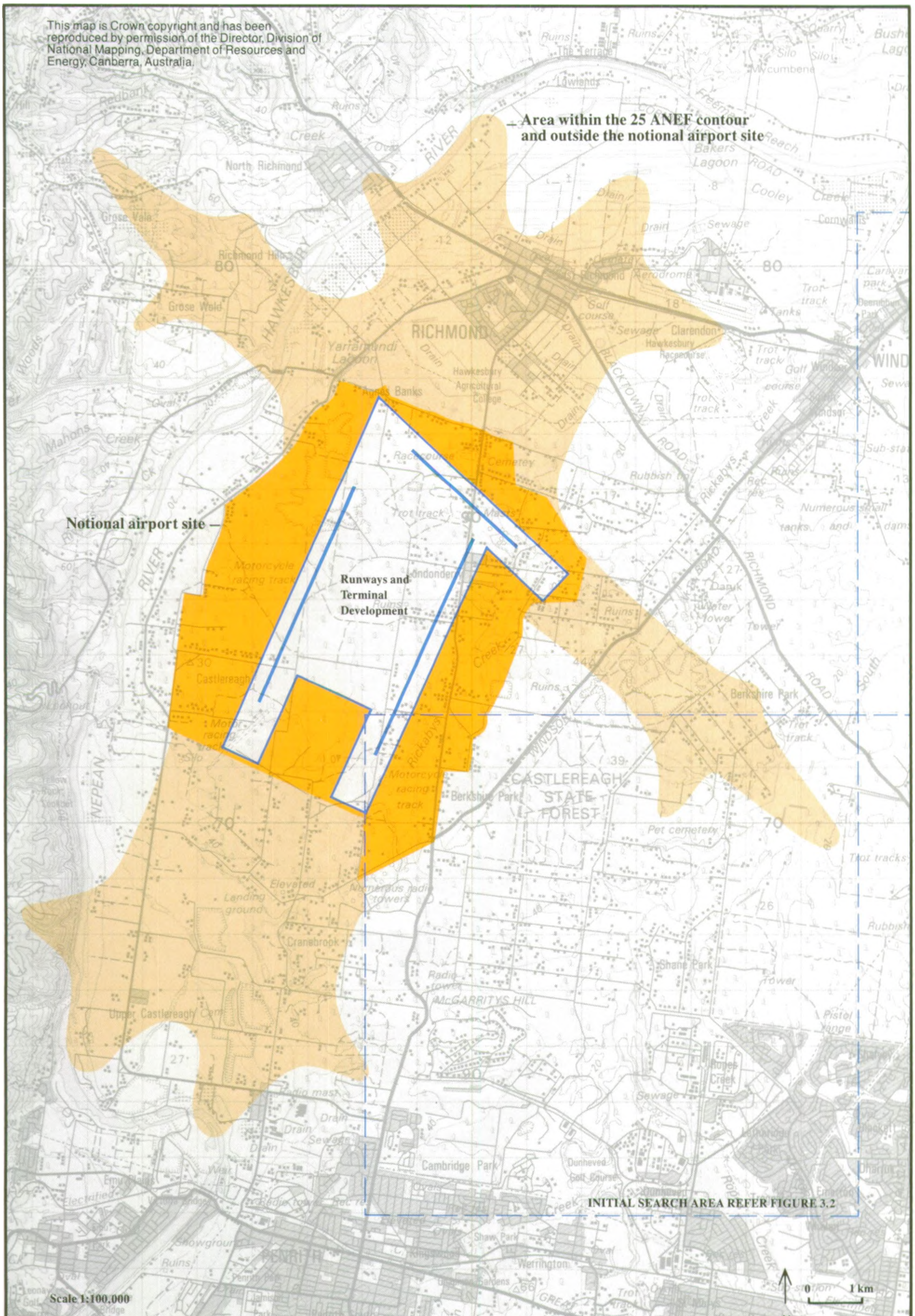


Figure 5.4
LONDONDERRY SITE AND WSPR LAYOUT

Road. Londonderry Road would be cut, although there are alternative routes along Windsor or Castlereagh roads. Richmond Road would require upgrading to the south to provide access to the Great Western Highway and the Western Freeway.

Two alternatives would be available for the provision of rail access from the existing network: from west of Penrith, or from west of St Marys via the Ropes Creek Branch to Dunheved and then along the Castlereagh Freeway alignment.

The Londonderry site would be about 62 km from Sydney on the assumed 2015 road network, with a road access time of 97 minutes. The corresponding distance by rail would be 68 km, with a travel time of 64 minutes.

A major advantage of the Londonderry site (an advantage that it shares with Scheyville) is its potential to meet general aviation needs in the north and north-west of the Sydney Region. At present, Schofields is the only available facility, but its public use is restricted to daytime flights at weekends and public holidays.

Airport operations

RAAF Base Richmond has about 100 closures per year owing to fog. The runway system illustrated in Figure 5.4 provides greater than 99.8% wind coverage.

Severe conflict would occur between aircraft movements at a second airport at the Londonderry site and at RAAF Base Richmond if these facilities were to be separately operated. For this reason, the concept plan and cost estimates assumed that a second Sydney airport at Londonderry would be used jointly by the RAAF, and that Richmond would be developed as a major RAAF maintenance base, with limited flying operations associated with that activity.

Cost

Of the five closer sites, Londonderry is estimated to be the least expensive to acquire, prepare and service, even after allowing $40 million to relocate the Londonderry Transmitting Station and to make provision for RAAF requirements at the civilian airport (at a cost of $50 million).

5.2.5 Scheyville

Figure 5.5 shows the nominated location and notional boundary of the Scheyville site used for short-listing. The site is north-east of Windsor Road and is broadly centred on Scheyville. The land is generally undulating to hilly, mostly cleared, and zoned non-urban. It includes portions of the Municipality of Windsor and the Shire of Baulkham Hills.

The primary runway alignment shown in Figure 5.5 is approximately north-north-west/south-south-east to take advantage of site conditions and to provide approach and departure corridors that are free of obstructions and that minimize noise effects beyond the site. High ground to the east and west constrains runway alignment in those directions.

Environment

Within the notional site boundary, the main land uses are rural residential, horse farms, vegetable production (irrigated from farm dams) and some poultry production. The land capability classes are very mixed as a result of the undulating to hilly terrain, and there is a significant residual timbered area of approximately 500 ha. There are approximately 3,750 ha of Class I-IV agricultural land of which approximately 1,900 ha are prime agricultural land. The vegetable production area is located towards the eastern margin of the site, where the soils are mainly clay loams of the Cumberland association, and

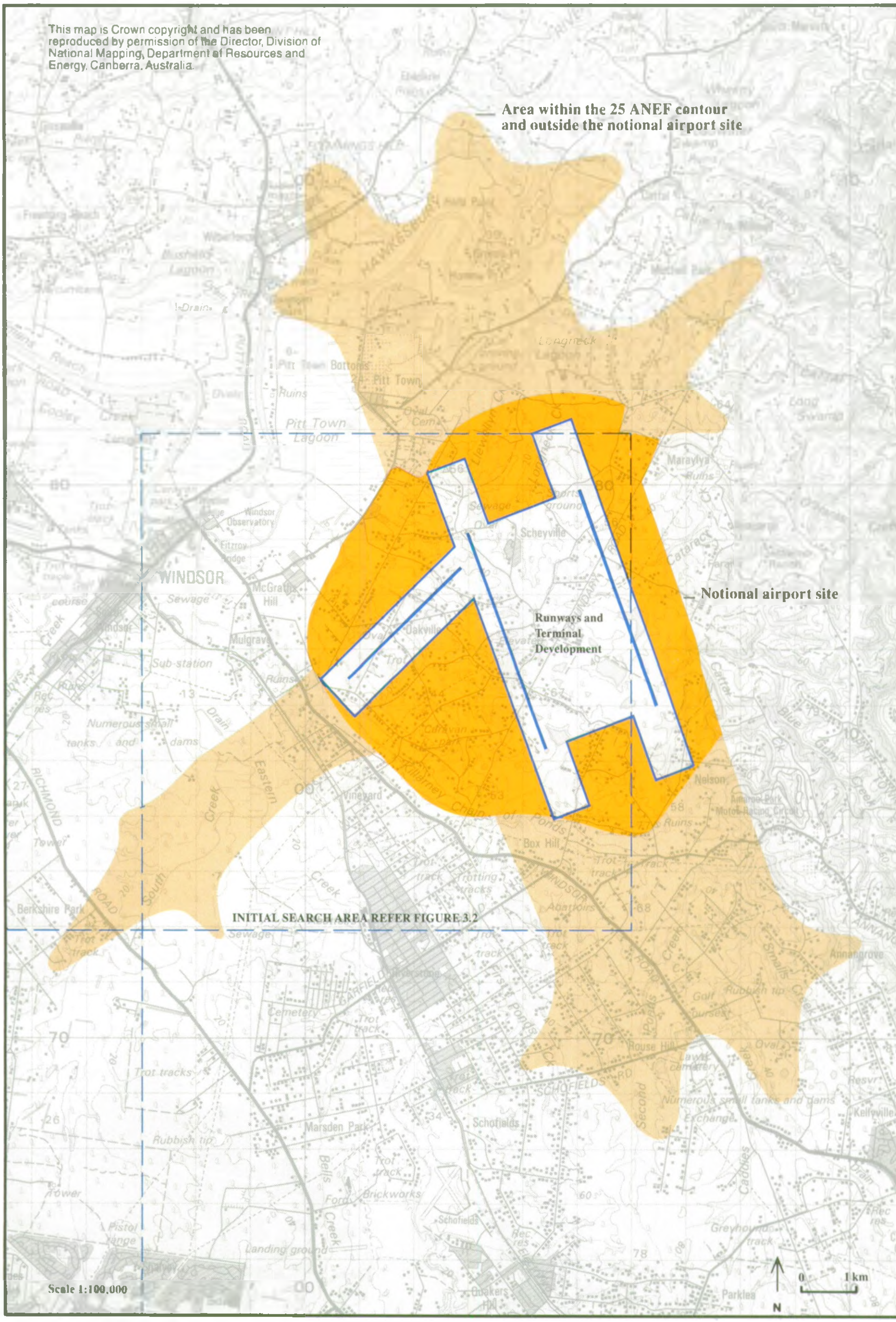


Figure 5.5
SCHEYVILLE SITE AND WSPR LAYOUT

hence prime agricultural land. Rural residential development is rapidly increasing, and the remaining open land is associated with the concentrated vegetable areas.

There is a significant remnant of natural vegetation in the northern part of the site which could potentially be conserved as part of an enlarged Longneck Lagoon Reserve. Longneck Creek also flows through part of the site and feeds the Long Neck Lagoon wetlands area. A number of sensitive species of fauna are found on the site including the cuckoo-shrike, the tiger cat, koala, squirrel glider, water rat and platypus. From time to time, flocks of large birds such as pelicans, swans and ibis frequent the numerous lagoons along the Hawkesbury Valley, and could present a hazard to aircraft.

There are seven known Aboriginal archaeological sites within the notional site boundary shown in Figure 5.5. The area was settled by Europeans at a very early stage, although initially this settlement was related to the development of the alluvial flats rather than to the more heavily wooded higher areas. Small farms were established, and some horse studs were developed during the 1820s and 1830s. Good local supplies of clay were probably also exploited for brick and tile making at an early period. Until the 1860s, small farms, orchards, market gardens and horse studs were predominant. However, the area went into sharp decline in the 1860s, primarily because of agricultural diseases; thereafter some pastoralism developed, followed by urban/rural fringe development. Although there are no recorded European heritage sites, a blacksmith's shop known as Huxley's Forge is still operating just within the perimeter of the site. Early local maps of the area show the names of eight properties that appear to have some historical connections. Pitt Town, north-east of the site, is of national historical significance.

The site is within the Hawkesbury Basin, an area that has been identified as having poor atmospheric dispersion characteristics. The area is also relatively heavily populated. For these reasons Scheyville was ranked last on the air quality sub-factor.

The site drains into Killarney Chain of Ponds and Longneck Creek, neither of which is a classified stream. However, some portions of this location, particularly in the east and north, are highly vulnerable to soil erosion; large-scale disturbance of the kind associated with airport construction could thus be expected to produce erosion and siltation problems. The area is low-lying and airport development could aggravate local flooding problems.

Some 3,160 people (1981 Census) were estimated to reside within the notional site boundary shown in Figure 5.5; only the notional Bringelly site has a higher population. The area of noise-incompatible land use within the 25 ANEF contour comprises approximately 3,415 ha, the largest area of noise-incompatible land associated with any of the sites. A further 3,533 ha were assessed as being capable of more intensive development which could render these additional areas noise-incompatible.

A 500 kV transmission line bisects the site and would require relocation.

Accessibility

Access to the Scheyville site would require a spur road from Windsor Road. Windsor Road and Old Windsor Road would both require upgrading to provide connection to the Castlereagh Freeway, which would also require upgrading to the east. In addition, Old Windsor Road and Seven Hills Road would need to be upgraded south of the proposed Castlereagh Freeway to provide access to the Great Western Highway and the Western Freeway, and Boundary Road would have to be relocated around the site. For rail access, a connecting spur would be required from the existing line, north of Riverstone.

The Scheyville site would be about 49 km from Sydney on the assumed 2015 road network. Travel time by road would be about 80 minutes. The distance by rail would be 56 km, with a travel time of 61 minutes.

A major advantage of locating a second Sydney airport at Scheyville (or Londonderry) would be the potential of these sites to meet the general aviation needs in the north and north-west areas, thus providing a better balance of facilities throughout the Sydney region.

Airport operations

The Bureau of Meteorology has estimated the average fog frequency at this location as sixty days per annum in the lower areas around Pitt Town, reducing to twenty-five days per annum in the southern portion which is higher and further from the river. The runway system illustrated in Figure 5.5 provides for greater than 99.8% wind coverage.

Airport operations at Scheyville would cause minimal interference with operations at Kingsford-Smith Airport, but conflict would occur with the movement of military aircraft at RAAF Base Richmond. While a small number of movements at Richmond could be accommodated, current training flights from Richmond involving circuit flying might have to be transferred to the Scheyville site. For this reason, the same joint use assumptions made for the Londonderry site were also used in evaluating the Scheyville site. In addition, it would be necessary to close the Schofields Aerodrome, thus displacing about 15,000 annual aircraft movements

Cost

The acquisition costs of the Scheyville site are estimated to be very much higher than the other sites and, overall, Scheyville was assessed as the most costly of all sites to acquire, prepare and service.

5.3 MID-DISTANCE SITES

5.3.1 Darkes Forest

Figure 5.6 shows the nominated location and notional boundary for the Darkes Forest site used for short-listing.

This location comprises an area west of the Southern Freeway and south of Darkes Forest. It is bounded on the south-west by Lake Cataract and on the north and north-west by steep gorges. The elevation is generally between 350 m and 450 m above sea-level, although the level of Lake Cataract is lower (less than 300 m), and the gullies to the north are also below this general level. The Illawarra escarpment, which falls rapidly to sea-level, is 3 km east of the notional site boundary.

The primary alignment shown in Figure 5.6 is north/south along a ridge line. An alternative east/west alignment is possible, although this would bring the approach threshold to within 2,500 m of the escarpment where severe turbulence could be expected during periods of strong westerly winds. Because of the topography, large scale earthworks would be required for the layout illustrated in Figure 5.6.

Environment

A ridge of cultivated land and the village of Darkes Forest are both located in the northern part of the site. The rest of the northern half is within the O'Hares Creek Water Catchment Area of the Metropolitan Water Sewerage and Drainage Board, while the southern portion is within the Cataract Catchment Area. There is no agricultural development in this southern portion and, as there appear to be only isolated occurrences of shale-derived soils amongst the laterized sandstone and network of swamps, its agricultural potential is very limited. The adjoining Darkes Forest orchard area to the north is located on shale-derived soils which have been classified as Woronora loam. The site contains no prime agricultural land.

The site is underlain by the Bulli coal seam at a depth of about 450 m and this low-ash, hard coking coal is at present being mined for export. The Darkes Forest mines are the only producers of this type of coal in New South Wales.

A number of rare plant communities and species are present on the site, and the condition of vegetation is generally very good. The site is of conservation value, and also forms part of a larger region which would be reduced in conservation value by the excision of an area of sufficient size for airport development. Of the ten sites, the Darkes Forest site also contains the greatest diversity of faunal habitats in the least disturbed condition. Several faunal species in the area require protection, and the large swampy areas are known to contain a wide variety of amphibians.

Some 103 Aboriginal archaeological sites, including shelters, axe grinding sites and art sites, have been identified within this site, making it one of the most sensitive of the ten sites on this sub-factor. There are no known European heritage sites within the notional site boundary shown in Figure 5.6.

The site is located in an elevated, well ventilated area outside the Cumberland Plain and airport development was assessed as unlikely to contribute significantly to air pollution problems either in the Sydney or Illawarra regions. Parts of the site are located within Metropolitan Water Sewerage and Drainage Board Water Catchment areas. Catchment protection works would therefore be required during both construction and operation of an airport at this site to prevent run-off from the site contaminating water storages. Flooding effects to local streams could be avoided through appropriate design of run-off collection and retention systems.

It was estimated that there were approximately thirty people (1981 Census) residing within the notional site boundary shown on Figure 5.6. The area of noise-incompatible land use within the 25 ANEF contour is estimated at 375 ha.

There are no existing power lines or other major facilities on the site which would require relocation.

Accessibility

To provide road access to the Darkes Forest site, a spur would need to be constructed from the Southern Freeway. This freeway would carry most of the airport traffic and would have to be upgraded as far as Sutherland, where traffic would begin to disperse. The Princes Highway in this area would also need upgrading. It would also be necessary to relocate a section of the Campbelltown—Bulli Road, and secondary access to the airport could be provided from this relocated road. Rail access could be provided from south of Waterfall, via the Southern Freeway alignment.

The Darkes Forest site would be about 57 km from Sydney on the assumed 2015 road network; travelling time by road would be 75 minutes. By rail, the corresponding distance would be 59 km with a travel time of 63 minutes. The region is relatively well served by general aviation facilities.

Airport operations

Fog is experienced along the tollway in the vicinity of the airport site for an average of 350 hours per annum. These fogs tend to persist throughout the day and can last for twenty-four hours or more. As noted above, severe turbulence could be experienced in the vicinity of the escarpment (see Section 6.3 for further discussion of these problems).

While flight paths would cause little interference with traffic at other airports, a north/south flight path would conflict with the Holsworthy military firing range.

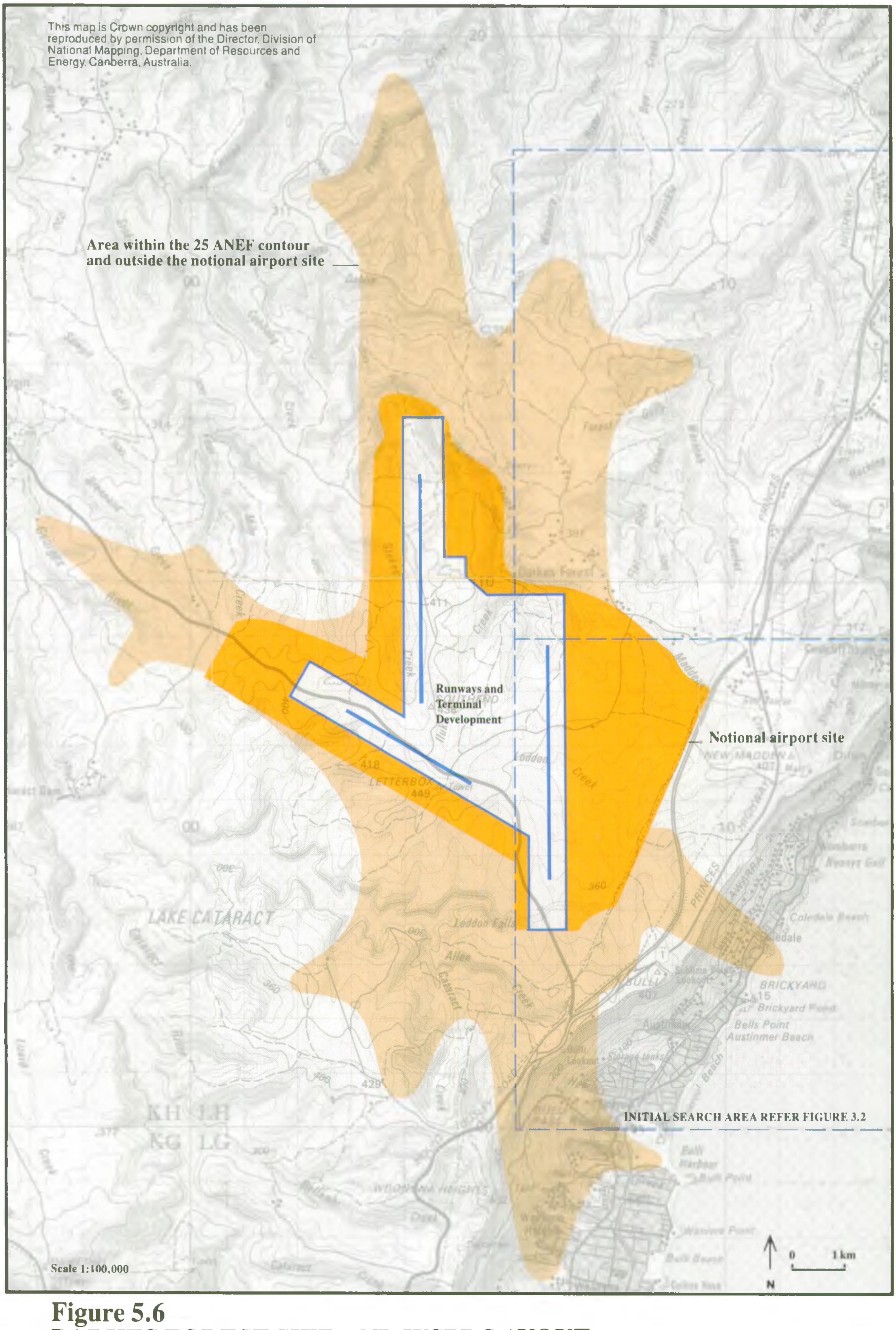


Figure 5.6
DARKES FOREST SITE AND WSPR LAYOUT

Cost

Because of its low estimated site acquisition cost, overall the Darkes Forest site was found to be the least costly of the ten sites to acquire, prepare and service.

5.3.2 Somersby

Figure 5.7 shows the nominated location and notional boundary for the Somersby site used for short-listing. The site is within the Hunter Range north-east of Gosford, and roughly centred on the triangle formed by Peats Ridge, Mangrove Mountain and Rannock. This area comprises a plateau 250-300 m above sea level, with the land falling away steeply to the incised beds of the adjacent creeks. The runway and taxiway systems are located along the ridge lines, with the terminal area in a central location. The approach and departure corridors are free of obstructions.

Environment

The principal existing land uses are citrus production, rural residential, and small farms mostly carrying horses but also poultry. The soils are mainly sandstone-derived and are well suited to citrus production, which is an economically significant local industry. There is no prime agricultural land but 1,500 ha, or about 63% of the site, are used for citrus growing.

Most of the site has been cleared for orchards, and the remaining areas of natural vegetation are generally small and disturbed. There is some native vegetation on a basalt outcrop at Kulnura, although this is also disturbed, and there are rainforest communities in the surrounding valleys where examples of the endangered species Grevillea shiressii are found. A number of faunal species of conservation importance are also found on and adjacent to the site.

The site is underlain by coal at a depth of 350 m. There is insufficient information to assess this resource, although the depth of cover would make it uneconomic to extract at this time.

Eleven Aboriginal archaeological sites have been identified within the site. However, the area's European heritage significance is less well documented than that of some of the other sites. There are no recorded sites within the notional site boundary; however, early local maps of the area show some properties that may have historical connections.

The site is located outside the Cumberland Plain and is well ventilated. Airport development would be unlikely to contribute significantly to the air quality problems of the Sydney Region. However, the site lies partly within the catchment area for Gosford's water supply. Flooding effects to local streams could be avoided through the design of appropriate site run-off collection and retention systems.

It was estimated that there were some 860 people (1981 Census) resident within the notional site boundary shown in Figure 5.7. The area of noise-incompatible land use within the 25 ANEF contour is approximately 1,010 ha. A further 2,264 ha were assessed as being capable of more intensive development which could render these areas noise-incompatible also.

The site is crossed by two high voltage transmission lines which would require relocation.

Accessibility

Road access would be south along the Pacific Highway, joining the F3 Freeway at Calga. Major upgrading of this section of the highway and of the freeway south of Calga would be required. The site would sever a small section of the Pacific Highway and would also cut a number of roads in the Central Mangrove area. Two alternatives are available for

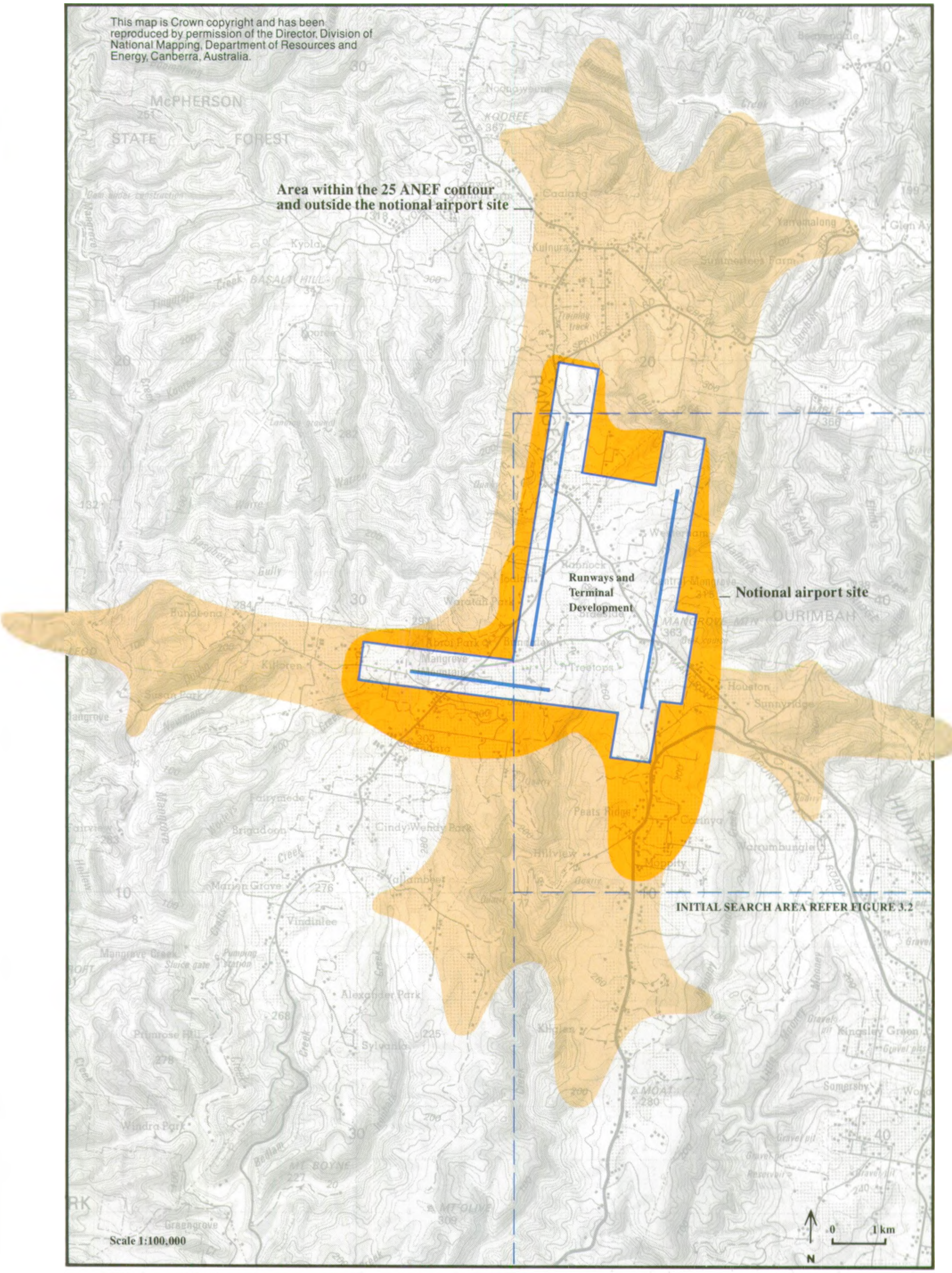


Figure 5.7
SOMERSBY SITE AND WSPR LAYOUT

public transport access: either express coach services from the railhead at Hawkesbury, or a new spur from north of Wondabyne, following Myron and Kariong Brooks and up the escarpment to the site.

The Somersby site would be about 74 km from Sydney on the assumed 2015 road network, with a travel time of 89 minutes. The corresponding distance by rail would be 92 km, with a travel time of 96 minutes.

Warnervale aerodrome is well located to serve the Central Coast and a second airport at Somersby would be unlikely to make as significant a contribution to general aviation requirements in the Sydney Region as sites at Scheyville, Londonderry, Badgerys Creek, Wilton or Darkes Forest.

Airport operations

Fog, low cloud or turbulence may provide restrictions on the use of this site. No wind data were available from which to assess runway usability. However, it was assumed that a runway orientation could be found which would provide at least 98.7% usability.

An airport at this site would have a minimal effect on existing airspace arrangements.

Cost

This site was estimated to have relatively high site preparation and infrastructure costs, but overall was among the least costly sites to acquire, prepare and service.

5.3.3 Warnervale

Figure 5.8 shows the nominated location and notional boundary of the Warnervale site used for short-listing. The site is located between the Main Northern railway line and Hue Hue Road, north of Warnervale Road, and incorporates the existing airport at Warnervale. The primary runways, which are shown in Figure 5.8, are aligned north-east/south-west. Other alignments would be constrained by the mountains to the west of the site and the urban development that has taken place to the east.

Environment

The principal land use is rural residential and small farms, although there are significant timbered areas. The soils are sandstone-derived and relatively infertile, but with pockets of better soils. There are about 2,020 ha of Class IV agricultural land, but no Class I-III prime agricultural land.

The site is underlain by the Fassifern and Wallara—Great Northern coal seams at depths of 350-400 m and 250-300 m respectively. The mineable section of the Fassifern seam is confined to the northern one-fifth of the site and is steaming coal, while the mineable section of the Wallara—Great Northern seam is confined to the west of the site.

The plant communities of significance on this site are the Melaleuca forests and heaths growing on poorly drained areas within and to the south of the site. As the site is well vegetated, and also contains several watercourses and part of an ephemeral swamp, the site and surrounding areas are rich in fauna and contain a number of species of conservation value.

One Aboriginal archaeological site has been identified within the site, but there are no known sites of European heritage significance.

The site is located outside the Cumberland Plain, and thus airport development would not contribute to air quality problems in the Sydney Basin. However, the site is in a poorly ventilated area adjacent to residential development, and the airport could be a significant contributor to any local air quality problems.

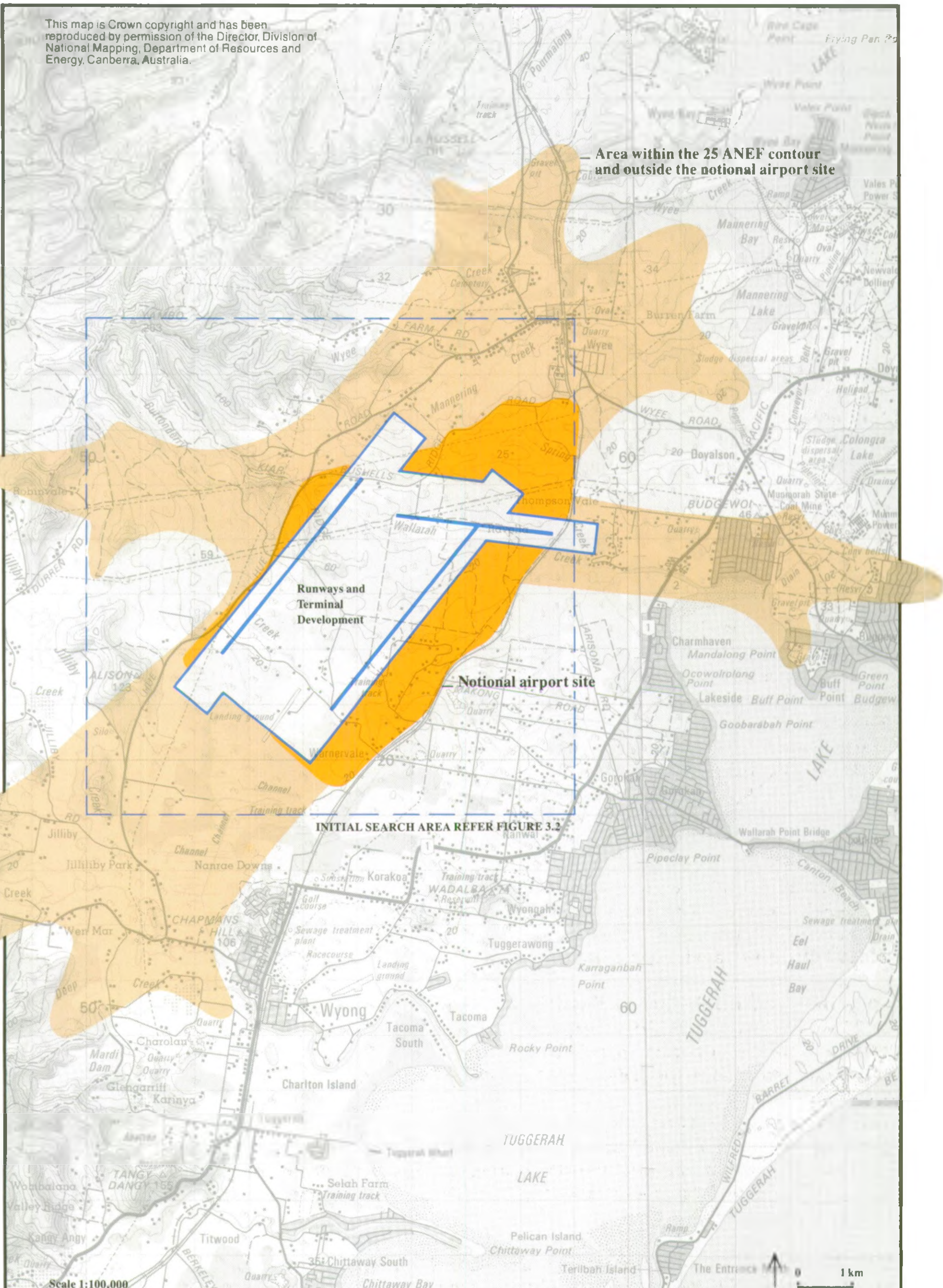


Figure 5.8
WARNERVALE SITE AND WSPR LAYOUT

The site is drained by the Wyong River and Wallarah and Spring creeks, all of which flow into Tuggerah Lake. The latter is a Class C (controlled) waterbody into which discharges are permitted subject to approved treatment and adequate dilution being available in the receiving waters. In the low-lying areas to the south, where the site drains into the Wyong River, airport development could contribute to flooding problems.

Some 380 people (1981 Census) were estimated to reside within the notional site boundary shown in Figure 5.8. The area of noise-incompatible land use within the 25 ANEF contour is approximately 2,403 ha, with a further 2,934 ha assessed as being capable of more intensive development which could render these areas noise-incompatible also.

The site is crossed by two high voltage transmission lines from Munmorah and Vales Point power stations.

Accessibility

Road access would be via a spur from the F3 Freeway, which would require upgrading south of this spur. Sparkes Road would be severed and would thus need to be relocated. Rail connection would be from the existing line north of Wyong.

The Warnervale site would be 94 km from Sydney on the 2015 road network assumed for the analysis. Average travel time would be 97 minutes. The corresponding distance by rail would be 108 km, with a travel time of 114 minutes.

There is a general aviation aerodrome at Warnervale, for which there are upgrading plans. A second Sydney airport at Warnervale would have limited impact on the existing distribution of general aviation facilities in the Sydney Region.

Airport operations

No persistent adverse meteorological conditions have been reported for this site. The runway system shown in Figure 5.8 achieves greater than 99.8% wind coverage.

An airport at this site would have a minimal effect on existing airspace arrangements, other than at the existing general aviation aerodrome which it would replace.

Cost

Of the four mid-distance sites (Darkes Forest, Somersby, Warnervale and Wilton), Warnervale has the highest acquisition cost, as well as the highest combined cost for acquisition, preparation and servicing.

5.3.4 Wilton

Figure 5.9 shows the nominated location and notional boundary of the Wilton site used for the short-listing analysis. The site lies to the south of Wilton Road, and between the gorge of the Cordeaux River on the west and south and that of Wallandoola Creek on the east. These gorges are precipitous and 50-80 m deep. Between them, the land slopes gently with a fall of 80 m from south to north.

Two primary runway alignments were considered: a north/south orientation as shown in Figure 5.9, and an east/west alignment parallel to the existing abandoned airstrip. Subsequent to the short-listing of the Wilton site, the requirement for a cross-wind runway was removed, and it became possible to prepare the more compact east/west layout which forms the basis of the preliminary master plan described in Chapter 13.

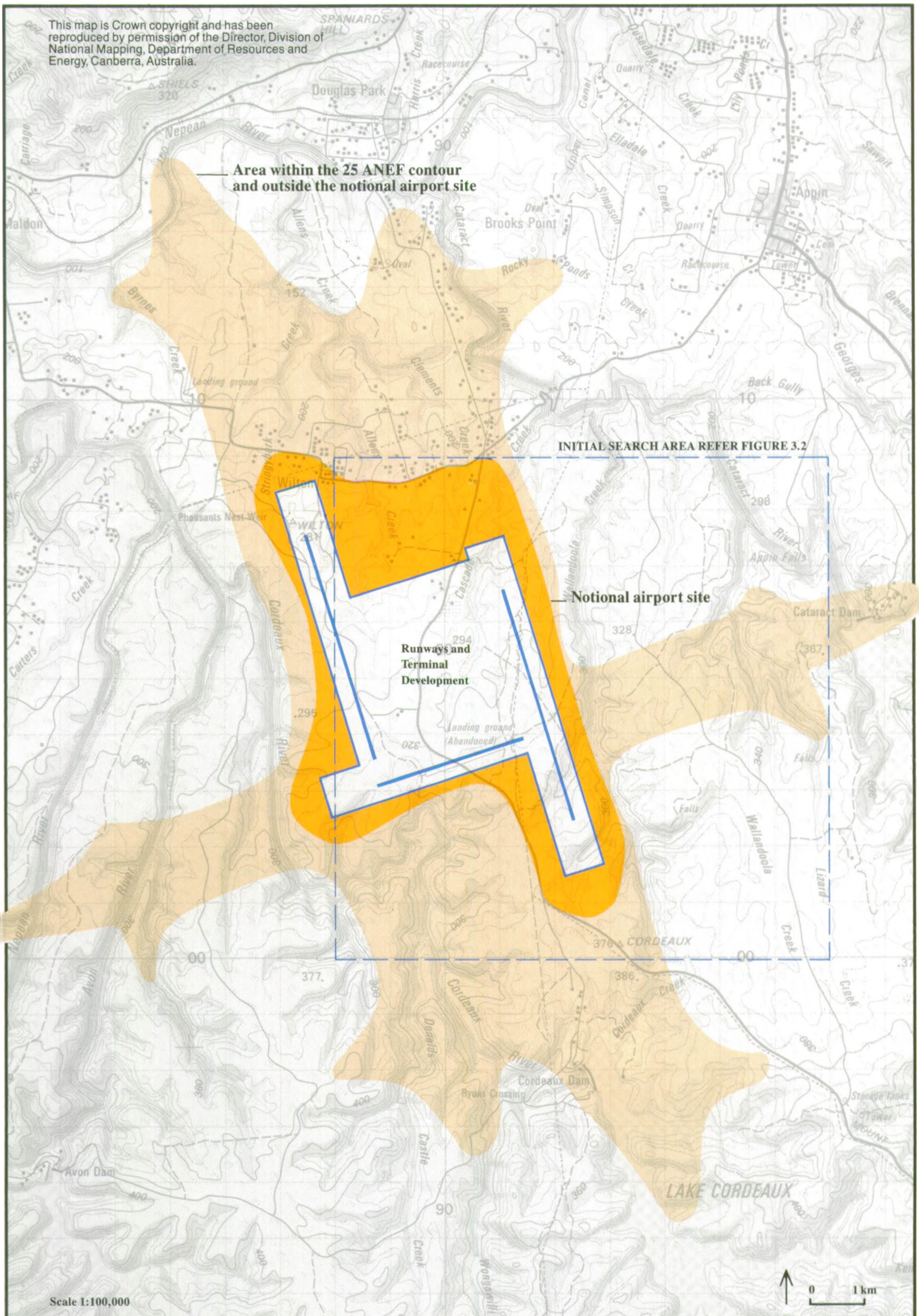


Figure 5.9
WILTON SITE AND WSPR LAYOUT

NOTE: This layout was used for the short-listing analysis only; see figure 13.3 for the proposed layout at Wilton.

Environment

A major part of the site lies in the Metropolitan Catchment area, and both access and alteration of land use is currently prohibited in this area. In the northern part, 620 ha are either Class III or IV agricultural land. The northern end of the nominated site is used for grazing, mainly for horses on small farms. The soils of the site are derived from the Wiannamatta Group and the Hawkesbury Sandstone.

The site used in the short-listing analysis is underlain by the Bulli and Wongawilli coal seams at depths of 380-440 m and 440-480 m respectively. These seams are medium to high in ash content. The Bulli seam is not considered economic in the west of the site. However, there are proposals by the Bellambi Coal Company to develop a coal extraction, washing and loading facility within the site, with a connection to the Maldon to Dombarton railway (under construction).

A large part of the area within the notional site boundary shown in Figure 5.9 carries relatively undisturbed native vegetation and the site is of significant value for the preservation of flora in the Sydney Region. The site is also considered of ecological value because of its wide diversity of fauna, among which are a number of endangered species.

There are known to be four Aboriginal archaeological sites within the notional site boundary as well as a number of sites (including an important art site) in the adjacent gorges and creek gullies. There are no known sites of European heritage significance within the notional site boundary, although early local maps show five properties with potential historical connections. There is also an abandoned World War II landing strip.

The site is located on the margin of the Sydney air basin and has relatively good air dispersion characteristics compared to the closer sites.

Part of the Wilton site is within the Metropolitan Water Sewerage and Drainage Board's Metropolitan Catchment area for Sydney's water supply. Stringent catchment protection measures would therefore be required to avoid siltation or other contamination of Sydney's water supply by run-off from the airport site. Changes to the hydrology of the catchment area could also occur as a result of site development. For these reasons, the cost estimates for this site for the short-listing analysis included approximately $70 million for a water treatment facility capable of handling the full flow capacity of the Upper Canal. With suitable run-off collection and retention systems, flood flows to Allens Creek could be regulated.

Some 310 people (1981 Census) were estimated to reside within the notional site boundary shown in Figure 5.9. The area of noise-incompatible land use within the 25 ANEF contour is estimated to be 492 ha. An additional 1,922 ha were assessed as being capable of more intensive development which could render these areas noise-incompatible also.

The site is crossed by a 330 kV transmission line, a natural gas pipeline, and the Appin to Mount Keira Road, all of which would require relocation.

Accessibility

Road access would be provided by a connection to Wilton Road (which would require upgrading) and thence to the Hume Highway (South-Western Freeway). Mount Keira Road, which would be severed and relocated, would provide access from Wollongong. Rail access could be provided from east of Maldon Junction along the new alignment to the site. The Wilton site would be 71 km by road from Sydney on the 2015 road network assumed for the study. Travel time by road would be 104 minutes. The corresponding distance by rail would be 83 km, with a travel time of 80 minutes.

The region is relatively well served by general aviation facilities.

Airport operations

Fog can be expected about fifteen to twenty times per year and some turbulence may be generated by the gorges during strong wind conditions. The runway system shown in Figure 5.9 achieves greater than 98.7% wind coverage.

An airport at this site with the orientation used for the short-listing analysis would severely restrict operations at Camden, but would not conflict in any major way with other existing airspace arrangements.

Cost

Site preparation and catchment protection costs would be relatively high, although these would not be incurred until airport development proceeded. However, estimated site acquisition costs are low, with only Darkes Forest estimated to cost less to acquire.

5.4 OUTLYING SITE

5.4.1 Goulburn

Figure 5.10 shows the Goulburn site used in the short-listing analysis. It is located on the Gundary Plains about 11 km south of Goulburn, east of the Goulburn—Tarago Road, and approximately between Saltpetre Lane in the south and the existing aerodrome in the north. The area is flat and approximately 700 m above sea-level.

The primary runway alignment shown in Figure 5.10 is approximately parallel to the existing runway of the Goulburn aerodrome.

Environment

The land is productive, with improved pasture land being used for both sheep and cattle grazing and occasional fodder cropping. The site is typical of better tableland soils. There are 3,550 ha of Class IV agricultural land. No coal or other economic extractive resources are known to exist at the site.

No significant occurrence of native vegetation has been identified on this site. There may be some sensitive species of fauna present but these could also be represented in surrounding areas.

No Aboriginal archaeological sites have been identified on the site. The Gundary Plains area was settled by Europeans as early as the 1820s and, proving to be an excellent pastoral area, it was intensively utilized. There are no known European heritage sites within the notional site boundary, although early local maps show two properties which may have historical connections.

There are no significant regional air quality problems to which airport development would contribute. The site is drained by the Saltpetre and Gundary creeks. Gundary Creek is classified as a Class P (protected) stream. Discharges of effluents into Class P waters are limited to those with a quality similar to that required as a 'raw' source of potable water. With suitable design for collection and retention of site run-off, flooding problems in local streams could be avoided.

Some twenty people (1981 Census) were estimated to reside within the notional site boundary shown in Figure 5.10. There were no noise-incompatible land uses within the 25 ANEF contour.

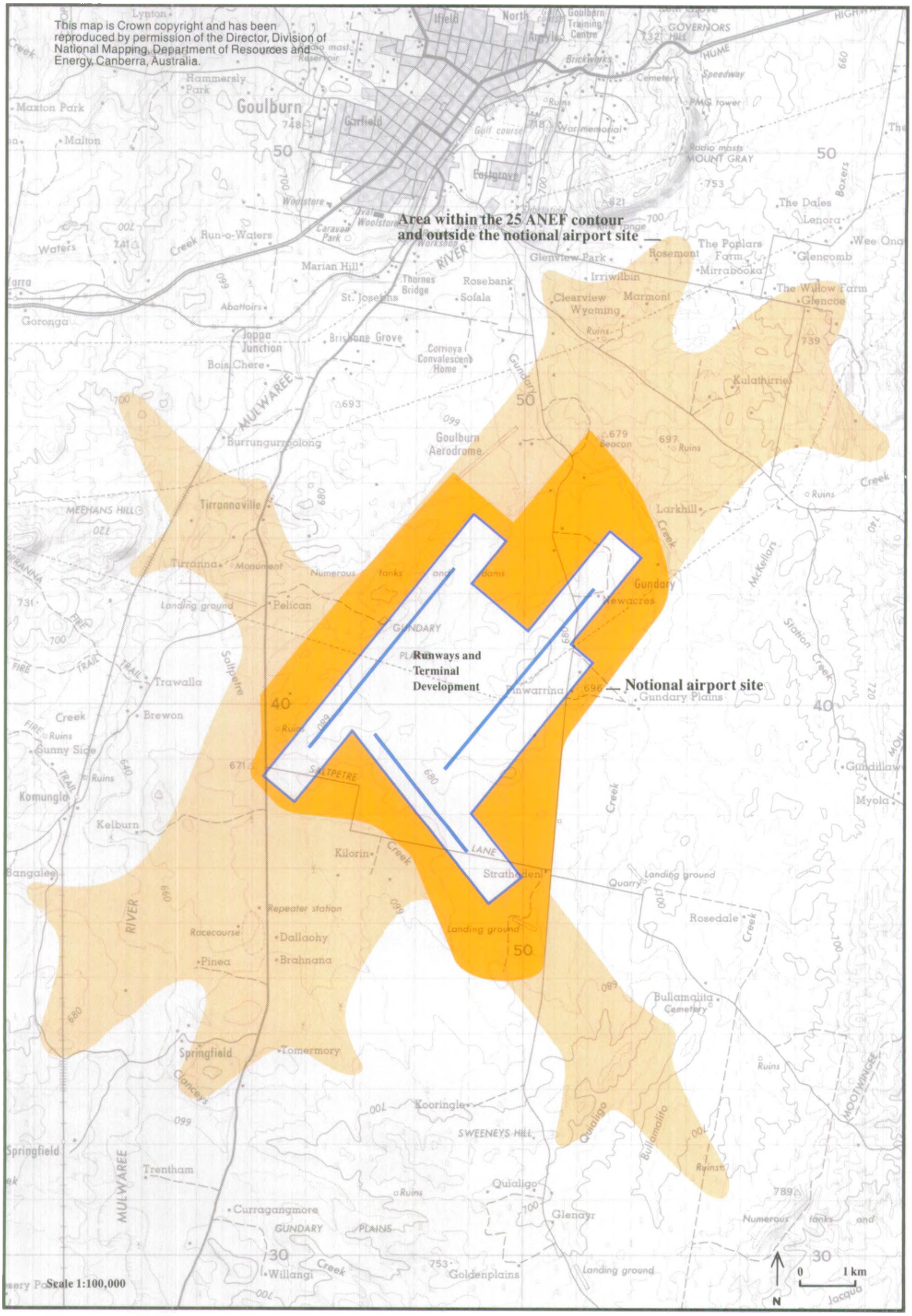


Figure 5.10
GOULBURN SITE AND WSPR LAYOUT

One transmission line crosses the site, and thus would need to be relocated.

Accessibility

Road access would be provided from the existing Hume Highway south of Goulburn. Conventional rail access would be by a spur line from Goulburn.

For the short-listing analysis the possibility that a high speed inter-city rail connection would be provided from Sydney to the site was also examined (see Chapter 6 for further discussion of this proposal).

The Goulburn site is estimated to be some 210 km from Sydney on the assumed year 2015 road network. Road travel time is estimated at 205 minutes. The corresponding distance and times by conventional rail transport would be 228 km and 173 minutes.

A second Sydney airport at Goulburn would not contribute to the efficient distribution of general aviation facilities in the Sydney Region.

Airport operations

The site is estimated to experience some fifty fogs per year and low cloud in the winter months. There could be some turbulence due to the surrounding hills. Wind coverage for the runway alignment shown in Figure 5.10 is relatively poor because of the strong westerly to south-westerly winds and the constraints that the surrounding hills place on runway alignments.

There would be no effect on airspace arrangements in the Sydney Region.

Cost

The high cost of access proposals make Goulburn the third most costly of the ten sites to acquire, develop and service.

CHAPTER 6

Selection of the Short-Listed Sites

6.1 SUMMARY OF THE SHORT-LISTING PROCESS

The short-listing process involved the following steps:

- analysis of sites in relation to site selection factors and grouping of sites with similar characteristics;
- identification of sites with severe liabilities;
- identification of the superior site(s) within each group of similar sites;
- examination of the differences between the superior sites from each group;
- sensitivity testing using the ranking matrix;
- recommendation on whether two or three sites should be compared in the Draft Environmental Impact Statement, and which sites they should be in each case.

6.2 SITE ANALYSIS AND GROUPING

The analysis of the characteristics of the ten different sites indicated a diverse range of advantages and disadvantages. Therefore, in order to achieve a manageable basis for comparing these widely differing sites, the information collected for each sub-factor was examined to establish whether or not groups of sites shared any common characteristic. From this examination, it was judged that the most significant shared characteristic by which sites could be grouped was their geographic relationship to the Sydney urban area. When grouped in this way, it was observed that:

- the sites that were closer to the metropolitan area generally:
  - were more accessible to potential air travellers;
  - were located in relatively developed or urban environments;
  - would affect more people through site acquisition and noise impacts associated with airport development;

- involved greater interaction with existing airspace arrangements;
- involved greater site acquisition cost;

. the sites at a greater distance from the metropolitan area generally:

- were less accessible to potential air travellers;
- were located in relatively undeveloped or rural environments;
- would affect fewer people through site acquisition and impacts associated with airport development;
- involved lesser interaction with existing airspace arrangements;
- involved less site acquisition cost.

These generalizations reflect the basic choice to be made between alternative sites with such different characteristics: the more accessible sites entail greater impact and site acquisition cost; the less accessible sites entail less impact and site acquisition cost. Thus, as a first step in the short-listing process, the ten sites were placed in three groups according to their distance from Sydney (as shown in Figure 6.1 and Table 6.1). There were five 'closer' sites, four 'mid-distance' sites, and one 'outlying' site.

Table 6.1 Distance of sites to the centre of Sydney's population and to the Sydney GPO

Group/site	Approximate straight line distance to centre of Sydney's population (km)		Approximate straight line distance to Sydney GPO (km)	
Closer sites				
Badgerys Creek	31	29.6 (average)	46	42.2 (average)
Bringelly	28		41	
Holsworthy	24		33	
Londonderry	37		52	
Scheyville	28		39	
Mid-distance sites				
Darkes Forest	47	61.3 (average)	52	63.3 (average)
Somersby	63		63	
Warnervale	78		74	
Wilton	57		64	
Outlying site				
Goulburn	162		170	

Table 6.2 further illustrates the distinction between these three groups of sites. The mid-distance sites are, on average, twice as far as the closer sites from the centre of Sydney's population. However, the number of residents who would be displaced by site acquisition at the mid-distance sites is, on average, one-sixth of those who would be displaced at closer sites, while the area of noise-incompatible land uses at the mid-distance sites is also, on average, less than half that of the closer sites. In addition, the average site acquisition cost at the closer sites is more than three times that of the average at the mid-distance sites.

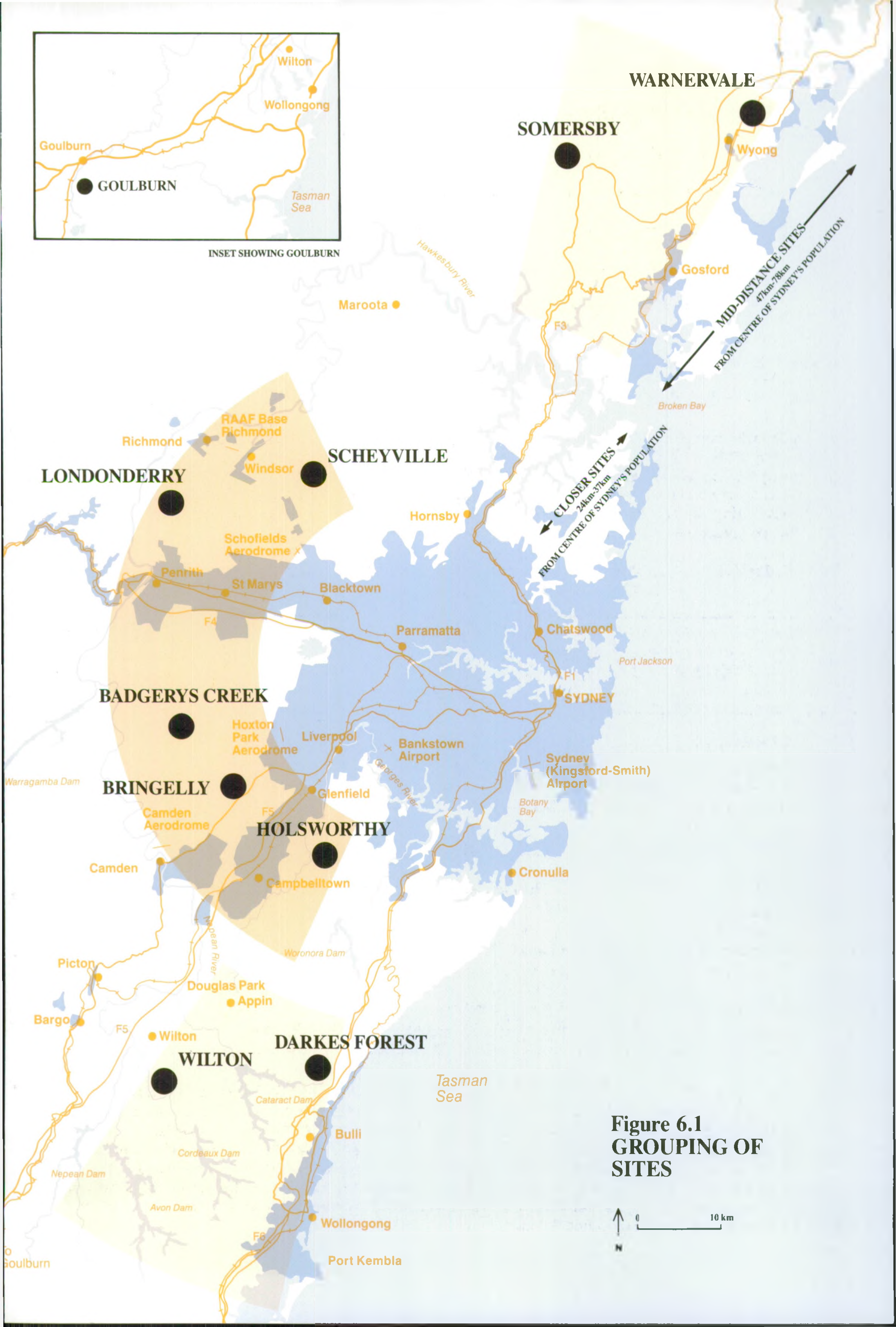


Figure 6.1 GROUPING OF SITES

Table 6.2 Grouping of sites

Factor	Closer sites (5 sites)	Mid-distance sites (4 sites)	Outlying site (1 site)
Average distance to centre of population (km)	29.6	61.3	162
Average no. of residents within notional sites (people)	2,340	395	20
Average area of noise-incompatible land use within 25 ANEF contours (ha)	2,610	1,070	0
Average cost of site acquisition (1984 $ millions)	89	24	16

In view of these marked differences between the groups of sites, the site selection methodology was directed towards, first, the elimination of unsuitable sites, and then the ranking of the remaining sites within their respective groups (i.e. comparing like sites with like.)

The characteristics of the ten sites are presented in Table 6.3 in terms of the twenty-five sub-factors identified in Chapter 4. Where a quantitative measure was used, this is given in the table (e.g. hectares of noise-incompatible land use). Where the ranking was based on a qualitative judgement, there is a brief description of the important considerations. The table also gives the ranking of each site for each sub-factor on a scale from 1 (top ranked or 'best' site) through to 10 (last ranked or 'worst' site).

In addition, the scores for each site that were used in the site ranking matrix (Section 6.6) are given, with the best site or sites receiving a score of 10.0 and the worst a score of 0.0. Where the quantitative measures are shown (e.g. 1,350 people estimated to be displaced by site acquisition), the score was obtained by placing all the data for that sub-factor on a ratio scale. However, this could not be done in the case of three of the sub-factors — archaeology, European heritage and agriculture — as the scores for these sub-factors included consideration not only of existing identified resources, but of the possible existence of further resources (Section 4.4).

Table 6.3 shows only the ranking between sites on each sub-factor; no comparison is made between the absolute level of effect of any sub-factor and any independent or widely accepted measure. For example, the loss of agricultural production relative to regional or State levels was not assessed, only the relative loss between sites. This approach was adopted as the most suitable for the short-listing process. However, in the evaluation of the two short-listed sites in subsequent chapters, the absolute level of impact of development at each site is described. Thus, using the same example, the loss of agricultural production at the short-listed sites at Badgerys Creek and Wilton is compared with local, regional and State levels of production.

As far as the relative importance of the sub-factors listed in Table 6.3 and in the subsequent tables is concerned, there is no universally accepted set of weights or values that can be used. This is because, as with other comparable development proposals, different groups of people within the various communities with an interest in the proposed project will attach quite different priorities to each of the factors. While in this case there may be consensus on the main objective — most interested groups would probably agree, for example, that any serious problem of congestion at Kingsford-Smith Airport should be addressed — this objective is very abstract, and too remote from specific proposals to serve as an adequate basis for action.

Nevertheless, from reference to previous airport location studies and attitudinal surveys conducted as part of this study, it is possible to identify the factors that would be regarded as being 'more important' than others by those major interest groups identified in Chapter 4. These factors, which have been highlighted in bold type in Table 6.3, are:

- acquisition of homes and consequent displacement of the population resident on each site (sub-factor 10);
- the effect of noise on people outside each site as measured by the area of noise-incompatible land use within the 25 ANEF contour (sub-factor 11);
- accessibility by private vehicle (sub-factor 14);
- any aspect of airport operations where considerations of air safety are involved (sub-factors 16 and 18);
- the cost of site acquisition, as this would be the first major cost incurred (sub-factor 20).

Having grouped the sites and arranged the data, the next step in the evaluation was to examine each site in terms of these critical factors. Where any site was deemed likely not to be feasible for airport development on one or more of these critical factors, then that site was excluded from further consideration.

6.3 SITES WITH SEVERE LIABILITIES

In the analysis of the characteristics of the ten sites, three sites displayed one or more severe disadvantages in comparison with the other sites. These three sites were Darkes Forest, Goulburn and Holsworthy.

In the absence of these disadvantages (which are discussed below), two of these sites — Darkes Forest and Holsworthy — might well have been candidates for short-listing, as they both have relatively good accessibility within their respective site groups: Holsworthy is the most accessible of all ten sites and Darkes Forest is the most accessible of the mid-distance sites. Goulburn's advantage is that, by virtue of its location well away from the fringe of Sydney, it has the lowest level of potential environmental impact of any site.

Recognizing that each of these sites has notable strengths when considered on some sub-factors, the question to be addressed in judging whether or not to consider these sites for short-listing was whether more intensive investigation would uncover information that would offset the effect of the severe disadvantages that had been identified. The conclusion reached was that it would not.

It was consequently decided that Darkes Forest, Goulburn and Holsworthy would be unsuitable as potential airport sites, and should therefore not be short-listed for detailed evaluation in this Draft Environmental Impact Statement. In the case of the Holsworthy and Goulburn sites this conclusion had also been reached in earlier studies (Chapter 3).

Table 6.3 Characteristics and ranking of the ten sites

	SUB-FACTOR	CLOSER SITES			
		Badgerys Creek	Bringelly	Holsworthy	Londonderry
ENVIRONMENT	1. AIR QUALITY Local and regional effects of emissions due to airport related activity – qualitative ranking	Located within Sydney Basin; some dispersion; populated area 7* (3.8)**	Located within Sydney Basin; some dispersion; populated area 8 (3.5)	On periphery of Sydney Basin; some dispersion; adjacent to populated area 6 (5.4)	Located within Hawkesbur Basin; poor dispersion; populated area 9 (0
	2. WATER QUALITY Potential effect on quality of receiving waters – qualitative ranking	Unclassified receiving water-body but with potential water quality problems =7 (3.0)	Unclassified receiving water-body but with potential water quality problems =7 (3.0)	Controlled receiving water-body; discharges subject to treatment 3 (6.0)	Unclassified receiving wate body; lower catchment 6 (4
	3. FLOOD POTENTIAL Contribution to downstream flooding or likelihood of site flooding – qualitative ranking	Could contribute to flooding risk on South Creek =6 (6.0)	Could contribute to flooding risk on South Creek =6 (6.0)	Can avoid flooding effects to local creeks =1 (10.0)	Low-lying site sub-ject to flooding; local flooding problems aggrava =9 (0
	4. FLORA Weighted score for the status and condition of species by proportion of site occupied	No rare/endangered species known to be present =2 (9.0)	No rare/endangered species known to be present =2 (9.0)	Some plant communities of conservation significance 6 (2.8)	Significant remnants of Cumberland Plain communities present =9 (0
	5. FAUNA Weighted score for faunal status and diversity and habitat status and diversity, by proportion of site occupied by given habitat type	No rare/endangered species known to be present 1 (10.0)	No rare/endangered species known to be present; creek forms wildlife corridor 2 (9.5)	Extensive habitat; sensitive species present; site forms environmental buffer 8 (3.7)	Extensive but degraded habitat; sensitive species present 7 (3
	6. ARCHAEOLOGY Weighted score for the frequency of occurrence, condition, and heritage and scientific significance of archaeological sites – number of known sites also shown	1 site known =1 (10.0)	0 sites known =1 (10.0)	23 sites known 10 (0.0)	6 sites known =3 (6
	7. EUROPEAN HERITAGE Weighted score for the frequency of occurrence and significance of sites – number of known sites also shown	No recorded sites; historical connections =8 (0.6)	Two recorded sites; historical connections =8 (0.6)	No recorded sites =1 (10.0)	One recorded site; early are of settlement; strong historical connections 10 (0
	8. AGRICULTURE Weighted score based on the class, versatility and degree of development of agricultural land at each site – area of class I-IV land shown (ha)	4,020 ha 9 (1.1)	4,100 ha 10 (0.0)	980 ha 3 (7.5)	3,410 ha 4 (5
	9. MINERAL RESOURCES Sterilization of valuable mineral resources – qualitative ranking	Coal at 830 m; unlikely to be mined; surface extractive resources present =7 (4.5)	Coal at 830 m; unlikely to be mined =3 (7.3)	Coal at 800 m; presently uneconomic =3 (7.3)	Coal at 860 m; unlikely to b mined; surface extractive resources present 9 (2
	10. DISRUPTION Residents displaced by site acquisition – no. of people (1981 Census)	**1,350 people 7 (6.9)**	**4,250 people 10 (0.0)**	**1,230 people 6 (7.1)**	**1,700 people 8 (6**
	11. EXISTING/COMMITTED NOISE-INCOMPATIBLE LAND USE Noise-incompatible land use within 25 ANEF contour (ha)	**2,518 ha 7 (2.6)**	**2,729 ha 8 (2.0)**	**1,424 ha 5 (5.8)**	**2,956 ha 9 (1**
	12. POSSIBLE FUTURE NOISE-INCOMPATIBLE LAND USE Potential future additions to noise-incompatible land use within the 25 ANEF contour (ha)	5,007 ha 10 (0.0)	4,014 ha 9 (2.0)	671 ha 3 (8.7)	1,833 ha 4 (6
ACCESSIBILITY	13. MARKET POTENTIAL (GENERAL AVIATION) Population within 20 km of site and not already within 20 km of a general aviation aerodrome	43,350 =3 (1.2)	0 =8 (0.0)	4,000 =6 (0.1)	171,730 2 (4
	14. PRIVATE VEHICLE ACCESSIBILITY Person-hours x 10^3	**22,229 2 (8.9)**	**22,646 3 (8.8)**	**16,768 1 (10.0)**	**30,071 6 (7**
	15. PUBLIC TRANSPORT ACCESSIBILITY Person-hours x 10^3	24,367 5 (8.9)	20,280 2 (9.9)	19,710 1 (10.0)	24,321 4 (8
OPERATIONS	**16. AIRSPACE Compatibility with existing air space arrangements**	**Minor interactions with Kingsford-Smith; major impact on general aviation training =7 (6.7)**	**Minor interactions with Kingsford-Smith; closure of Hoxton Park 9 (4.4)**	**Moderate interaction with Kingsford-Smith; major impact on Bankstown (closure) 10 (0.0)**	**No interaction with Kingsford-Smith; major impact on Richmond and Schofields 6 (7**
	17. WIND COVERAGE Runway usability (% availability)	> 99.8% =1 (10.0)	> 99.8% =1 (10.0)	> 98.7% =6 (5.0)	> 99.8% =1 (10
	18. OTHER METEOROLOGICAL CONDITIONS Degree to which other meteorological phenomena may affect airport usability and operations	**Fog 12-25 days per year =1 (10.0)**	**Fog 12-25 days per year =1 (10.0)**	**None observed =3 (7.8)**	**100 closures at Richmond annually due to fog =3 (7**
	19. SITE FLEXIBILITY Degree to which runway alignment can be altered	Good =2 (8.9)	Very good 1 (10.0)	None 10 (0.0)	Moderate =4 (6
VARIABLE CAPITAL COSTS	**20. SITE ACQUISITION**	**76.7**	**116.0**	**17.3**	**59.8**
	21. RELOCATION OF COMMONWEALTH FACILITIES	50.0	0	360.0	90.0
	22. RELOCATION OF EXISTING MAJOR INFRASTRUCTURE Cost of relocation of major grid transmission lines	10.8	12.3	9.5	0
	23. SITE PREPARATION Cost of site clearing and levelling	94.6	84.6	375.3	84.5
	24. ACCESS WORKS Cost of connecting the airport site to existing transport infrastructure	218 (road) 104 (rail)	187 132	137 106	226 123
	25. NEW INFRASTRUCTURE Cost of water and sewerage works	49	44	55	56
	Present value of savings relative to most expensive site (1984 $ millions)†	91 6 (5.2)	67 7 (3.8)	27 9 (1.5)	95 5 (5.

NOTE: Sub-factors in bold type are likely to be those of critical importance to major interested groups.

* Rank: 1 = best; 10 = worst
** Score as used in site ranking matrix (0.0 = worst; 10.0 = best)
† See Appendix B for an explanation of the method used to calculate these figures.

	MID-DISTANCE SITES					OUTLYING SITES
Scheyville	Darkes Forest	Somersby	Warnervale	Wilton		Goulburn
cated within wkesbury Basin; poor persion; populated area (0.0)	Outside Sydney Basin; good dispersion =2 (8.5)	Outside Sydney Basin; good dispersion =2 (8.5)	Outside Sydney Basin; poor ventilation locally 5 (6.5)	On margin of Sydney Basin; good dispersion 4 (8.3)		Outside Sydney Basin; good dispersion 1 (10.0)
classified receiving terbody; lower catchment; tential for soil erosion 4 (5.0)	Receiving waters classified as 'protected' and 'specially protected' 9 (2.0)	Partial drainage into Gosford supplementary water supply system =4 (5.0)	Waterbody classified as controlled owing to estuarine location; discharges subject to treatment 2 (7.0)	'Specially protected' waterbody 10 (0.0)		Receiving waters classified as protected; land based disposal possible 1 (10.0)
w-lying site subject to oding; local flooding blems aggravated 9 (0.0)	Can avoid flooding effects to local creeks =1 (10.0)	Can avoid flooding effects to local creeks =1 (10.0)	Low-lying site; potential for flooding problems 8 (4.0)	Can avoid flooding effects to local creeks =1 (10.0)		Can avoid flooding effects to local creeks =1 (10.0)
nificant remnant natural getation in north of site (1.2)	Rare communities and species present; condition good =9 (0.0)	Little native vegetation remains; adjacent rainforest communities could be affected 5 (3.0)	Some plant communities of conservation significance present 4 (4.4)	Significant remnant shale vegetation; rare communities and species present 7 (1.7)		No significant native vegetation identified 1 (10.0)
portant habitat associated h Long Neck Lagoon; sitive species present (7.8)	High diversity of habitats and fauna; sensitive species present 10 (0.0)	Some sensitive species present 4 (7.4)	Extensive habitat; sensitive species present 9 (1.7)	High diversity of habitats in south of site; sensitive species present 6 (4.0)		Some sensitive species may be present 5 (7.0)
ites known (3.4)	103 sites known 9 (0.2)	11 sites known 7 (2.2)	1 site known 5 (5.5)	4 sites known 8 (2.0)		0 sites known =3 (6.2)
recorded sites; historical nnections (1.9)	No recorded sites =1 (10.0)	No recorded sites; some historical connections 5 (6.6)	No recorded sites 6 (6.5)	No recorded sites 3 (7.8)		No recorded sites; some historical connections 4 (7.0)
50 ha (1.4)	0 ha 1 (10.0)	2,380 ha 7 (2.0)	2,020 ha 5 (3.8)	620 ha 2 (7.7)		3,550 ha 6 (2.1)
al at 860 m; unlikely to be ned (8.6)	Coal at 450 m; presently mined 10 (0.0)	Coal at 350 m; presently uneconomic 5 (6.4)	Mineable reserves at 250-400 m 6 (5.0)	Coal at 380-480 m =7 (4.5)		No coal resources identified 1 (10.0)
60 people **(2.6)**	**30 people** **=1 (10.0)**	**860 people** **5 (8.0)**	**380 people** **4 (9.1)**	**310 people** **3 (9.3)**		**20 people** **=1 (10.0)**
15 ha **(0.0)**	**375 ha** **2 (8.9)**	**1,010 ha** **4 (7.0)**	**2,403 ha** **6 (3.0)**	**492 ha** **3 (8.6)**		**0 ha** **1 (10.0)**
33 ha (2.9)	0 ha =1 (10.0)	2,264 ha 6 (5.5)	2,934 ha 7 (4.1)	1,922 ha 5 (6.2)		0 ha =1 (10.0)
,880 (10.0)	20,000 5 (0.5)	3,650 =6 (0.1)	0 =8 (0.0)	44,980 =3 (1.2)		0 =8 (0.0)
970 **(8.4)**	**26,957** **5 (8.0)**	**31,779** **7 (7.0)**	**34,446** **9 (6.5)**	**33,408** **8 (6.7)**		**67,502** **10 (0.0)**
536 (9.1)	26,803 6 (8.3)	35,160 8 (6.2)	41,160 9 (4.7)	29,424 7 (7.6)		60,424 10 (0.0)
nor interaction with **gsford-Smith; major** **pact on Schofields** **Richmond** **(6.7)**	**Minor interaction with Kingsford-Smith** **=4 (8.9)**	**Minimal interactions** **=1 (10.0)**	**Minimal interactions (except own airport)** **=1 (10.0)**	**Minor interaction with Camden** **=4 (8.9)**		**Minimal interactions (except own airport)** **=1 (10.0)**
9.8% (10.0)	No wind data available Est. >98.7% =6 (5.0)	No wind data available Est. >98.7% =6 (5.0)	>99.8% =1 (10.0)	>98.7% =6 (5.0)		Poor coverage due to strong W-SW winds 10 (0.0)
60 days per year **(6.7)**	**Low stratus fog; severe turbulence; thunderstorms** **10 (0.0)**	**Fog, low cloud and turbulence possible** **=3 (7.8)**	**None observed** **=3 (7.8)**	**Fog 15-20 days per year; some turbulence** **=3 (7.8)**		**Fog 50 days per year; some turbulence** **=3 (7.8)**
od (8.9)	0Moderate =4 (6.7)	Poor 9 (1.1)	Low =7 (3.3)	Low =7 (3.3)		Moderate =4 (6.7)
.4	**3.9**	**32.0**	**51.0**	**10.9**		**15.9**
)	0	0	0	0		0
5	0	10.5	3.5	4.2		4.6
2	169.4	135	88	103.4		135
	192 70	250 145	313 114	184 134		370 368
	49	100	50	104		75
st expensive site (0.0)	175 Least expensive site 1 (10.0)	108 3 (6.2)	106 4 (6.1)	156 2 (8.9)		50 8 (2.9)

Darkes Forest

Among the mid-distance sites, Darkes Forest possesses some distinct advantages as an airport location. These advantages include:

- less population displaced by acquisition than at all other sites except Goulburn;
- minimal off-site noise impacts;
- no loss of productive agricultural land;
- no effect on sites of European heritage significance;
- lowest site acquisition and development costs of all sites.

Darkes Forest is also the most accessible of the mid-distance sites; in fact it is almost comparable to the Scheyville site in terms of accessibility.

However, the critical weakness of the Darkes Forest site is the assessed probability of occurrence of meteorological conditions such as wind shear, fog and turbulence that could seriously limit the operational capacity of the site. The Bureau of Meteorology (1984) has concluded:

> The Darkes Forest airport site is not a safe location for an airport. The major hazards associated with the site are stratus fog, which in many rain situations associated with onshore flow will extend from ground level to cloud top, and turbulence and strong down draughts associated with gale-force westerly winds. It is not difficult to envisage instances of aircraft undershooting the runway when approaching in gale-force westerly wind situations.

This is the reason for elimination of the Darkes Forest site. However, this site had other disadvantages, including the possibility that its use as an airport would preclude extraction of significant mineral resources. The low-ash, hard coking coal produced for export from the Bulli seam at Darkes Forest is unique to the site. At 150 Mt, the estimated resource is significant and is currently being mined. Apart from Holsworthy, Darkes Forest also has the most significant concentration of sites of Aboriginal archaeological importance; like Wilton, it is located within part of Sydney's water supply catchment; and the site is rich in flora and fauna.

Other sites in the mid-distance group, such as Wilton and Somersby, also offer relatively strong environmental and cost advantages without the critical operational liability in terms of aircraft safety of the Darkes Forest site. In view of this, and the fact that any further assessment of meteorological conditions at Darkes Forest that could be undertaken within the timetable of this study would be unlikely to produce new information that would alter the Bureau's recommendation, it was concluded that Darkes Forest did not merit short-listing as a second Sydney airport site.

Goulburn

The Goulburn site ranks highly in terms of most of the environmental sub-factors (it is the top ranked site on eight out of the twelve environmental sub-factors). However, it ranks very poorly on all access considerations, given its location in relation to the foreseeable market for air services at a second Sydney airport.

Two proposals have been canvassed publicly for different high speed access systems that could serve an airport located at Goulburn:

- the Transrapid International Intercity Maglev
- the CSIRO-promoted very high speed railway.

Both proposals claim a travel time capability of one hour between a station in the Goulburn—Canberra area and Sydney's central business district. If such a system were available, it is probable that a higher proportion of travellers would use the train, rather than car, to travel from the Sydney region to an outlying airport site. An assessment of travel times by road and public transport was therefore made by assuming the existence of a direct express line from Goulburn to Sydney Central Station, where collection and distribution of air travellers would be by private car or public transport. Neither of the rapid transit proposals has included an examination of the practicalities of gaining running rights to the centre of Sydney or of providing the necessary transport interchange and parking facilities. However, in order to assess the merits of one of these systems for access to an airport site at Goulburn it has been assumed that such provisions could be made.

If a nominal one hour journey is assumed, plus some waiting time, an all-inclusive 90 minute Sydney—Goulburn travel time may be possible. In public transport travel time, Goulburn could therefore approach Wilton (80 minutes). However, as the rationale for the high speed transport system is not that it should be built solely to serve an airport at Goulburn but that it should connect Sydney and Melbourne, then, by the same logic, Wilton (or any intervening site along the line between Wilton and Goulburn) could equally be a beneficiary of such a high speed service and in turn reduce its public transport travel time against the closer sites. However, for travel by road, Goulburn would still be at a great disadvantage relative to Sydney region sites.

Goulburn had been included in the group of ten sites not only as a possible site in its own right but as a general example of sites that might be found at designated non-metropolitan growth centres some distance from Sydney, such as Bathurst—Orange. The logic in placing an airport at one of these decentralized locations is that the growth centre would receive the stimulus of employment creation associated with airport development and operation. The success of such a growth strategy would rely upon the long-term viability of a second Sydney airport at a decentralized location, as employment generated would be broadly related to the level of passenger activity. However, the further a second airport is from its planned markets, the more constraints on its role (and hence on its viability) would have to be accepted. The uncertainties associated with the practical aspects of implementing some form of high speed inter-city ground transport system are also considerable and include basic issues such as whether or not a broader social or economic justification exists for such a system, the availability of funding, and the timing of implementation. Resolution of these issues would have to precede consideration of the appropriateness of placing a second Sydney airport at some point along the inter-city line, and whether or not Goulburn (as distinct from other locations) was the best location.

These uncertainties, which could not be resolved within the timing of this current study, and the intrinsically poor access attributes of the Goulburn site (and, by definition, other decentralized sites) relative to the closer and mid-distance sites led to the conclusion that Goulburn did not merit short-listing as a second Sydney airport site.

Holsworthy

Holsworthy, on the other hand, by virtue of its proximity to Sydney, offers significant advantages in terms of private and public transport accessibility when compared with all other sites. However, Holsworthy has severe weaknesses in terms of airport operations and cost, and its ranking on environmental factors is mixed when compared with the sites in the closer group.

First, the use of Holsworthy would create an irresolvable airspace conflict with aircraft movements at Bankstown Airport. This would necessitate the closure of Bankstown for aircraft operations and the relocation elsewhere of the facilities serving those operations. To this extent, selection of the Holsworthy site as a second Sydney airport could be seen to be in conflict with a basic objective of the Second Sydney Airport Site Selection Programme — to increase runway capacity in the Sydney region.

Second, the physical constraints of the Holsworthy site allow very little flexibility in terms of runway orientation and would present significant cost penalties as far as site preparation was concerned. A further important cost disadvantage for Holsworthy would be the need to relocate Commonwealth Defence facilities. There is also the unanswered question of the extent and significance of unexploded ordnance as an impediment to the site's development as an airport.

It is considered that the access advantages of Holsworthy are not sufficient to expect the airport proponent and operators to support Holsworthy as a second Sydney airport site, given that other reasonably accessible sites in the closer group do not present such severe operational and cost disadvantages. It was therefore concluded that Holsworthy did not merit short-listing for detailed evaluation in this Draft Environmental Impact Statement.

6.4 THE REMAINING CLOSER SITES COMPARED

In this section, the closer sites remaining after the deletion of Holsworthy — Badgerys Creek, Bringelly, Londonderry and Scheyville — are compared on the basis of the environmental, access, operational and cost factors. The assessment is based on the worst case assumption of a WSPR layout and 25 million annual passenger movements.

Environment

Table 6.4 (developed from Table 6.3) shows the relative merits of each of the four remaining closer sites on the twelve environmental sub-factors. The number of times each site was ranked first (or equal first), second, third or fourth within the closer group on those environmental sub-factors is shown in Table 6.5.

The seven environmental sub-factors on which Badgerys Creek was ranked first (or equal first) were:

- air quality
- flood risk
- flora
- fauna
- archaeology
- population displaced by site acquisition
- existing noise-incompatible land use.

Of the twelve environmental sub-factors, the following two were identified as likely to be seen as being more significant than the others:

- displacement of residents by site acquisition (disruption);
- existing noise-incompatible land use within the 25 ANEF noise contour.

Tables 6.6 and 6.7 compare the rankings of the four closer sites on these two sub-factors.

Table 6.4 Environmental sub-factors for closer sites

Environmental sub-factors	Ranking*			
	Badgerys Creek	Bringelly	Londonderry	Scheyville
Local and regional effects of emissions due to airport related activity	1	2	3	4
Potential effect on quality of receiving waters	= 3	= 3	2	1
Contribution to downstream flooding or likelihood of site flooding	= 1	= 1	= 3	= 3
Potential loss or destruction of rare or endangered communities or species of flora	= 1	= 1	4	3
Potential loss or destruction of habitat of rare or endangered species of fauna	1	2	4	3
Potential loss or destruction of sites or land of archaeological value	= 1	= 1	3	4
Potential loss or destruction of sites or features of heritage significance	= 2	= 2	4	1
Loss of productive agricultural land	3 (4,020 ha)	4 (4,100 ha)	1 (3,410 ha)	2 (3,750 ha)
Sterilization of valuable mineral resources	3	2	4	1
Residents displaced by site acquisition (no. of people)	**1 (1,350)**	**4 (4,250)**	**2 (1,700)**	**3 (3,160)**
Existing noise-incompatible land use within the 25 ANEF contour	**1 (2,518 ha)**	**2 (2,729 ha)**	**3 (2,956 ha)**	**4 (3,415 ha)**
Potential future additions to noise-incompatible land use within the 25 ANEF contour	4 (5,007 ha)	3 (4,014 ha)	1 (1,833 ha)	2 (3,533 ha)

* Scale of ranking is from 1 (top ranked or 'best' of remaining four closer sites) to 4 (last ranked or 'worst' of remaining four closer sites).

Note: Quantitative measures are shown in brackets, e.g. (4,020 ha).

Table 6.5 Ranking on environmental sub-factors

Site	Number of times a site was ranked:			
	First	Second	Third	Fourth
Badgerys Creek	7	1	3	1
Bringelly	3	5	2	2
Londonderry	2	2	4	4
Scheyville	3	2	4	3

Table 6.6 Disruption ranking

Site and ranking		Disruption (no. of people displaced by acquisition)	% above lowest measured value
1	Badgerys Creek	1,350	0
2	Londonderry	1,700	+26
3	Scheyville	3,160	+134
4	Bringelly	4,250	+215

Table 6.7 Land use compatibility ranking

Site and ranking		Existing noise-incompatible land use within 25 ANEF contour (ha)	% above lowest measured value
1	Badgerys Creek	2,518	0
2	Bringelly	2,729	+8
3	Londonderry	2,956	+17
4	Scheyville	3,415	+36

The difference between the values obtained on the disruption sub-factor for Badgerys Creek and Londonderry may not be significant: estimating error and adjustments to site boundaries arising from detailed planning could narrow this difference. However, after allowing for these considerations, the acquisition of a site at either Scheyville or Bringelly would still displace a significantly higher number of people than at Badgerys Creek or Londonderry.

The difference between Badgerys Creek, Bringelly and Londonderry on noise impact may not be significant, as shown in Table 6.7. However, development at Scheyville, which is located in a more densely settled area, would have significantly greater noise impact than development at these other sites.

As Tables 6.6 and 6.7 indicate, on the disruption and land use compatibility measures, (which are broadly judged to be more important than the other environmental sub-factors) the Badgerys Creek site was ranked ahead of the other three closer sites. While Bringelly was ranked either first or second on eight of the twelve environmental sub-factors, compared with four and five first and second rankings for Londonderry and Scheyville respectively, it ranked fourth on the important measure of disruption.

Therefore, of the four closer sites, Badgerys Creek is not only the superior site on more environmental sub-factors, but it is also the top ranked site on the important disruption and land use compatibility measures. On the basis of these results, Badgerys Creek is judged to be the superior of the four remaining closer sites on environmental grounds.

Accessibility

The access attributes of each of the closer sites are given in Table 6.8, which has been developed from Table 6.3.

Table 6.8 Accessibility

Access sub-factors	Ranking*			
	Badgerys Creek	Bringelly	Londonderry	Scheyville
Accessibility to general aviation facility (no. of people within 20 km of the site and not already served by a general aviation aerodrome)	3 (43,350)	4 0	2 (171,730)	1 (367,880)
Private vehicle accessibility (person-hours x 10^3)	**1 (22,229)**	**2 (22,646)**	**4 (30,071)**	**3 (24,970)**
Public transport accessibility (person-hours x 10^3)	4 (24,367)	1 (20,280)	3 (24,321)	2 (23,536)

* Scale of ranking is from 1 (top ranked or 'best' of remaining four closer sites) to 4 (last ranked or 'worst' of remaining four closer sites).

Note: Quantitative measures are shown in brackets, e.g. (43,350 people).

Of the three accessibility sub-factors, private vehicle access was identified as likely to be seen as being more important than the others. Table 6.9 compares the four closer sites on this sub-factor.

Table 6.9 Private vehicle accessibility ranking

Site and ranking		Person hours x 10^3	% above lowest measured value
1	Badgerys Creek	22,229	0
2	Bringelly	22,646	+ 2
3	Scheyville	24,970	+ 12
4	Londonderry	30,071	+ 35

It can be seen that the Badgerys Creek and Bringelly sites are more accessible in terms of private transport than the Scheyville site, and these three sites are in turn more accessible than the Londonderry site. On the public transport sub-factor, Badgerys Creek, Londonderry and Scheyville have comparable accessibility, but Bringelly is the most accessible site.

The Scheyville and Londonderry sites offer the opportunity to distribute general aviation facilities more evenly throughout the metropolitan area. However, this advantage is substantially lost if it is assumed that present restrictions on the public's use of Schofields aerodrome could be lifted.

Airport operations

The attributes of each site relating to airport operations are summarized in Table 6.10 (developed from Table 6.3).

Table 6.10 Airport operations

Operations sub-factors	Ranking*			
	Badgerys Creek	Bringelly	Londonderry	Scheyville
Compatibility with existing airspace arrangements	**= 2**	**4**	**1**	**= 2**
Runway usability within cross-wind tolerance (% availability)	= 1 (>99.8%)	= 1 (>99.8%)	= 1 (>99.8%)	= 1 (>99.8%)
Degree to which other meteorological phenomena may affect airport usability and operations	**= 1**	**= 1**	**3**	**4**
Degree to which runway alignment can be altered within topographic and obstruction clearance limitations	= 2	1	4	= 2

* Scale of ranking is from 1 (top ranked or 'best' of remaining four closer sites) to 4 (last ranked or 'worst' of remaining four closer sites).

Note: Quantitative measures are shown in brackets, e.g. (>99.8%).

All these closer sites could be considered operationally equivalent. However, Badgerys Creek may have a marginal advantage in that it offers relatively good site planning flexibility (and hence potential to respond to operational, environmental and cost objectives).

It should be noted that Londonderry rates higher than the other three closer sites in terms of compatibility with existing air traffic operations. This ranking arises from the assumption that the existing RAAF Richmond Base would be integrated with a second airport at Londonderry, thus eliminating the severe airspace conflict that would otherwise occur if the two airfields were to operate in close proximity. (The capital cost estimate correspondingly incorporates this assumption.)

Capital costs

The variable capital costs involved in acquiring and developing the four closer sites are set out in Table 6.11 (developed from Table 6.3). Site acquisition costs are estimated to be significantly less for Badgerys Creek and Londonderry than for Bringelly or Scheyville. Overall, Scheyville would be the most costly of the four closer sites to acquire and develop, while Londonderry would be the least costly.

Table 6.11 Variable capital costs in $millions (1984 values)

Cost sub-factors	Badgerys Creek	Bringelly	Londonderry	Scheyville
Site acquisition	**76.7**	**116.0**	**59.8**	**174.4**
Relocation of Commonwealth facilities	50.0	0	90.0	51.0
Relocation of existing infrastructure	10.8	12.3	0	11.6
Site preparation	94.6	84.6	84.5	79.2
Access works (road and rail)	322.0	319.0	349.0	308.0
New infrastructure	49.0	44.0	56.0	49.0
Present value of savings relative to most expensive site (Scheyville)*	91.0	67.0	95.0	0**

* The present value of savings relative to the most expensive site is based on a speculative schedule for site acquisition, relocation of facilities and infrastructure, and completion of earthworks as described in Appendix B.

** Most expensive closer site.

Ranking of the closer sites

In the comparison of the four closer sites, a site based at Badgerys Creek emerges as superior, principally because of its relative environmental and cost advantages. There is less to distinguish between the closer sites on access or operations sub-factors. However, given the limited site planning or location options at Londonderry and Scheyville, it is not readily apparent that some of their respective disadvantages within the closer group of sites could be reduced to a scale that would make either competitive with a site in the vicinity of Badgerys Creek.

It was further concluded that, in view of the scale of disruption that could be occasioned by acquisition of the Bringelly site, and given the generally better ranking of Badgerys Creek with which it shared other characteristics, Bringelly did not merit further consideration as a site for a second Sydney airport.

If it were considered desirable to include a second site from among the closer group of sites for more detailed consideration in this Draft Environmental Impact Statement, the choice would therefore be between Londonderry and Scheyville. Londonderry ranks higher than Scheyville on the important environmental criteria of disruption and noise effects. Londonderry is also superior to Scheyville on cost. On the other hand, Scheyville is superior to Londonderry on access considerations. Given the different realms of superiority of each of these sites, a choice between the two (if there were no other better sites) would have to be made by assigning priority to one or other set of considerations.

However, as there is a site at Badgerys Creek which is distinctly superior to either Londonderry or Scheyville, a decision as to which of these sites to compare with Badgerys Creek may be more reasonably made on the grounds of which site would offer the strongest performance on those measures where it may be superior to Badgerys Creek. On this basis, Londonderry would, on balance, offer a better contrast in the areas of site acquisition cost, future noise-incompatible land use, and impact on agriculture — the sub-factors on which Badgerys Creek is weaker.

The conclusion reached was that if a second closer site were to be evaluated in detail in this Draft Environmental Impact Statement, then it should be Londonderry.

6.5 THE REMAINING MID-DISTANCE SITES COMPARED

This section compares Somersby, Warnervale and Wilton, the three mid-distance sites that remain after the deletion of Darkes Forest from further consideration. The comparison employs the same array of characteristics used for comparing the closer sites and is also based on the worst case assumption of a WSPR layout and 25 million annual passenger movements.

Environment

The environmental characteristics of each site are summarized in Table 6.12 (developed from Table 6.3). The number of times each site was ranked first (or equal first), second or third on the twelve environmental sub-factors is shown in Table 6.13.

Wilton was ranked first more often than Somersby. However, Somersby was ranked either first or second on ten of the twelve environmental sub-factors, while Wilton was ranked first or second only eight times. A distinction can be drawn between the types of sub-factors on which these two sites showed comparative advantages: Somersby ranked first or second on all five natural environment sub-factors (air and water quality, flooding, flora, and fauna); conversely, Wilton ranked first on five of the seven socio-economic sub-factors (European heritage, agriculture, population displacement and land use compatibility).

Tables 6.14 and 6.15 compare the rankings of the three mid-distance sites on the two environmental sub-factors considered to be most significant: displacement of population, and land use compatibility.

Wilton and Warnervale could be considered comparable sites on the disruption measure. However, acquisition of a site at Somersby would involve significantly more disruption than at the other two mid-distance sites.

On the land use compatibility measure, development of a second airport at Somersby or Warnervale would involve significantly higher off-site noise impact than at Wilton, as shown in Table 6.15.

Both Wilton and Somersby have environmental advantages over Warnervale when these three mid-distance sites are ranked on the twelve environmental sub-factors on an unweighted basis. Which of these two sites is to be considered superior on environmental grounds depends upon the weight one attaches to socio-economic issues compared with those relating to the natural environment. Traditionally in airport location studies, greater weight has been attached to socio-economic concerns (particularly noise and disruption), and to this extent Wilton could be considered a superior site to Somersby. However, the notable weakness of the Wilton site is its location within one of Sydney's water supply catchments.

Table 6.12 Comparison of environmental sub-factors for mid-distance sites

Environmental sub-factors	Ranking*		
	Somersby	Warnervale	Wilton
Local and regional effects of emissions due to airport related activity	1	3	2
Potential effect on quality of receiving waters	2	1	3
Contribution to downstream flooding or likelihood of site flooding	= 1	3	= 1
Potential loss or destruction of rare or endangered communities or species of flora	2	1	3
Potential loss or destruction of habitat of rare or endangered species of fauna	1	3	2
Potential loss or destruction of sites or land of archaeological value	2	1	3
Potential loss or destruction of sites or features of heritage significance	2	3	1
Loss of productive agricultural land	3 (2,380 ha)	2 (2,020 ha)	1 (620 ha)
Sterilization of valuable mineral resources	1	2	3
Residents displaced by site acquisition (no. of people)	**3 (860)**	**2 (380)**	**1 (310)**
Existing noise-incompatible land use within the 25 ANEF contour	**2 (1,010 ha)**	**3 (2,403 ha)**	**1 (492 ha)**
Potential future additions to noise-incompatible land use within the 25 ANEF contour	2 (2,264 ha)	3 (2,934 ha)	1 (1,922 ha)

* Scale of ranking is from 1 (top ranked or 'best' of the remaining three mid-distance sites) to 3 (last ranked or 'worst' of the remaining three mid-distance sites).

Note: Quantitative measures are shown in brackets, e.g. (2,380 ha).

Table 6.13 Ranking on environmental sub-factors

Site	Number of times a site was ranked:		
	First	Second	Third
Somersby	4	6	2
Warnervale	3	3	6
Wilton	6	2	4

Table 6.14 Disruption ranking

Site and ranking		Disruption (no. of people displaced by acquisition)	% above lowest measured value
1	Wilton	310	0
2	Warnervale	380	+23
3	Somersby	860	+177

Table 6.15 Land use compatibility ranking

Site and ranking		Existing noise-incompatible land use within 25 ANEF contour (ha)	% above lowest measured value
1	Wilton	492	0
2	Somersby	1,010	+105
3	Warnervale	2,403	+388

Accessibility

The access attributes of the three mid-distance sites are set out in Table 6.16 (developed from Table 6.3).

Both Wilton and Somersby are significantly more accessible than Warnervale. Somersby is marginally (5%) more accessible than Wilton on the private vehicle access measure, although this may not be a significant difference given the margin of accuracy involved in the estimation of access calculations. The reverse is true for the public transport measure, with the aggregate of travel time for Somersby being almost 20% greater than for Wilton.

None of the mid-distance sites offers any particular advantage in terms of meeting general aviation requirements.

Table 6.16 Accessibility

Access sub-factors	Ranking*		
	Somersby	Warnervale	Wilton
Accessibility to general aviation facility (no. of people)	2 (3,650)	3 (0)	1 (44,980)
Private vehicle accessibility (person-hours x 10^3)	**1 (31,779)**	**3 (34,446)**	**2 (33,408)**
Public transport accessibility (person-hours x 10^3)	2 (35,160)	3 (41,160)	1 (29,424)

* Scale of ranking is from 1 (top ranked or 'best' of the three remaining mid-distance sites) to 3 (last ranked or 'worst' of the three remaining mid-distance sites).

Note: Quantitative measures are shown in brackets, e.g. number of people (3,650).

Airport operations

The airport operations attributes of each site are set out in Table 6.17 (developed from Table 6.3).

Table 6.17 Airport operations

Operations sub-factors	Ranking*		
	Somersby	Warnervale	Wilton
Compatibility with existing airspace arrangements	**= 1**	**= 1**	**3**
Runway usability within cross-wind tolerance (% availability)	= 2 (>98.7%)	= 1 (>99.8%)	= 2 (>98.7%)
Degree to which other meteorological phenomena may affect airport usability and operations	**= 1**	**= 1**	**= 1**
Degree to which runway alignment can be altered within topographic and obstruction clearance limitations	3	= 1	= 1

* Scale of ranking is from 1 (top ranked or 'best' of the three remaining mid-distance sites) to 3 (last ranked or 'worst' of the three remaining mid-distance sites).

Note: Quantitative measures are shown in brackets, e.g. (>98.7%).

There appear to be no significant differences between the three mid-distance sites when considered on the criteria related to airport operations. Wilton's lower ranking on airspace arises from minor interactions with Camden. Topographic constraints at Somersby were judged to be more severe for runway alignment than at either Warnervale or Wilton.

Variable capital costs

The cost attributes of each site are given in Table 6.18 (from Table 6.3).

Table 6.18 Variable capital costs in $millions (1984 values)

Cost sub-factors	Somersby	Warnervale	Wilton
Site acquisition	**32.0**	**51.0**	**10.9**
Relocation of Commonwealth facilities	0	0	0
Relocation of existing infrastructure	10.5	3.5	4.2
Site preparation	135.0	88.0	103.4
Access related costs (road and rail)	395.0	427.0	318.0
New infrastructure	100.0	50.0	104.0
Present value of savings* relative to most expensive site (Scheyville)	108.0	106.0**	156.0

* See Appendix B.
** Most expensive mid-distance site.

In terms of site acquisition costs, Wilton (approximately $11 million) is ranked better than Somersby ($30 million) and Warnervale ($50 million). Development costs at the Wilton site would also be significantly less than at Somersby or Warnervale, even after allowing for catchment protection works at Wilton (included in 'new infrastructure').

Ranking of the mid-distance sites

Warnervale appears to offer very few advantages as a second Sydney airport site over the other two mid-distance sites. It is considered by State Government authorities as an attractive area for current and longer term urban development. With the exception of its lesser impacts on water quality, flora and sites of archaeological interest, Warnervale also offers no advantages over Somersby or Wilton on environmental grounds. In terms of accessibility, it is clearly inferior to Wilton and Somersby. Warnervale also compares unfavourably with Wilton and Somersby as far as site acquisition costs are concerned. While it is superior in certain other cost attributes (the cost of site preparation and new infrastructure), this does not produce an advantage in terms of overall costs. On all these grounds it was concluded that Warnervale did not merit short-listing as a second Sydney airport site.

The distinction between the Somersby and Wilton sites is less clear. Their relative strengths are compared below. Table 6.19 shows the number of times each site ranked first, second or third of the three mid-distance sites for twenty sub-factors (twelve environment; three access; four airport operations; and the one overall cost factor, present value of savings).

Table 6.19 Somersby and Wilton - ranking on twenty sub-factors

Sub-factor/site	Number of times site ranked:		
	First	Second	Third
Environmental			
Somersby	4	6	2
Wilton	6	2	4
Access			
Somersby	1	2	0
Wilton	2	1	0
Airport operations			
Somersby	2	1	1
Wilton	2	1	1
Cost			
Somersby	0	1	0
Wilton	1	0	0
Total for all sub-factors			
Somersby	7	10	3
Wilton	11	4	5

Somersby ranks either first or second seventeen times, compared to fifteen times for Wilton. On this basis, Somersby could be seen to rank higher more consistently across a wider range of sub-factors, with Wilton presenting a more contrasting performance between sub-factors. Table 6.20 summarizes these contrasting strengths and weaknesses of each site.

It was considered that engineering solutions were available to mitigate or eliminate the perceived risk to Sydney's water supply in an airport development at the Wilton site. On the other hand, it was considered that opportunities were limited at the more detailed site planning stage to reduce the disruption impacts at Somersby by relocating that site within the general Somersby area. Thus it was considered possible to reduce the main disadvantage associated with Wilton (effects on water quality) but not one of the main disadvantages associated with Somersby (disruption). So, despite Wilton's disadvantage in relation to water supply, the short-listing analysis concluded that, if one mid-distance site were to be evaluated in the Draft Environmental Impact Statement, then it should be Wilton. If two mid-distance sites were to be evaluated, then they should be Wilton and Somersby.

Table 6.20 Advantages and disadvantages of the Somersby and Wilton sites

Factor	Somersby	Wilton
Environment	Ranks higher on natural environmental sub-factors	Ranks higher on socio-economic sub-factors and ranks first on disruption and noise effects
		Ranks poorly on potential effects on water quality
Access	May be marginally more accessible by private vehicle	Significantly more accessible by public transport
		No particular advantage
Cost	Higher site acquisition cost	Lower site acquisition cost
	Higher overall cost	Lower overall cost

6.6 SENSITIVITY TESTING

The preceding sections have concluded that, after elimination of the Darkes Forest, Goulburn and Holsworthy sites, Badgerys Creek is the superior of the four remaining closer sites, while Wilton is the superior of the three remaining mid-distance sites.

A search method in which the data were accumulated and reviewed in a number of ways was used for this short-listing task because it was considered to be both theoretically and practically more defensible than an approach relying solely upon the application of specific factor weights (i.e. a cost-benefit method using some speculative notion of economic values). Thus, beyond the identification of certain sub-factors as being of critical importance, no attempt has been made so far in the presentation to give weights either to individual sub-factors or to the main factors in terms of their significance. It is interesting, however, to speculate on how the sites might be ranked if a deliberate effort were made to give one set of factors a particular weight.

The matrix or 'weighted average factors' approach was therefore used for sensitivity testing purposes. While not producing a single value or cost for each site, as in the cost-benefit technique, the matrix does produce a single ranking in tabular form. It also allows the presentation of considerable information in a direct and convenient manner and permits the ranking effect of changing a factor weight to be traced and considered.

Operation of the matrix

The site ranking matrix is shown in Figure 6.2 for the worst case level of activity of 25 million annual passenger movements with a WSPR layout. The table in Figure 6.2 is based on Table 6.3 and comprises:

- a list of four factors, each with N sub-factors;
- factor scores (FS) for each sub-factor for the ten sites. These scores were determined by scaling the data presented for each sub-factor in Table 6.3 from 0.0 for the lowest or 'worst' score to 10.0 for the highest or 'best' score;
- factor weights (FW) for the four factors (environment, access, operations and cost), the relative values for which can be varied from 0% to 100% but must always add to 100%;

SECOND SYDNEY AIRPORT STUDY SITE RANKING PROGRAMME Proj.No.S84011/0050
LAYOUT : WSPR ; PAX NO. 25.0 (MILLION)

FACTORS/SUBFACTORS	FACTOR WEIGHT	SUBFACTOR WEIGHT	Badg. Creek	Bring.	Hols.	Lond.	Schey.	Darkes Forest	Som.	Warn.	Wilton	Goul.
ENVIRONMENT	31.5											
. Air quality		1.2	3.8	3.5	5.4	0.7	0.0	8.5	8.5	6.5	8.3	10.0
. Water quality		1.3	3.0	3.0	6.0	4.0	5.0	2.0	5.0	7.0	0.0	10.0
. Flood risk		1.3	6.0	6.0	10.0	0.0	0.0	10.0	10.0	4.0	10.0	10.0
. Flora		2.1	9.0	9.0	2.8	0.0	1.2	0.0	3.0	4.4	1.7	10.0
. Fauna		2.1	10.0	9.5	3.7	3.8	7.8	0.0	7.4	1.7	4.0	7.0
. Archaeology		2.7	10.0	10.0	0.0	6.2	3.4	0.2	2.2	5.5	2.0	6.2
. European heritage		2.7	0.6	0.6	10.0	0.0	1.9	10.0	6.6	6.5	7.8	7.0
. Agriculture		1.6	1.1	0.0	7.5	5.3	1.4	10.0	2.0	3.8	7.7	2.1
. Mineral resources		2.0	4.5	7.3	7.3	2.7	8.6	0.0	6.4	5.0	4.5	10.0
. Population displaced		4.9	6.9	0.0	7.1	6.0	2.6	10.0	8.0	9.1	9.3	10.0
. Existing noise incompatible land use		4.7	2.6	2.0	5.8	1.3	0.0	8.9	7.0	3.0	8.6	10.0
. Future noise incompatible land use		3.6	0.0	2.0	8.7	6.3	2.9	10.0	5.5	4.1	6.2	10.0
ENVIRONMENTAL RANKING			3.7	3.0	4.9	2.7	2.2	5.1	4.8	4.1	5.0	6.9
ACCESS	21.9											
. General aviation market		2.6	1.2	0.0	0.1	4.7	10.0	0.5	0.1	0.0	1.2	0.0
. Private vehicle accessibility		4.3	8.9	8.8	10.0	7.4	8.4	8.0	7.0	6.5	6.7	0.0
. Public transport accessibility		3.7	8.9	9.9	10.0	8.9	9.1	8.3	6.2	4.7	7.6	0.0
ACCESSIBILITY RANKING			5.4	5.4	5.9	5.6	7.0	4.8	3.9	3.3	4.4	0.0
AIRPORT OPERATIONS	31.3											
. Airspace		4.3	6.7	4.4	0.0	7.8	6.7	8.9	10.0	10.0	8.9	10.0
. Wind coverage		3.0	10.0	10.0	5.0	10.0	10.0	5.0	5.0	10.0	5.0	0.0
. Other meteorological conditions		4.7	10.0	10.0	7.8	7.8	6.7	0.0	7.8	7.8	7.8	7.8
. Site flexibility		2.3	8.9	10.0	0.0	6.7	8.9	6.7	1.1	3.3	3.3	6.7
OPERATIONAL RANKING			9.9	9.3	4.0	9.0	8.7	5.4	7.6	9.2	7.6	7.4
VARIABLE CAPITAL COSTS	15.3											
. Present value of savings relative to most expensive site		1.0	5.2	3.8	1.5	5.4	0.0	10.0	6.2	6.1	8.9	2.9
VARIABLE CAPITAL COST RANKING			0.8	0.6	0.2	0.8	0.0	1.5	0.9	0.9	1.4	0.4
AGGREGATED RANKING			19.8	18.3	15.1	18.2	17.8	16.9	17.3	17.5	18.4	14.8

RESULTANT RANKING

SITE	SCORE	RANKING
Badgerys Creek	19.8	1
Wilton	18.4	2
Bringelly	18.3	3
Londonderry	18.2	4
Scheyville	17.8	5
Warnervale	17.5	6
Somersby	17.3	7
Darkes Forest	16.9	8
Holsworthy	15.1	9
Goulburn	14.8	10

Figure 6.2
SITE RANKING MATRIX

- sub-factor weights (W) for each of the N sub-factors within each factor. These sub-factor weights can be varied from 1.0 (least important sub-factor) to 5.0 (most important sub-factor).

The aggregated ranking (R) for each site was obtained by the following calculation:

$$\sum_{i=1}^{N} W_i \times FS_i = \text{factor raw score (FRS)}$$

$$(FRS \times FW) \div N = \text{factor ranking (FR)}$$

The aggregated ranking is the sum of all factor rankings.

Thus for the 'access' factor ranking for Badgerys Creek, the calculation was:

$$(2.6 \times 1.2) + (4.3 \times 8.9) + (3.7 \times 8.9) = 74.32$$

$$(74.32 \times 0.219) \div 3 = 5.42536 \approx 5.4.$$

The four factor rankings (environment, accessibility, operations, variable capital cost) were added to give the aggregated ranking. A computer program was used to calculate the factor ranking to approximately fifteen decimal places and to present the aggregated ranking rounded to one decimal place. Where two sites have an equal aggregated ranking, the order of these sites in the resultant ranking list at the bottom of Figure 6.2 has been determined by the actual factor ranking, not by the rounded values of the aggregates shown in the table.

The results of operation of the matrix are dependent upon the accuracy of the data which form the basis of the factor scores. A number of these scores are based upon qualitative (not quantitative) assessments. The estimating margin of the factor scores based upon qualitative assessments is necessarily greater than that for the quantitatively based scores. However, minor variations in factor scores do not change the broad pattern of ranking results for a given set of sub-factor and factor weights.

The advantage of the matrix is that, once factor and sub-factor weights are set, a single ranking can be calculated that takes into account all sub-factors. The disadvantage is the very large number of possible combinations of factor and sub-factor weights. Thus, to enable results of the matrix to be presented, a basis for setting factor and sub-factor weights was required.

Setting sub-factor weights

To set sub-factor weights, the average of the weights nominated by the principal members of the study team (who are listed in Appendix T) was used. This average is shown in the sub-factor weight column in Figure 6.2 and remained fixed for all trials of the matrix, including the examples summarized in Figure 6.3. The average of sub-factor weights suggested by study team members places greatest weight on noise impact, population displaced by site acquisition, and private vehicle accessibility.

A survey of public attitudes towards a second Sydney airport was carried out by the Department of Aviation in January 1984 (Burke 1984). A total of 1,350 respondents were interviewed, with this sampling being drawn by a random quota technique from the Sydney metropolitan area and those other locations which could potentially be affected by the proposed sites. Table 6.21 lists the disadvantages perceived by respondents in a second Sydney airport. (Overall, the benefits of a second airport were seen to be stronger than the disadvantages, although the disadvantages are a more useful guide to sub-factor weighting. The principal advantages were seen to be relief of air traffic congestion at Kingsford-Smith Airport and the creation of employment; these factors do not discriminate between alternative sites.)

Table 6.21 Disadvantages of a second Sydney airport

Disadvantage*	% of respondents (base = 1,350 respondents)
More noise	31
Disruptions to residents	20
Distance/extra travel	13
More pollution	10
Waste of money/too expensive	9
There will be problems wherever it's situated	7
Depends where it is built	7
Only if it is in my area	7

* Some respondents noted more than one disadvantage.

The results of this survey (which are further discussed in Chapter 18) could be interpreted as indicating that the average sub-factor weights set by the study team members (in so far as they weighted most heavily the noise, disruption and access sub-factors) are consistent with the broader community view reflected in the survey sample.

However, there can be no one 'correct' set of sub-factor weights. Many sub-factor weightings and combinations of weightings are possible and a different set of sub-factor weightings will give rise to a different ranking of sites.

Setting factor weights

The factor weightings were then varied to test the sensitivity of the ranking of sites to broad changes in the weight that could be attached to the environmental, access, operations and cost factors. In order to reduce the possible combinations of factor weights to a manageable number, limits were set on the minimum and maximum weight that any one factor could achieve. The basis for this range is that if some factors are given weights in excess of 55% or less than 15%, then one or more of the three sites with severe liabilities — Darkes Forest, Goulburn and Holsworthy — emerge as top ranked sites.

This point can be illustrated by the rankings which arise when extreme factor weights are set (e.g. 100% for one factor and 0% for the other three) which can be inferred from the factor ranking scores that appear at the end of each list of sub-factors in Figure 6.2. Thus, if environment were the only factor considered (and if the sub-factor weights used by the Consultant were accepted), then Goulburn would be the top ranked site. Similarly, if access were the only consideration, Scheyville would be the top ranked site; if airport operations were the only consideration, Badgerys Creek would be the top ranked site; and if cost were the only consideration, Darkes Forest would be the top ranked site.

Having set limits of 15% and 55% on the range for factor weights, the ranking of sites on twelve combinations of factor weights was calculated. The combinations of factor weights were designed to test, within the 15-55% limits, extreme weightings. The twelve examples of factor weight combinations used are set out in Table 6.22.

Table 6.22 **Twelve examples of factor weighting**

Example number	Factor weights (%)				Example represents
	E*	A**	O+	C++	
1	**31.5**	**21.9**	**31.3**	**15.3**	Average of weights nominated by study team members
2	**25**	**25**	**25**	**25**	Equal weights
3	**55**	15	15	15	High environment weight
4	15	**55**	15	15	High access weight
5	15	15	**55**	15	High airport operations weight
6	15	15	15	**55**	High cost weight
7	**35**	**35**	15	15	Combined high environment and access weights
8	15	**35**	**35**	15	Combined high access and operations weights
9	15	15	**35**	**35**	Combined high operations and cost weights
10	**35**	15	15	**35**	Combined high environment and cost weights
11	**35**	15	**35**	15	Combined high environment and operations weights
12	15	**35**	15	**35**	Combined high access and cost weights

* Environment.
** Access.
+ Operations.
++ Cost.

Sensitivity of worst case ranking to changed factor weights

The rankings resulting from these factor weightings are shown in Figure 6.3 both for the worst case of 25 million annual passenger movements and for the lower level of activity of 5 million annual passenger movements. The groups of sites are coloured (closer sites are dark tan; mid-distance sites are light tan; and Darkes Forest, Goulburn and Holsworthy are grey).

Of the twelve examples illustrated for the worst case level of activity:

- Badgerys Creek is the top ranked site overall in eight examples;

- Badgerys Creek is the top ranked of the closer sites in eleven examples; Scheyville is the top ranked closer site in one example;

- Wilton is the top-ranked site overall in three examples;

- Wilton is the top ranked of the mid-distance sites in nine examples;
- Holsworthy is the ninth or tenth ranked site in eight examples;
- Goulburn is the ninth or tenth ranked site in nine examples.

As the rankings are sensitive to weightings given to factors and sub-factors, it is not possible to demonstrate objectively that one site is better than another. However, the rankings resulting from use of the matrix enable the effect of different weightings to be illustrated. The reader must judge whether the range of weightings used in the twelve examples in Figure 6.3 is consistent with his or her view of the relative importance of the four factors and twenty-five sub-factors on which the site ranking matrix has been based.

Sensitivity of ranking to a lower level of development

Measurements were made to rank each site on the basis of a single runway development and a traffic volume for this layout of 5 million annual passenger movements. The accumulation of data and scoring of sites on each sub-factor were carried out using the same approach as described in Section 6.2. Figure 6.3 presents the rankings that result from application of the twelve weighting examples described in Table 6.22.

Of the twelve examples illustrated:

- Badgerys Creek is the top ranked site overall in four examples;
- Scheyville is also the top ranked site overall in four examples;
- Badgerys Creek is the top ranked of the closer sites in seven examples; Scheyville is the top ranked closer site in four examples;
- Wilton is the top ranked site overall in three examples;
- Wilton is the top ranked mid-distance site in six examples;
- Somersby's ranking fell from that obtained in the worst case in four of the twelve examples, and did not improve on any example.

Tables 6.23 and 6.24 show the number of times a site ranked first, second, third etc. for the twelve factor weighting examples presented in Figure 6.3. For example, the top left hand cell of Table 6.23 shows that Badgerys Creek ranked first in eight of the twelve factor weighting examples given in Figure 6.3 for the worst case.

Although their rankings vary to some degree between the worst case of 25 million annual passenger movements and the lower level of 5 million annual passenger movements, Badgerys Creek and Wilton remain the superior sites within their groups. The sites that clearly improved their ranking in Table 6.24 over that in Table 6.23 were Bringelly, Scheyville and Warnervale. This is because the sub-factor scores that change significantly when a lower level of development is assumed are primarily those depending on site area (which reduces for an SR layout from that required for a WSPR layout) and on noise impact (which also reduces). Access and operations sub-factors remain largely unchanged. In the case of Bringelly, Scheyville and Warnervale, the scores received for the disruption, noise, flora, fauna and archaeology sub-factors on the worst case are improved relative to the other sites for the lower level of activity. However, the improvement is not sufficient for those sites to outrank the sites previously identified as superior within their respective groupings.

RANKINGS FOR WORST CASE (25 MILLION ANNUAL PASSENGER MOVEMENTS)

FACTOR WEIGHTING EXAMPLE

FACTOR WEIGHT	1	2	3	4	5	6
ENVIRONMENT	31.5	25.0	55.0	15.0	15.0	15.
ACCESS	21.9	25.0	15.0	55.0	15.0	15.
OPERATIONS	31.3	25.0	15.0	15.0	55.0	15.
COSTS	15.3	25.0	15.0	15.0	15.0	55.
	100.0	100.0	100.0	100.0	100.0	100.

RESULTANT RANKING

RANK	1 SITE	SCORE	2 SITE	SCORE	3 SITE	SCORE	4 SITE	SCORE	5 SITE	SCORE	6 SITE	SCORE
1	Badgerys Creek	19.8	Badgerys Creek	18.3	Wilton	16.7	Scheyville	22.7	Badgerys Creek	23.6	Wilton	13.
2	Wilton	18.4	Wilton	17.3	Darkes Forest	16.4	Badgerys Creek	20.9	Bringelly	22.1	Darkes Forest	13.
3	Bringelly	18.3	Londonderry	17.1	Goulburn	16.1	Londonderry	20.5	Londonderry	21.8	Badgerys Creek	13.
4	Londonderry	18.2	Bringelly	17.0	Badgerys Creek	15.7	Bringelly	20.1	Warnervale	21.3	Londonderry	12.
5	Scheyville	17.8	Scheyville	16.6	Somersby	15.6	Holsworthy	19.2	Scheyville	21.0	Somersby	12.
6	Warnervale	17.5	Darkes Forest	16.4	Holsworthy	14.8	Darkes Forest	18.7	Wilton	20.1	Warnervale	12.
7	Somersby	17.3	Warnervale	15.9	Warnervale	14.8	Wilton	18.4	Somersby	19.2	Bringelly	11.
8	Darkes Forest	16.9	Somersby	15.9	Bringelly	14.0	Somersby	16.6	Goulburn	16.8	Scheyville	10.
9	Holsworthy	15.1	Holsworthy	14.2	Londonderry	13.7	Warnervale	15.6	Darkes Forest	16.7	Holsworthy	9.
10	Goulburn	14.8	Goulburn	12.2	Scheyville	12.7	Goulburn	7.3	Holsworthy	13.7	Goulburn	8.

RANKINGS FOR LOWER LEVEL OF ACTIVITY (5 MILLION ANNUAL PASSENGER MOVEMENTS)

FACTOR WEIGHTING EXAMPLE

FACTOR	1	2	3	4	5	6
ENVIRONMENT	31.5	25.0	55.0	15.0	15.0	15.0
ACCESS	21.9	25.0	15.0	55.0	15.0	15.0
OPERATIONS	31.3	25.0	15.0	15.0	55.0	15.0
COSTS	15.3	25.0	15.0	15.0	15.0	55.0
	100.0	100.0	100.0	100.0	100.0	100.0

RESULTANT RANKING

RANK	1 SITE	SCORE	2 SITE	SCORE	3 SITE	SCORE	4 SITE	SCORE	5 SITE	SCORE	6 SITE	SCORE
1	Badgerys Creek	19.4	Badgerys Creek	17.9	Wilton	17.7	Scheyville	23.4	Badgerys Creek	23.0	Wilton	14.3
2	Bringelly	18.9	Wilton	17.7	Darkes Forest	17.2	Badgerys Creek	20.7	Bringelly	22.5	Darkes Forest	14.0
3	Warnervale	18.9	Bringelly	17.7	Warnervale	16.9	Bringelly	20.5	Warnervale	22.0	Warnervale	13.4
4	Wilton	18.9	Scheyville	17.7	Badgerys Creek	15.5	Londonderry	20.2	Scheyville	21.8	Bringelly	12.8
5	Scheyville	18.7	Warnervale	17.2	Somersby	15.5	Holsworthy	19.0	Londonderry	21.2	Londonderry	12.7
6	Londonderry	17.3	Darkes Forest	16.7	Bringelly	14.9	Darkes Forest	18.9	Wilton	20.2	Badgerys Creek	12.6
7	Darkes Forest	17.3	Londonderry	16.6	Holsworthy	14.6	Wilton	18.6	Somersby	19.2	Somersby	12.2
8	Somersby	17.2	Somersby	15.9	Goulburn	14.0	Somersby	16.6	Darkes Forest	16.8	Scheyville	11.6
9	Holsworthy	14.9	Holsworthy	13.9	Scheyville	13.8	Warnervale	16.4	Goulburn	16.2	Holsworthy	8.3
10	Goulburn	13.6	Goulburn	11.2	Londonderry	12.2	Goulburn	6.7	Holsworthy	13.5	Goulburn	8.0

FACTOR WEIGHTING EXAMPLE

7

FACTOR WEIGHT	
ENVIRONMENT	35.0
ACCESS	35.0
OPERATIONS	15.0
COSTS	15.0
	100.0

RESULTANT RANKING

SITE	SCORE
Badgerys Creek	18.3
Scheyville	17.7
Wilton	17.6
Darkes Forest	17.5
Londonderry	17.1
Bringelly	17.1
Holsworthy	17.0
Somersby	16.1
Warnervale	15.2
Goulburn	11.7

8

FACTOR WEIGHT	
ENVIRONMENT	15.0
ACCESS	35.0
OPERATIONS	35.0
COSTS	15.0
	100.0

RESULTANT RANKING

SITE	SCORE
Badgerys Creek	22.3
Scheyville	21.9
Londonderry	21.2
Bringelly	21.1
Wilton	19.3
Warnervale	18.4
Somersby	17.9
Darkes Forest	17.7
Holsworthy	16.5
Goulburn	12.1

9

FACTOR WEIGHT	
ENVIRONMENT	15.0
ACCESS	15.0
OPERATIONS	35.0
COSTS	35.0
	100.0

RESULTANT RANKING

SITE	SCORE
Badgerys Creek	18.4
Londonderry	17.1
Wilton	17.0
Bringelly	16.9
Warnervale	16.6
Somersby	15.6
Scheyville	15.5
Darkes Forest	15.3
Goulburn	12.6
Holsworthy	11.4

10

FACTOR WEIGHT	
ENVIRONMENT	35.0
ACCESS	15.0
OPERATIONS	15.0
COSTS	35.0
	100.0

RESULTANT RANKING

SITE	SCORE
Wilton	15.3
Darkes Forest	15.1
Badgerys Creek	14.4
Somersby	13.8
Warnervale	13.4
Londonderry	13.1
Bringelly	12.9
Goulburn	12.3
Holsworthy	12.0
Scheyville	11.3

11

FACTOR WEIGHT	
ENVIRONMENT	35.0
ACCESS	15.0
OPERATIONS	35.0
COSTS	15.0
	100.0

RESULTANT RANKING

SITE	SCORE
Badgerys Creek	19.7
Wilton	18.4
Bringelly	18.0
Warnervale	18.0
Londonderry	17.8
Somersby	17.4
Scheyville	16.9
Darkes Forest	16.6
Goulburn	16.5
Holsworthy	14.2

12

FACTOR WEIGHT	
ENVIRONMENT	15.0
ACCESS	35.0
OPERATIONS	15.0
COSTS	35.0
	100.0

RESULTANT RANKING

SITE	SCORE
Badgerys Creek	17.0
Londonderry	16.5
Scheyville	16.4
Darkes Forest	16.3
Wilton	16.2
Bringelly	15.9
Somersby	14.3
Holsworthy	14.2
Warnervale	13.8
Goulburn	7.9

FACTOR WEIGHTING EXAMPLE

7

FACTOR	
ENVIRONMENT	35.0
ACCESS	35.0
OPERATIONS	15.0
COSTS	15.0
	100.0

RESULTANT RANKING

SITE	SCORE
Scheyville	18.6
Wilton	18.2
Badgerys Creek	18.1
Darkes Forest	18.0
Bringelly	17.7
Holsworthy	16.8
Warnervale	16.6
Londonderry	16.2
Somersby	16.0
Goulburn	10.4

8

FACTOR	
ENVIRONMENT	15.0
ACCESS	35.0
OPERATIONS	35.0
COSTS	15.0
	100.0

RESULTANT RANKING

SITE	SCORE
Scheyville	22.6
Badgerys Creek	21.8
Bringelly	21.5
Londonderry	20.7
Wilton	19.4
Warnervale	19.2
Somersby	17.9
Darkes Forest	17.8
Holsworthy	16.2
Goulburn	11.5

9

FACTOR	
ENVIRONMENT	15.0
ACCESS	15.0
OPERATIONS	35.0
COSTS	35.0
	100.0

RESULTANT RANKING

SITE	SCORE
Badgerys Creek	17.8
Warnervale	17.7
Bringelly	17.6
Wilton	17.3
Londonderry	17.0
Scheyville	16.7
Somersby	15.7
Darkes Forest	15.4
Goulburn	12.1
Holsworthy	10.9

10

FACTOR	
ENVIRONMENT	35.0
ACCESS	15.0
OPERATIONS	15.0
COSTS	35.0
	100.0

RESULTANT RANKING

SITE	SCORE
Wilton	16.0
Darkes Forest	15.6
Warnervale	15.2
Badgerys Creek	14.1
Bringelly	13.9
Somersby	13.8
Scheyville	12.7
Londonderry	12.5
Holsworthy	11.5
Goulburn	11.0

11

FACTOR	
ENVIRONMENT	35.0
ACCESS	15.0
OPERATIONS	35.0
COSTS	15.0
	100.0

RESULTANT RANKING

SITE	SCORE
Warnervale	19.5
Badgerys Creek	19.2
Wilton	19.0
Bringelly	18.7
Scheyville	17.8
Somersby	17.4
Darkes Forest	17.0
Londonderry	16.7
Goulburn	15.1
Holsworthy	14.0

12

FACTOR	
ENVIRONMENT	15.0
ACCESS	35.0
OPERATIONS	15.0
COSTS	35.0
	100.0

RESULTANT RANKING

SITE	SCORE
Scheyville	17.5
Bringelly	16.7
Badgerys Creek	16.7
Londonderry	16.5
Darkes Forest	16.5
Wilton	16.4
Warnervale	14.9
Somersby	14.4
Holsworthy	13.7
Goulburn	7.4

Figure 6.3
12 EXAMPLES OF FACTOR WEIGHTING AND RESULTANT SITE RANKING

Table 6.23 Worst case (25 million annual passenger movements)

Site	Number of times a site ranked first, second, third etc. in the twelve weighting examples									
	1	2	3	4	5	6	7	8	9	10
Badgerys Creek	8	1	2	1	-	-	-	-	-	-
Bringelly	-	1	2	4	-	2	2	1	-	-
Holsworthy	-	-	-	-	1	1	1	1	5	3
Londonderry	-	2	4	2	2	1	-	-	1	-
Scheyville	1	2	1	-	3	-	2	1	-	2
Darkes Forest	-	3	-	2	-	2	-	4	1	-
Somersby	-	-	-	1	2	2	4	3	-	-
Warnervale	-	-	-	2	2	3	2	-	3	-
Wilton	3	3	2	-	2	1	1	-	-	-
Goulburn	-	-	1	-	-	-	-	2	2	7

Table 6.24 Lower activity level (5 million annual passenger movements)

Site	Number of times a site ranked first, second, third etc. in the twelve weighting examples									
	1	2	3	4	5	6	7	8	9	10
Badgerys Creek	4	3	2	2	-	1	-	-	-	-
Bringelly	-	3	4	2	2	1	-	-	-	-
Holsworthy	-	-	-	-	1	1	1	-	6	3
Londonderry	-	-	-	3	3	1	1	3	-	1
Scheyville	4	-	-	2	2	1	1	1	1	-
Darkes Forest	-	3	-	1	1	2	2	3	-	-
Somersby	-	-	-	-	1	2	4	4	1	-
Warnervale	1	1	5	-	1	1	2	-	1	-
Wilton	3	2	1	2	1	2	1	-	-	-
Goulburn	-	-	-	-	-	-	-	1	3	8

The assumed future level of passenger traffic on which the preliminary master plans for Badgerys Creek and Wilton are based is 13 million annual passenger movements (Section 4.3). This level is approximately half that assumed for the worst case used in the short-listing process and more than twice that of the lower level of activity of 5 million annual passenger movements against which the rankings derived under worst case assumptions were checked. Without explicitly ranking all ten sites for a case of 13 million annual passenger movements, the judgement was made that the 25 million and 5 million cases, as described above, embraced a reasonable range of alternative assumptions, and that comparable rankings would be achieved for an intermediate level of development.

6.7 THE CLOSER AND MID-DISTANCE SITES COMPARED

Characteristically, the group of closer sites are more accessible, have less impact on the natural environment but significantly greater impact on the socio-economic environment, and cost more to acquire than the mid-distance sites. Selection of short-listed sites from one or other group of sites will involve, explicitly or implicitly, a compromise between accessibility on the one hand and type of impact or cost on the other. The respondents to the survey that was discussed earlier identified noise, disruption and distance from the city as the three most significant disadvantages of a second Sydney airport (Table 6.21). The relative disadvantage of the groups of closer and mid-distance sites on these issues is graphically illustrated in Figure 6.4. Also shown are the positions of Badgerys Creek and Wilton on the same issues.

The mid-distance sites have a very considerable advantage in terms of noise impacts and disruption, and Wilton more so than the mid-distance sites as a group. However, the additional travel time to the mid-distance sites (as compared to the closer group) would necessarily imply acceptance of some constraints on the role of an airport at one of these sites — in particular, greater difficulties with market acceptance than would be encountered at the closer sites — and the time at which an airport at one of the mid-distance sites would become viable is likely to be later than at the closer sites.

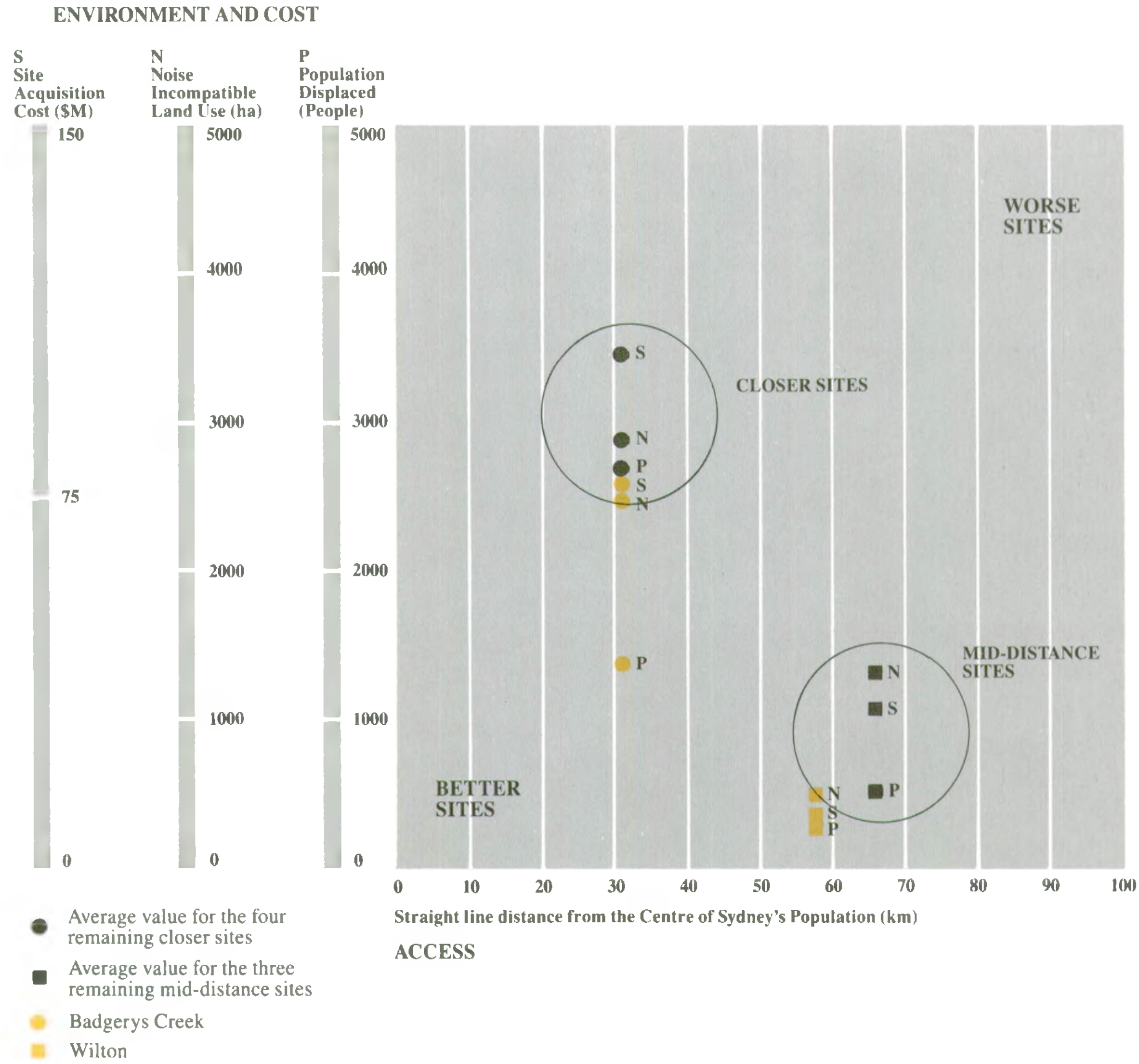


Figure 6.4
RELATIVE DISADVANTAGES OF CLOSER AND MID-DISTANCE SITES

6.8 SITES FOR EVALUATION IN AN ENVIRONMENTAL IMPACT STATEMENT

The objective of the short-listing phase of the Site Selection Programme was to identify two (or three) sites which would then be evaluated in further detail in this Draft Environmental Impact Statement.

The analysis presented in the preceding sections concludes that:

- Badgerys Creek is the superior of the closer sites (Section 6.4)
- Wilton is the superior of the mid-distance sites (Section 6.5).

However, there are a number of alternative site comparisons that could be made between two (or three) short-listed sites. These comparisons could be between:

- two similar sites (two of the closer site group)
- two different sites (one closer and one mid-distance)
- three sites (two closer and one mid-distance)
- three sites (one closer and two mid-distance).

On these choices, the Consultant made the following recommendations:

- Badgerys Creek (the location broadly defined) should be the closer site if only one closer site were to be evaluated.
- Either Scheyville or Londonderry could be the second closer site.
- Wilton should be the mid-distance site if only one mid-distance site were to be evaluated.
- If two mid-distance sites were to be evaluated, then the second should be Somersby.

The Consultant also advised that there was no apparent benefit in analysing three sites in detail for presentation in the Draft Environmental Impact Statement: a two-site comparison would enable all relevant issues to be examined.

On 18 September 1984, the Minister for Aviation announced that the number of locations being studied for reservation of a site for a second Sydney airport had been reduced to two: Badgerys Creek and Wilton.

Chapters 7-16 present the environmental evaluation for the Badgerys Creek and Wilton sites and in Chapter 17 the two sites are compared.

PART B

THE PROPOSAL AT BADGERYS CREEK

CHAPTER 7

Introduction to the Assessment of the Proposed Airport Site at Badgerys Creek

7.1 ASSESSMENT PROCESS

Following completion of the short-listing phase of the programme described in Part A of this Draft Environmental Impact Statement, Badgerys Creek was confirmed as one of the two short-listed sites to be subjected to a more detailed evaluation. This work involved the following steps:

- the assumptions for the worst case used in the short-listing phase (Chapter 4) were reviewed;
- additional runway orientations were investigated within the broad area in which the notional Badgerys Creek site was situated, and a specific site boundary was defined;
- a preliminary airport master plan was prepared, taking into account the requirements for airport facilities and airspace;
- a detailed environmental assessment was then undertaken in accordance with the Draft Environmental Impact Statement guidelines.

7.2 LOCATION OF THE PROPOSED BADGERYS CREEK SITE AND ITS ENVIRONS

The proposed site is located in the Liverpool local government area which is situated in the south-western portion of the Cumberland Basin about 46 km directly west of Sydney's central business district. The City of Liverpool comprises about 30,300 ha of urban, semi-rural and rural land uses. Urban development is limited to the eastern portion of the Liverpool local government area and covers about 16% of the total land area. In the remaining 84%, semi-rural development is generally located in the central portion while rural uses with scattered concentrations of semi-rural land and village areas cover the remaining western and southern regions.

The proposed airport site (Figure 7.1) is situated between the villages of Luddenham and Badgerys Creek in the western portion of the Liverpool local government area. The surrounding local government areas are Fairfield, Penrith, Camden and Wollondilly.

The site is at an average elevation of about 80 m above sea-level on a ridge system that divides the Nepean and South Creek river systems. Both these rivers run parallel in a northerly direction. About 92% of the proposed site area drains into South Creek and thence into the Nepean—Hawkesbury River system north of McGraths Hill near Windsor. The other 8% drains westward into the Nepean River.

The eastern portion of the site contains the village area of Badgerys Creek and some poultry farms. The central portion is largely used for the grazing of cattle and horses, while the western portion is used for dairying and market gardens. Part of the route (about 3.2 km) of a 330 kV steel tower transmission line passes through the site south of Luddenham.

The most direct road access from the centre of Sydney to the proposed site is along Elizabeth Drive from Cabramatta, while The Northern Road provides access from the Penrith and Camden—Campbelltown areas. The most direct route from the northern suburbs of Sydney is via peripheral connector roads (Wallgrove Road, Mamre/Luddenham Roads) from the F4 Freeway to Elizabeth Drive, and from Parramatta along Smithfield Road to Elizabeth Drive.

There are about 16.6 km of roads within the proposed site boundaries. However, only two roads, The Northern Road and Badgerys Creek Road, are connector roads. The Badgerys Creek Road serves the village of Badgerys Creek while The Northern Road serves as a major north/south connector road.

Much of the surrounding land use is devoted to agriculture, particularly poultry production, dairying, grazing and market gardening. However, there are also a number of specialized facilities nearby, including the Fleurs Radio Observatory, the Overseas Telecommunications Commission (Australia) radio receiving station, various facilities operated by the Department of Defence, the CSIRO McMaster research station, and the University of Sydney's McGarvie Smith farm.

7.3 STRUCTURE OF THE REPORT ON THE ENVIRONMENTAL ASSESSMENT OF THE BADGERYS CREEK SITE

The assessment of the Badgerys Creek site is contained in the following Chapters (8 to 11) of Part B. These chapters describe the acquisition proposal as it relates to the Badgerys Creek site, and the environmental effects likely to arise from possible future development of a second Sydney airport at that site. They are structured as follows:

- **Chapter 8:** In this chapter, the proposed site area is described, the assumptions relating to the worst case are reviewed, and the preliminary master plan for possible future airport development is described.

- **Chapter 9:** This chapter, which is concerned with the socio-economic environment and the likely effects of the proposal and of subsequent airport development, contains the following principal sections:

  - **Section 9.1** — a discussion of site acquisition procedures and of likely effects on the resident populaton;

  - **Section 9.2** — a description of the extent of noise effects likely to be associated with future airport development at the proposed site;

  - **Section 9.3** — the conclusions of the archaeological assessment of the proposed site;

  - **Section 9.4** — an account of the views and concerns of Aboriginal people who may be affected by the acquisition of the site and future airport development there;

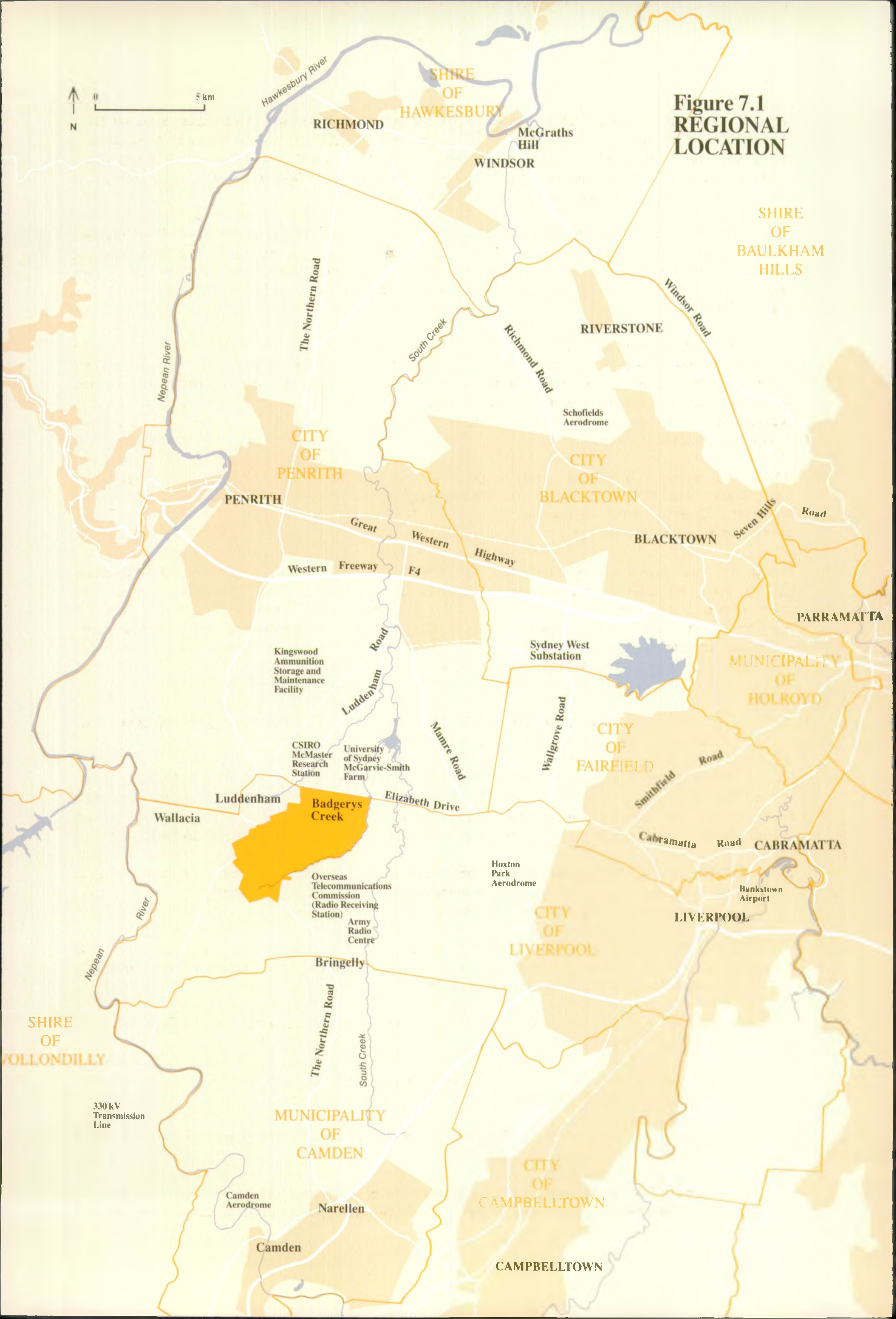


Figure 7.1
REGIONAL LOCATION
0
5 km
N
Hawkesbury River
SHIRE OF HAWKESBURY
RICHMOND
McGraths Hill
WINDSOR
SHIRE OF BAULKHAM HILLS
Windsor Road
RIVERSTONE
Richmond Road
South Creek
The Northern Road
Nepean River
Schofields Aerodrome
CITY OF PENRITH
CITY OF BLACKTOWN
PENRITH
Great Western Highway
BLACKTOWN
Seven Hills Road
Western Freeway F4
PARRAMATTA
Sydney West Substation
MUNICIPALITY OF HOLROYD
Kingswood Ammunition Storage and Maintenance Facility
Luddenham Road
Mamre Road
Wallgrove Road
CITY OF FAIRFIELD
Smithfield Road
CSIRO McMaster Research Station
University of Sydney McGarvie-Smith Farm
Elizabeth Drive
Luddenham
Wallacia
Badgerys Creek
Cabramatta Road
CABRAMATTA
Hoxton Park Aerodrome
Overseas Telecommunications Commission (Radio Receiving Station)
Army Radio Centre
Bankstown Airport
LIVERPOOL
CITY OF LIVERPOOL
Nepean River
Bringelly
SHIRE OF WOLLONDILLY
The Northern Road
South Creek
330 kV Transmission Line
MUNICIPALITY OF CAMDEN
CITY OF CAMPBELLTOWN
Camden Aerodrome
Narellen
Camden
CAMPBELLTOWN

- **Section 9.5** — an assessment of the European heritage of the proposed site;
- **Section 9.6** — a description of the economic effects of acquisition, construction and operation of a second Sydney airport at the site;
- **Section 9.7** — an examination of the nature and extent of agricultural activities likely to be affected by site acquisition and future airport development.
- **Section 9.8** — an assessment of the implications for regional planning, particularly for those portions of the Macarthur and Sydney Western Sub-Regions that would be affected by the acquisition and future development of an airport at Badgerys Creek.

. **Chapter 10:** This chapter describes the physical environment of the Badgerys Creek site and the likely effects of the proposal on it. It is divided into the following principal sections:

- **Section 10.1** — a description of the geology, soils and physiography of the site in terms of the site's suitability for future airport development;
- **Section 10.2** — an assessment of the effects of future airport development on drainage and water quality;
- **Section 10.3** — a discussion of the sources and quantities of airport related air emissions and an assessment of the likely contribution of these emissions to Sydney's future total air emissions;
- **Section 10.4** — an examination of the potential requirements for road and rail access in relation to the future development of an airport at the site;
- **Section 10.5** — an evaluation of infrastructural requirements associated with airport development (the relocation of existing infrastructure and the need for its extension and upgrading), and of the relative consumption of electricity and fuel;
- **Section 10.6** — an assessment of the landscape character and relative scenic quality of the proposed site both in its current state and after future airport development.

. **Chapter 11:** This chapter, which describes the biological environment and effects of the proposal, is divided into the following two sections:

- **Section 11.1** — a description of the flora within the site and the effects that future airport development would have on important species;
- **Section 11.2** — the results of the faunal survey of the proposed site and an assessment of the effects of airport development on important species and on the ecological value of wildlife habitats.

The sub-sections within Chapters 9, 10 and 11 have a common structure: the existing environment is described; the effects of acquisition of the proposed airport site, and of construction and operation of an airport are assessed; and environmental safeguards and monitoring programmes are proposed.

Following the assessment of the proposed Badgerys Creek site presented in Part B, and a similar assessment of the proposed Wilton site in Part C, a comparison of the characteristics and anticipated effects of airport development at these two sites is presented in Part D. This comparison follows the structure of Parts B and C, and takes the form of a table which summarizes the information contained in each section of Parts B and C. No attempt is made to nominate a preferred site.

CHAPTER 8

Description of the Proposal at Badgerys Creek

8.1 PURPOSE OF THE PRELIMINARY MASTER PLAN

A preliminary airport master plan was prepared for the proposed airport site at Badgerys Creek in order to:

- define a site boundary for acquisition of property;
- provide a project definition (in terms of operational levels and physical characteristics) for a maximum level of future development at a second Sydney airport in sufficient detail to permit assessment of the potential impacts at Badgerys Creek;
- predict noise contours based on this maximum level of development so that, if this site were finally selected, appropriate land use planning controls could be implemented to protect potentially noise-affected areas from further incompatible development;
- identify required airspace for a new airport so that, if this site were finally selected, this airspace could be reserved and necessary modifications planned in the existing airspace in order to avoid disruptions to the aviation system in the future;
- establish requirements for access to an airport at the site so that long-range planning could be undertaken.

This chapter describes this preliminary master plan. The plan is based on a set of two widely spaced parallel runways, one 4,000 m in length and the other 2,500 m, with a separation of 1,660 m between runways. This configuration was arrived at after considering four possible runway configurations developed during the short-listing phase, and airport operating parameters which the Department of Aviation believes will satisfy aviation requirements well into the future. The airspace requirements for operating a second Sydney airport are also described.

8.2 THE PROPOSED AIRPORT SITE

The proposed airport site (Figure 8.1) is 1,770 ha in area. There are approximately 241 separate land titles within the site boundary, most of which are privately owned, and about 207 residences. The northern boundary of the site extends along Elizabeth Drive from about 250 m east of Adams Road in the west to the intersection of Badgerys Creek and Elizabeth Drive. The eastern and southern boundary follows Badgerys Creek until it reaches Mersey Road; it encompasses the last block of land on the western side of Mersey Road and then extends south along the back of the properties facing the western side of Mersey Road until it reaches The Northern Road. The boundary then extends westward for about 1 km, from where it takes a north-westerly direction for a further 2.8 km.

The north-western boundary, which extends north-east/south-west, reaches The Northern Road near the southern intersection with Eaton Road. From there, it follows property boundaries to Anton Road, then along Jackson Road for a short distance before following property boundaries once again, and then along the Oaky Creek until it reaches Elizabeth Drive.

Where possible, potential property severance has been kept to a minimum. However, some severance of holdings would be necessary along some of the boundaries owing to the Commonwealth's obligation to acquire only the land that is needed for Commonwealth purposes.

The method of acquiring the finally selected site, together with the related compensation procedures, are described in Section 9.1. Once the selected site has been announced, the processes for acquiring the site under Commonwealth acquisition procedures would commence. Properties within the site would be acquired either by compulsory process or by agreement.

8.3 PRELIMINARY MASTER PLAN ASSUMPTIONS

The assumptions used during the short-listing process (Chapter 4) were reviewed for the more detailed analysis required of the two short-listed sites.

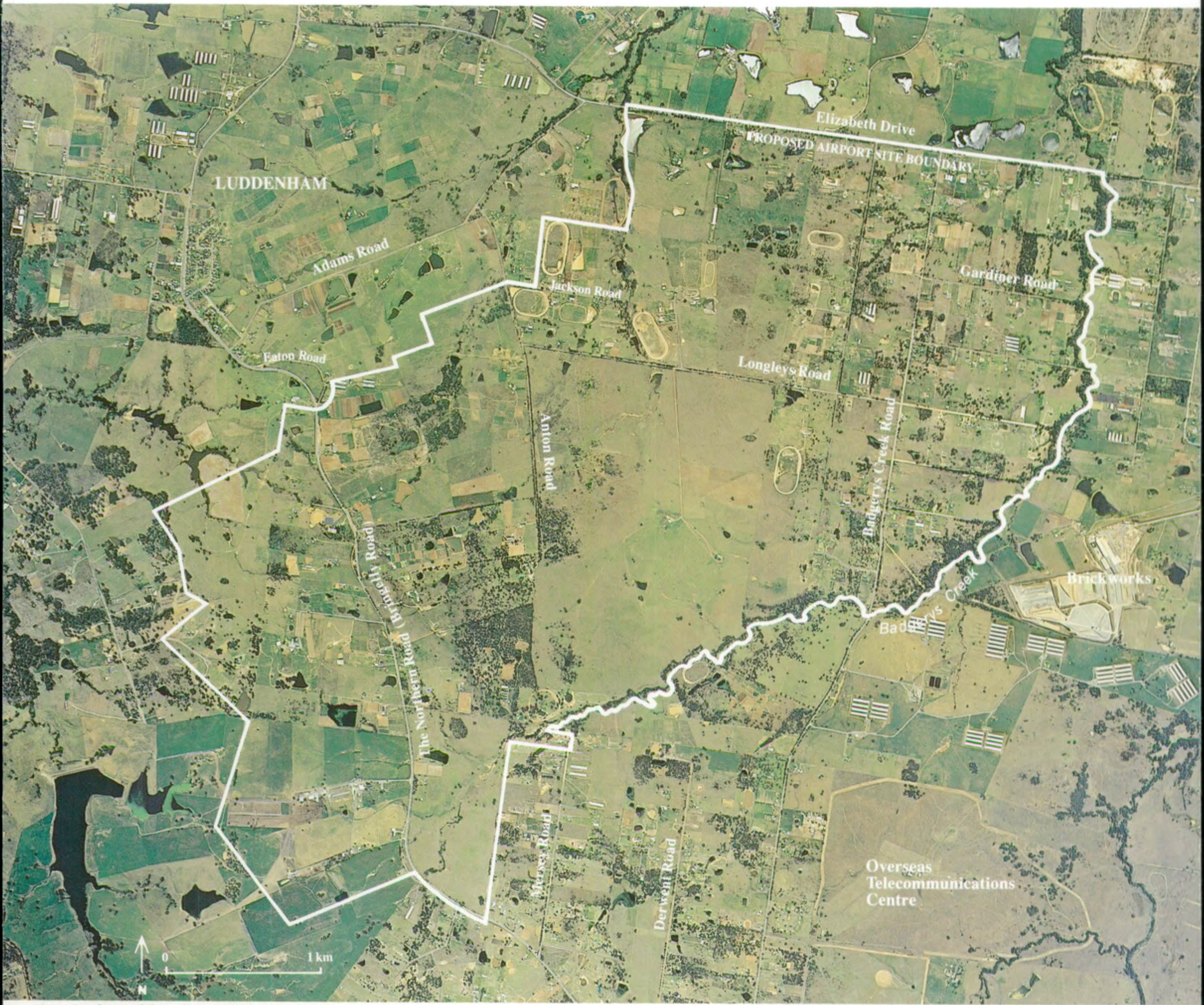
As a result of this review, the following assumptions were adopted:

- a second Sydney airport would be planned to serve all types of aircraft, from small piston-engined general aviation aircraft to large, wide bodied jet operations (including a future generation of larger aircraft which could have wing-spans of up to 95 m);
- the operational mix of aircraft activity would be similar to that currently experienced at major airports but with a higher proportion of general aviation;
- the future airport would operate without a night curfew, thus requiring careful consideration of potential aircraft noise levels and existing and future land uses.

For planning and evaluation purposes, it was determined that the maximum level of development that could be accommodated within the proposed site would be an airport with a capacity of 275,000 annual aircraft movements and 13 million annual passenger movements on a widely spaced parallel runway layout without a cross-wind runway.

8.3.1 Operational capacity

Tables 8.1, 8.2 and 8.3 set out the number of aircraft movements, operational mix, and capacity assumed for the purposes of the preliminary master plan.



Australian Survey Office – flown 7.10.84

Final delineation of boundary subject to survey

Figure 8.1
PROPOSED BADGERYS CREEK SITE

Table 8.1 Annual aircraft movements

Aircraft type	Number of movements	Percentage
B747, DC10	37,500	14
A300, B767, B727	87,500	32
F27, Metroliner	60,000	21
General aviation*	90,000	33
Total	275,000	100

* Business jet, twin and single piston-engined aircraft.

Utilizing the above mix of operations, a calculation of passenger activity was made as follows:

Table 8.2 Passenger activity

Aircraft type	Number of annual aircraft movements	Average passenger load per aircraft movement	Total annual passenger movements
B747, DC10	37,500	150	5,625,000
A300, B767, B727	87,500	75	6,562,500
F27, Metroliner	60,000	15	900,000
Total			13,087,500*

* Does not include passengers carried on general aviation (estimated at less than 5% of the total).

8.3.2 Runway layout

During the short-listing process, various airfield layouts were examined for each of the ten sites under consideration. These layouts were:

- SR — a single runway
- CSPR — a set of closely spaced parallel runways
- WSPR — a set of widely spaced parallel runways
- DWSPR — a double set of widely spaced parallel runways.

Airfield capacities were calculated for each layout and found to vary from 117,000 annual aircraft movements for the SR layout to over 300,000 annual aircraft movements for the DWSPR layout (without a cross-wind runway). Given the operational mix and passenger movement assumptions described above and the range of likely forecasts for aviation activity, each of the four preliminary layout types was considered for its suitability.

The SR layout was rejected because of its limited potential capacity (117,000-138,000 annual aircraft movements) and the difficulty of providing a wide range of operational mixes on a single runway. A mix of heavy and light aircraft using a single runway considerably restricts the number of aircraft movements: this is because it is necessary to provide greater longitudinal separation between aircraft, to ensure that smaller aircraft are not affected by wing tip vortices generated by large aircraft.

The DWSPR layout, which gives a total of four primary runways, was rejected because the theoretical additional gain in capacity over that of a WSPR layout did not justify either the additional land needed or the cost of that land.

The final choice of layouts was thus between the CSPR and the WSPR layouts. Table 8.3 provides a theoretical comparison between these two layouts based on a hypothetical airfield using minimum dimensional criteria (no allowance for local topography, subdivision of land and severance) and assuming no cross-wind runway.

Table 8.3 Capacity and area comparison between CSPR and WSPR layouts

Layout type	Approximate annual aircraft movements (000s)	Minimum land area requirements* (ha)
CSPR	190	1,070
WSPR	275	1,340
Percentage difference	45%	25%

* The difference between these figures and those in Table 4.2 results from exclusion of the area for a cross-wind runway.

The WSPR layout was selected as it allowed greater operational flexibility for an aircraft mix containing a high proportion of smaller aircraft, and it was more efficient in terms of total runway capacity related to land area requirements.

8.3.3 Cross-wind runway

The number of runway directions required at an airport site is influenced by the direction and strength of prevalent winds at that site. A cross-wind is defined as the component of wind normal (perpendicular) to the direction of travel of the aircraft which, in the case of landings and take-offs, coincides with the orientation of the runway in use. Generally, the lighter the aircraft and the slower its design speed, the more difficulty it will have in compensating for cross-winds during landing and take-off. Transport category aircraft can manoeuvre in cross-winds as high as 30 knots but other categories of aircraft with lower flying speeds have less cross-wind capability. Nonetheless, 20 knot cross-winds can be tolerated by most general aviation aircraft when landing on dry runways.

International airport design criteria, however, are quite conservative with respect to operations with cross-winds in order to allow for such factors as variations in pilot proficiency, wet pavements, and a range of runway surface conditions. The International Civil Aviation Organization recommends that 'the number and orientation of runways at an aerodrome should be such that the usability factor of the aerodrome is not less than 95% for the aeroplanes that the aerodrome is intended to serve' (International Civil Aviation Organization 1983). The usability factor is the percentage of instances when at least one runway at an airport is available for use by the aircraft using that airport without exceeding their specified cross-wind tolerances.

The requirement for inclusion of a cross-wind runway at a second Sydney airport was reviewed following completion of the short-listing phase of the study. It was concluded that the Department of Aviation's current requirements for wind coverage (99.8% at capital city airports) would be unnecessary when applied to a second Sydney airport, given the presence of Kingsford-Smith Airport and several general aviation airports within reasonable flying distance of either of the short-listed second airport sites. It was therefore recommended that the Department of Aviation's requirement be relaxed to 95% wind coverage for the second airport. When this criterion was applied to the two short-listed sites at Badgerys Creek and Wilton, it was found that there was no need to provide a cross-wind runway.

It is estimated that aircraft certified to operate in cross-winds up to 10 knots would be able to use an airport at Badgerys Creek for 95% of the time, while aircraft certified to operate in 20 knot cross-winds would be able to use it for more than 99.6% of the time.

8.4 PRELIMINARY MASTER PLAN CRITERIA

8.4.1 Dimensional criteria

The preliminary master plan is based on dimensional criteria generally accepted for airport planning. Comparisons were made with airport planning criteria published by the Department of Aviation and other agencies throughout the world (principally the International Civil Aviation Organization and the US Federal Aviation Administration). In order to ensure that a second Sydney airport would meet future, as well as present, aviation needs, current aviation planning criteria were augmented with available information about long-range trends in aircraft design as applicable to airport layouts.

The results of this study concluded that planning for a second Sydney airport should allow for a future generation of large aircraft (as yet not designed) with wing-spans of up to 95 m. Wing-span is the principal basis for establishing airfield geometric spacing for safety purposes. However, it was recognized that, with the diversity of aircraft types expected to use the airport, not all components needed to be designed to handle such large aircraft, and lesser geometric criteria could therefore be used in certain areas.

Table 8.4 sets out the dimensional criteria that were established for the purposes of the preliminary master plan.

Table 8.4 Dimensional criteria used for preliminary master plan

Component	Criteria (m)		
	Future aircraft (95 m wing-span)	ICAO* (60 m wing-span)	ICAO (36 m wing-span)
Runway width	60	60	45
Taxiway width	30	30	23
Runway/taxiway separation	200	190	168
Taxiway/taxiway separation	122	101	46.5
Taxiway/apron edge separation	107	86	35

* International Civil Aviation Organization.

8.4.2 Runway length

Determination of runway length was based on a review of the runway requirements of existing aircraft as well as likely maximum haul lengths. Examination of performance characteristics of the various aircraft showed that the Boeing 747, operating at maximum gross loads over maximum haul lengths, would require a runway of 4,000 m. Research of available data on future aircraft trends revealed that this length should also be adequate for any new aircraft likely to be designed in the foreseeable future. A length of 4,000 m was therefore used for the primary runway in the preliminary master plan.

The second runway does not need to be the same length as the primary runway, and it was established that a sufficient length would be 2,500 m — the length required for most short and some long haul lengths.

8.4.3 Runway separation

The International Civil Aviation Organization standard for the minimum separation required between parallel widely spaced runways to allow independent aircraft movements is 1,500 m, while the US Federal Aviation Administration standard minimum separation is 1,300 m. However, although these widths may be sufficient for operational purposes, it was considered that they could be restrictive given the need to develop and operate a terminal between the two runway systems.

Therefore, in order to establish a separation width between runways that would be suitable for a second Sydney airport, separation distances between parallel runways at other existing or planned airports around the world were reviewed for a variety of terminal layout concepts. Although these separations ranged from 1,311 m to over 2,500 m, it was found that many of the busy airports with activity levels similar to the maximum assumed for a second Sydney airport (275,000 annual aircraft movements) had separations of 1,500-1,600 m. This separation dimension was reviewed for a variety of terminal concept configurations and for the spatial requirements of large aircraft with 95 m wing-spans. It was concluded that a distance of 1,660 m would be a minimum but adequate separation which balanced all airfield operational requirements, and ensured that a second Sydney airport did not occupy more land than was needed.

8.5 PRELIMINARY MASTER PLAN

8.5.1 Alternative airport layouts

For the short-listing phase of the present study, a layout with a north-west/south-east orientation was used. Subsequent to the short-listing of Badgerys Creek, two additional alignments were examined. These were a north/south alignment (published in the 18 September press release announcing the short-listing of the Badgerys Creek and Wilton sites) and a north-east/south-west alignment. These two alignments plus the one used in the earlier short-listing phase are shown in Figure 8.2. The principal basis for selecting the north-east/south-west alignment for the preliminary master plan was its lesser noise impact on people in surrounding areas (Section 9.2 describes the relative noise impacts of the two alignments examined for this Draft Environmental Impact Statement).

An additional consideration in determining an appropriate layout was the effect of airport operations on the operations of surrounding airports. These airspace considerations involved a review of the effects of an airport at Badgerys Creek on military airspace at Richmond, on the general aviation training areas and general aviation airport operations, and on the restricted airspace over sensitive sites in the area such as St Marys and Kingswood.

8.5.2 Future airport development based on the configuration adopted

Figure 8.3 shows the basic layout used in the preliminary airport master plan for the proposed site. This layout incorporates all building and facility requirements as described in Sections 8.5.3 to 8.5.7 for a fully operational airport and depicts the likely access to the proposed site.

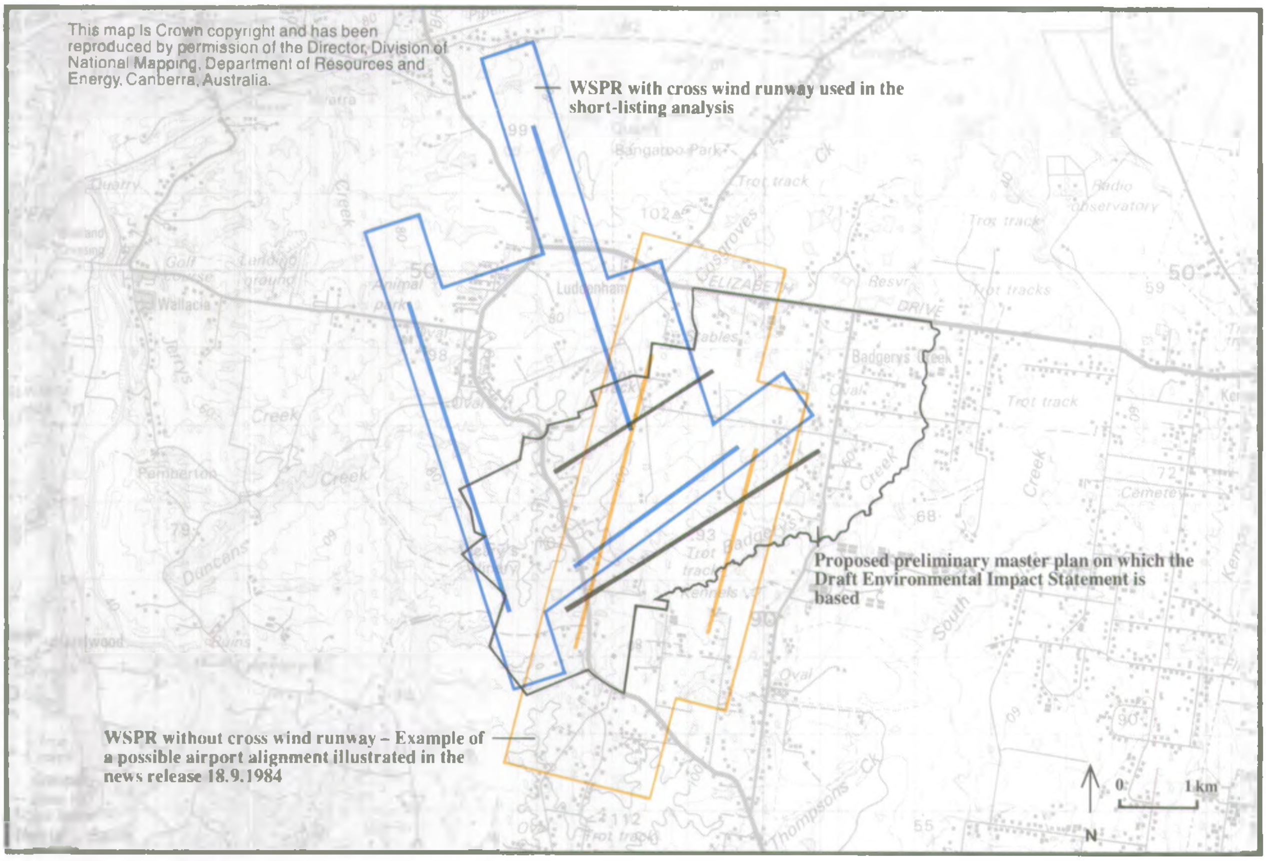


Figure 8.2
ALTERNATIVE RUNWAY ALIGNMENTS

The proposed runway layout is based on a set of widely spaced parallel runways designated 05R-23L and 05L-23R, with the terminal area located between them. Runway 05R-23L is 4,000 m in length and runway 05L-23R is 2,500 m. The distance between the runways is 1,660 m. The approach and departure surfaces have a 1.6% gradient, and thus meet the Department of Aviation's criteria.

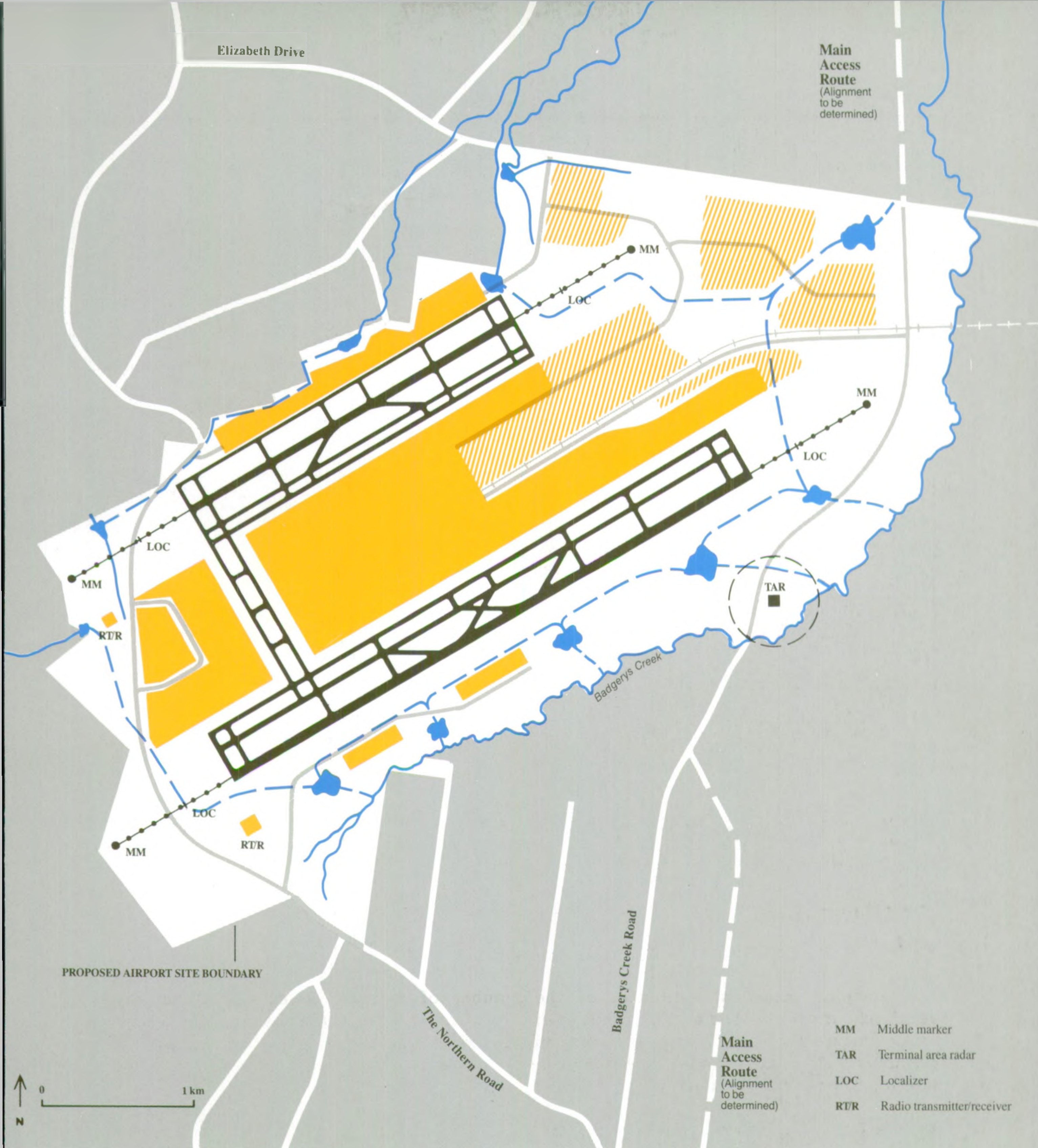
8.5.3 Considerations relating to the general apron area

For planning purposes, estimates of the number of aircraft gates and apron areas required for each of the different categories of aircraft were made based on the assumed mix of aircraft (Table 8.1) and the maximum forecast capacity of the airport (Table 8.2). Estimates of possible gate and apron area requirements for air cargo and aircraft maintenance were also made.

Wide and narrow bodied aircraft apron areas

The apron area for B747, DC10 or larger sized aircraft was planned to accommodate twenty-four aircraft, with twelve gates sized for aircraft of 60 m wing-span and twelve for aircraft of 95 m wing-span. The total of twenty-four aircraft was arrived at by starting with the number of wide bodied aircraft expected to use the airport on an annual basis and converting this to peak-period requirements. A total of 113 aircraft movements per day was assumed. This is 10% more than the assumed average daily aircraft movements and was used as the worst case for planning purposes. Aircraft movements during the peak period of a day were assumed to be 33% of the assumed daily aircraft movements (or 38 aircraft movements).

Using similar reasoning for the gate requirements for A300, B767 and B727 type aircraft, a total of twenty-five positions was calculated as being required. This number was



Runway and taxiways

Runway approach lighting

Terminal and apron area

Leased site for airport related activity

Perimeter drainage system

Possible road access route

Possible rail access route

Figure 8.3
PRELIMINARY MASTER PLAN BADGERYS CREEK

arrived at by starting with 87,500 annual aircraft movements and then assuming 264 daily aircraft movements. Again, this number is 10% more than the assumed average daily aircraft movements and was used as the worst case for planning purposes.

Although a mix of aircraft gate sizes would be appropriate for final planning purposes, for this initial planning effort all gates were sized to accommodate aircraft of 60 m wing-span.

Commuter apron area

This area was designed to accommodate a total of ten positions based on 60,000 annual aircraft movements.

General aviation area

It was estimated that 25% of the 90,000 annual aircraft movements assigned to general aviation would consist of itinerant operations requiring tie-down spaces (parking space with anchoring facilities). On average, it was assumed that about 40% would stay for two days, so that approximately eighty-five itinerant tie-down spaces would be required. Additional space for fixed base operators, hangars and other general aviation facilities has been provided.

After examining various aircraft positioning arrangements for tie-downs, it was determined that, for small single and twin-engined aircraft, an allocation of twenty-five aircraft per hectare was reasonable. For large multi-engined general aviation aircraft, an allocation of five aircraft per hectare was used.

The same allocation of twenty-five aircraft per hectare was used when estimating hangar space requirements for small and twin-engined aircraft utilizing the airport but not based there, with five hangars per hectare being allocated for this purpose. Commercial operations based at the airport were allocated a minimum of 1 ha per operator.

Altogether, a total of 25 ha was allocated for the general aviation facilities area.

Air cargo area

An allocation of eighteen to twenty parking positions was made to accommodate air cargo operations. To ensure that adequate space was available, all gates were based upon accommodating aircraft of 95 m wing-span. Although this space is significantly more than that typically found at large airports, it anticipates the possibility that aircraft of such a size will be designed in the future thus enabling air cargo to be transported in bulk at competitive rates.

In order to accommodate such volumes of cargo, adequate storage and sorting facilities must be available, together with truck manoeuvring areas, cold storage accommodation, bonded warehousing and office facilities. It was estimated that these requirements, plus customer and employee parking areas and access roads, necessitated approximately 2.5 ha per aircraft position. The total allocation was thus 50 ha.

Aircraft maintenance area

This area was planned to accommodate up to fourteen large aircraft on outside aprons, with associated maintenance hangars, workshops, equipment, storage facilities and employee car parking. A total of 40 ha was allocated for this purpose.

8.5.4 Passenger terminal facilities

Several factors influence the design and size of terminal facilities at an airport. These factors include the function of the airport, the type of operations and traffic, the number of user airlines, the airfield configuration, the number of passengers to be accommodated, and the types of ground access available.

The assumptions for a second Sydney airport which therefore had to be taken into account in planning the terminal facility layout were:

- the potential need to accommodate a wide range of aircraft types
- an airfield with two widely spaced runways
- the potential to accommodate a maximum of 13 million passenger movements
- direct servicing of the terminal area by rail and road
- a likely requirement to construct in stages.

While it is not necessary at this stage to select a specific terminal concept, the planning must ensure that adequate space has been allocated to accommodate the potential passenger load and associated aircraft gate requirements. The layout type incorporating widely spaced parallel runways that was selected for a second Sydney airport dictated that the terminal area be located between the two runways. It was therefore necessary to ensure that the separation distance between these runways was sufficient to allow for the taxiways, apron, terminal building, access roads, automobile parking and associated facilities. A variety of terminal configurations is possible within this separation distance. Figure 8.4 illustrates a typical section between runway systems showing the airfield and terminal area requirements that would be appropriate to the maximum level of activity assumed for a second Sydney airport.

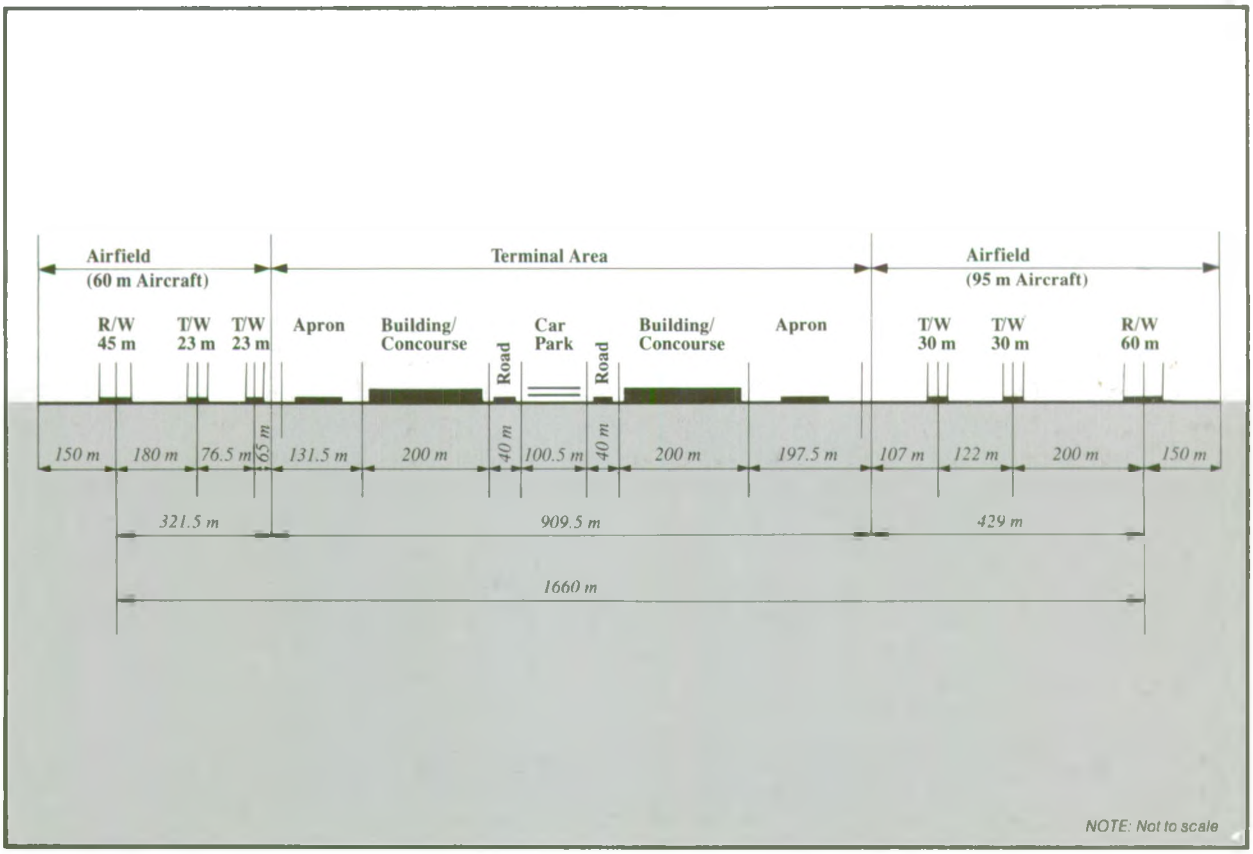


Figure 8.4
TYPICAL AIRFIELD CROSS SECTION FOR 1660M RUNWAY SEPARATION

8.5.5 Taxiway considerations

Two important elements in an airfield layout are the circulation taxiways for aircraft manoeuvring and the entrance/exit taxiways that connect the runways to the circulation taxiways. To ensure maximum flexibility for aircraft to circulate from the runway complex to various apron areas, provision has been made for two uni-directional taxiways paralleling each of the runways. The separations between runway and taxiway, taxiway and taxiway, and taxiway and apron edge conform to the criteria stipulated in Table 8.4. An apron edge taxiway has also been included in the passenger terminal area.

8.5.6 Air navigation aids and air traffic control facilities

A second Sydney airport at its maximum level of development would incorporate a full complement of electronic and visual air navigation aids and air traffic control facilities. The siting of these facilities shown on the master plan layout took into account the special grading and clearance requirements recommended by relevant Australian and international bodies. The various systems that might be used at a second Sydney airport are listed below:

- **Instrument landing system:** This provides aircraft with the lateral, longitudinal and vertical guidance necessary for a landing, and consists of the following elements:

  - localizer

  - glide slope

  - very high frequency marker beacon system comprising an outer, middle and inner beacon.

  For planning purposes, a complete instrument landing system has been shown on the master plan for each runway approach. Other radio navigational aids would include:

  - distance measuring equipment

  - non-directional beacons

- **Visual guidance systems:** These systems are associated with the instrument landing system and include:

  - high intensity approach lights
  - touchdown zone lighting
  - runway centreline lighting
  - high intensity runway edge lighting
  - runway visual range
  - visual approach slope indicators.

- **Air traffic control facilities:** The air traffic control facilities that would be provided include:

  - air traffic control tower
  - air traffic service centres
  - terminal area radar
  - route surveillance radar
  - surface movement radar
  - radio transmitter and receiver sites.

- **Landing aids:** Other landing aids that could be included on the airport are:

  - wind cones
  - weather reporting systems
  - rotating beacons
  - wind shear detection equipment.

8.5.7 Other facilities

Planning provision has been made for the following supporting facilities which are commonly found at major airports and would be required at a second Sydney airport at the maximum level of development:

- car hire area
- Federal Police
- Customs
- catering
- freight forwarders
- employee parking
- post office
- hotel/motel
- banking services
- Department of Aviation maintenance
- Department of Aviation administration
- access to railway and roads
- utility corridors
- fuel storage
- wastewater treatment
- weather service
- flight service stations
- remote car parking

8.6 AIRSPACE ARRANGEMENTS

At present there are four types of designated airspace in the Sydney Region:

- control zones, which are established around busy airports to ensure the safe and orderly flow of traffic;
- a control area, which is a volume of airspace centred on Kingsford-Smith Airport, and is determined by the climb and descent performance of the variety of aircraft using that airport;
- restricted areas, which are volumes of airspace around military facilities, or civil installations such as the Fleurs Radio Observatory;
- danger areas, which are designated volumes of airspace to identify potentially hazardous areas (such as flying training or parachuting areas).

The development of a second major airport in the Sydney Region would require changes in the existing allocation of airspace to accommodate the different arrival and departure patterns at Kingsford-Smith Airport and the second airport. Arriving traffic would need to be split into flows towards either Kingsford-Smith Airport or the second Sydney airport at some point en route at a distance of perhaps 100 nautical miles from Sydney, while traffic departing from either airport and using a similar route to their destinations would need to join this common route at some distant point from the airports. Figure 8.5 shows an example of control zones with a combined control area for both Kingsford-Smith Airport and a future airport at Badgerys Creek. The radius of the control area at Badgerys Creek has been reduced in the eastern and south-eastern sectors to preserve access to Bankstown and Camden aerodromes. The changes required to the existing airspace allocations are discussed below.

Military and restricted airspace

For unrestricted operations at Badgerys Creek, amendments to Richmond control zone would be required. However, minor limitations to Badgerys Creek operations would eliminate the need for major changes to the Richmond control zone or substantial restrictions on military operations. If the Richmond Military Control Zone could be sufficiently reduced in area in future years, areas in the north-west of the Sydney Basin could be made available for training purposes, to replace those areas rendered unavailable as a result of the establishment of the control zone for a future airport at Badgerys Creek. These replacement areas would be available to general aviation aircraft based at Bankstown, Schofields and perhaps Richmond itself.

Aircraft operating outside controlled airspace are also currently denied access to the coast for a distance of 20 nautical miles south of Bankstown because of the presence of the Holsworthy restricted area and the overlying control area steps. The eastern boundaries of the Badgerys Creek control zone would form another constraint, producing a long, low, narrow corridor (30 nautical miles long and 4 nautical miles wide, with a 2,000 ft upper limit) for use by general aviation aircraft operating outside controlled airspace to reach northern and southern areas. The continued presence of the Holsworthy restricted airspace would thus concentrate non-controlled traffic in growing numbers into less airspace, with the associated increased risk of collision between aircraft. If Holsworthy firing activities were eliminated and this airspace restriction removed, access to the south from Bankstown would be greatly improved.

The restricted area around the Fleurs Radio Observatory (R515) is directly in line with the proposed runways at Badgeys Creek and could not co-exist with future airspace requirements for a second airport at Badgerys Creek. There is also a 1,000 ft limit above the Kingswood Defence Facility (R529A). (This facility accommodates a range of functions related to the storage, maintenance and disposal of explosives and missiles.) If this limit were to be retained, it would place some restrictions on circling approaches to a future airport at Badgerys Creek. In the longer term, as airport traffic increased, it might become necessary to relocate some of the functions presently carried out at Kingswood so that this restriction could be removed. In addition, there is a 4,000 ft restricted area (R529B) around a portion of the Kingswood facility which is only activated at certain times when explosives may be detonated. With increased traffic, the times for such detonations would need to be co-ordinated with aircraft movements. However, it may be that, by the time a future airport were operating, the increase in residential and industrial development throughout the area would have rendered some or all of the activities at Kingswood and Fleurs unsuitable in their present locations. The future airport would therefore be only one of a number of pressures, any or all of which may cause the relocation of such facilities which had been originally located in this area because of its sparse population.

General aviation

The control zone for a future airport at Badgerys Creek would remove almost all of the present designated flying training areas, and Hoxton Park aerodrome would probably have to be closed. Bankstown and Camden could continue to operate on the edges of the control zones for Kingsford-Smith Airport and a future airport at Badgerys Creek, although it would not be possible for these aerodromes to have adjacent training areas. While uncontrolled airspace for training could be made available if the airspace restrictions at Richmond and Holsworthy were reduced, it is undesirable to locate training areas any great distance from an aerodrome.

The training area (D502) to the south-west of Camden could remain open, but its upper limit would be reduced to 2,000 ft under the control area step for a future airport at Badgerys Creek. This would limit the effectiveness of this training area because of the height of the surrounding terrain. While it would be possible to extend this area over Douglas Park where a 4,000 ft upper limit would be available, weather conditions may be less favourable there for visual flight rules training operations. Such a rearrangement of the training area to the south would result in a smaller training area than at present and it would be less accessible from Bankstown. Use of airspace to the north of Sydney over the Hawkesbury River below Wisemans Ferry is considered impracticable for training purposes because of the terrain and the other traffic currently operating in that area.

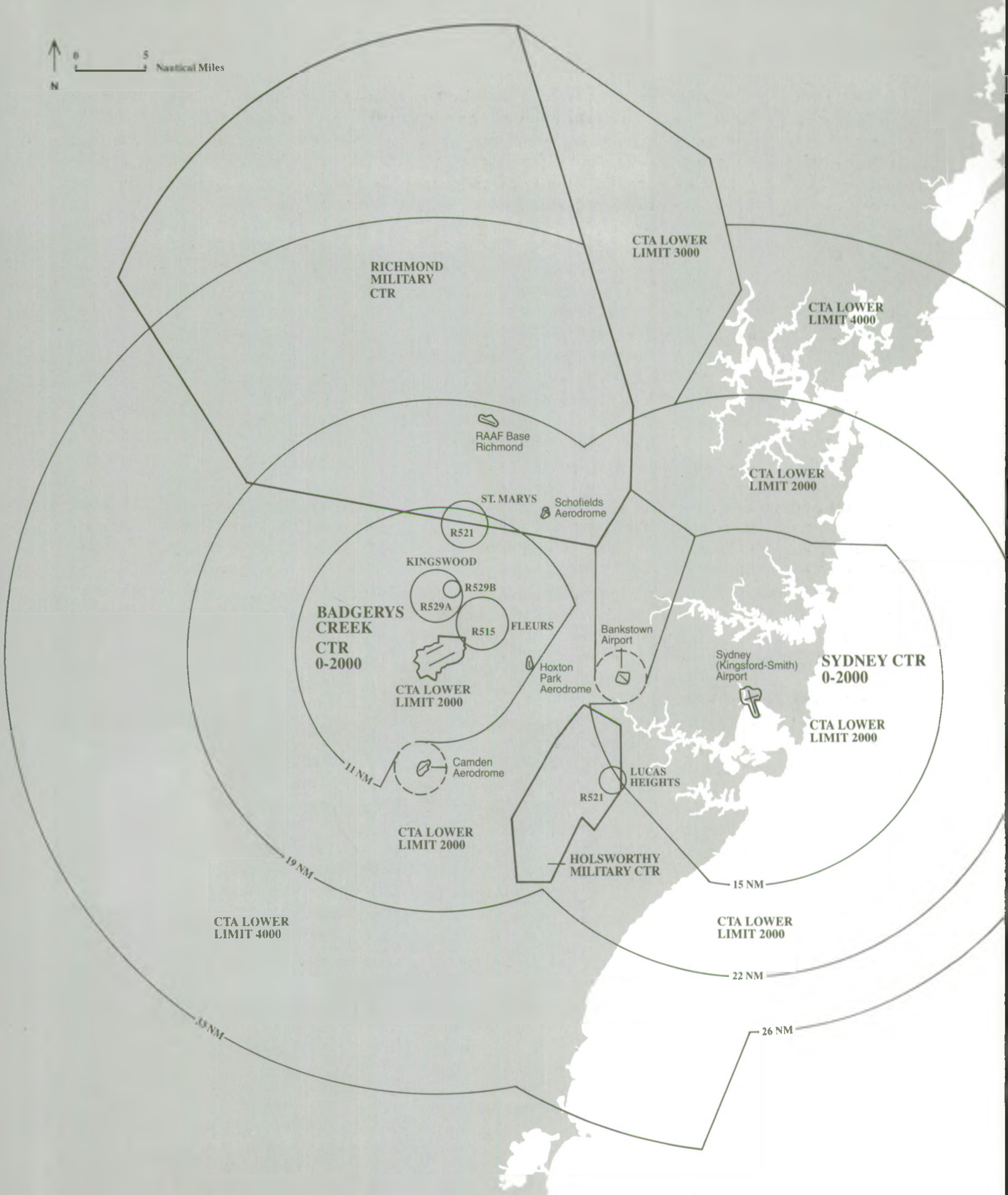


Figure 8.5
POSSIBLE AIR SPACE ARRANGEMENTS FOR COMBINED CTA — KSA AND BADGERYS CREEK
(Preliminary sketch only)

If airspace within the Richmond military control zone were made available for general aviation, a proportion of this airspace could be used for flying training. While this area is a similar distance from Schofields and Bankstown as it is from the Lower Hawkesbury area, the terrain is lower and more suitable for flying operations.

Under the airspace arrangements shown in Figure 8.5, access to Bankstown from the west by aircraft operating outside controlled airspace would be denied because of the control zones for Richmond and for the future airport at Badgerys Creek, and the restricted airspace (R512) associated with the munitions factory at St Marys.

Also under these arrangements, the current gliding activities at Camden would need to be restricted or possibly eliminated. The 2,000 ft control zone step overlying Camden and D502 to the west would prevent soaring above that level, effectively limiting gliding activities to the circuit area at Camden. The terrain to the south-west beneath the 4,000 ft step would also make that area unsuitable for gliding. In addition, the parachuting activities currently conducted from Bringelly would be incompatible with a high activity level at a future airport at Badgerys Creek. Depending on the amount and type of traffic using a second Sydney airport, it may be possible for parachuting to continue at another location within the second Sydney airport control zone for some time after the airport was built, but when airport traffic began to approach capacity these activities would need to be relocated.

Kingsford-Smith Airport

If aircraft travelling to and from the Sydney Region used common routes to within a short distance of the two major airports, the spacing of traffic associated with Kingsford-Smith Airport would need to be greater than it is at present to ensure safe. Therefore, in order to take full advantage of the potential capacity of both Kingsford-Smith Airport and a second Sydney airport, independent routes to each airport would be necessary. The airspace needed to accommodate new routes to a future airport at Badgerys Creek may be different to that shown in Figure 8.5, and a continual review of airspace allocation would be needed based on the changing requirements of users.

8.7 AIRCRAFT EMERGENCY PROCEDURES

Prior to the commencement of airport operations, a set of Aerodrome Emergency Procedures would be prepared — a normal practice for all major airports. These plans would be developed in consultation with all relevant local, State and Commonwealth authorities, and would detail the co-ordinated responses required in the event of any foreseeable type of emergency involving the airport. Key personnel would be familiarized with the actions required of them, and emergency drills would be practised. The procedures would be designed to minimize the harmful effects of any emergency or accident on people and property, and would for example specifically take into account the protection of community services such as water supply.

CHAPTER 9

The Socio-Economic Environment and Effects of the Proposal

Introduction

This chapter describes the socio-economic environment and the likely effects of the proposal. Each of its principal sections describes the existing environment, the likely effects of acquisition of an airport site and of its construction and operation, and outlines proposals for implementation of environmental safeguards and monitoring programmes.

The principal social effects of the proposal arise from site acquisition and from future noise impacts. These are the subject of the first two sections. Sections 9.3 and 9.4 then review the archaeological resources of the site and the concerns of Aboriginal people in the area. This is followed by a discussion of the European heritage resources of the site (Section 9.5). Sections 9.6 and 9.7 describe the economic and employment effects of the proposal and its impact on existing agricultural activities. Chapter 9 concludes with an assessment of the implications of airport development for regional planning (Section 9.8).

9.1 LAND ACQUISITION

On announcement of the selected site, one of the following two procedures would be implemented:

- If properties within the site were to be acquired by compulsory process:
  - Notices to Treat would be delivered to all land owners within the acquisition area;
  - the boundary of the area to be acquired would be published in the Commonwealth of Australia Gazette and placed on display locally;
  - complementary planning controls would be implemented by the New South Wales Government around the perimeter of the site to be acquired, and for other areas which may be affected by aircraft noise.

- If properties within the site were to be acquired by agreement:
  - all land owners within the acquisition area would be informed of the Commonwealth's desire to enter into negotiations to purchase land;
  - complementary planning controls would be gazetted by the New South Wales Government for the site to be acquired, and for other areas which may be affected by aircraft noise or by access proposals.

The procedures to be followed under either of these possible courses of action are described in the following sections.

9.1.1 The proposed Badgerys Creek airport site

Figure 9.1.1 shows the boundary of the proposed site at Badgerys Creek. The area enclosed by the boundary is approximately 1,770 ha. There are approximately 241 separate titles within the boundary. The number of houses within the boundary is estimated at 207 and the total resident population at 750. Most of the site is zoned Non-urban 'A' (minimum lot size, 40 ha).

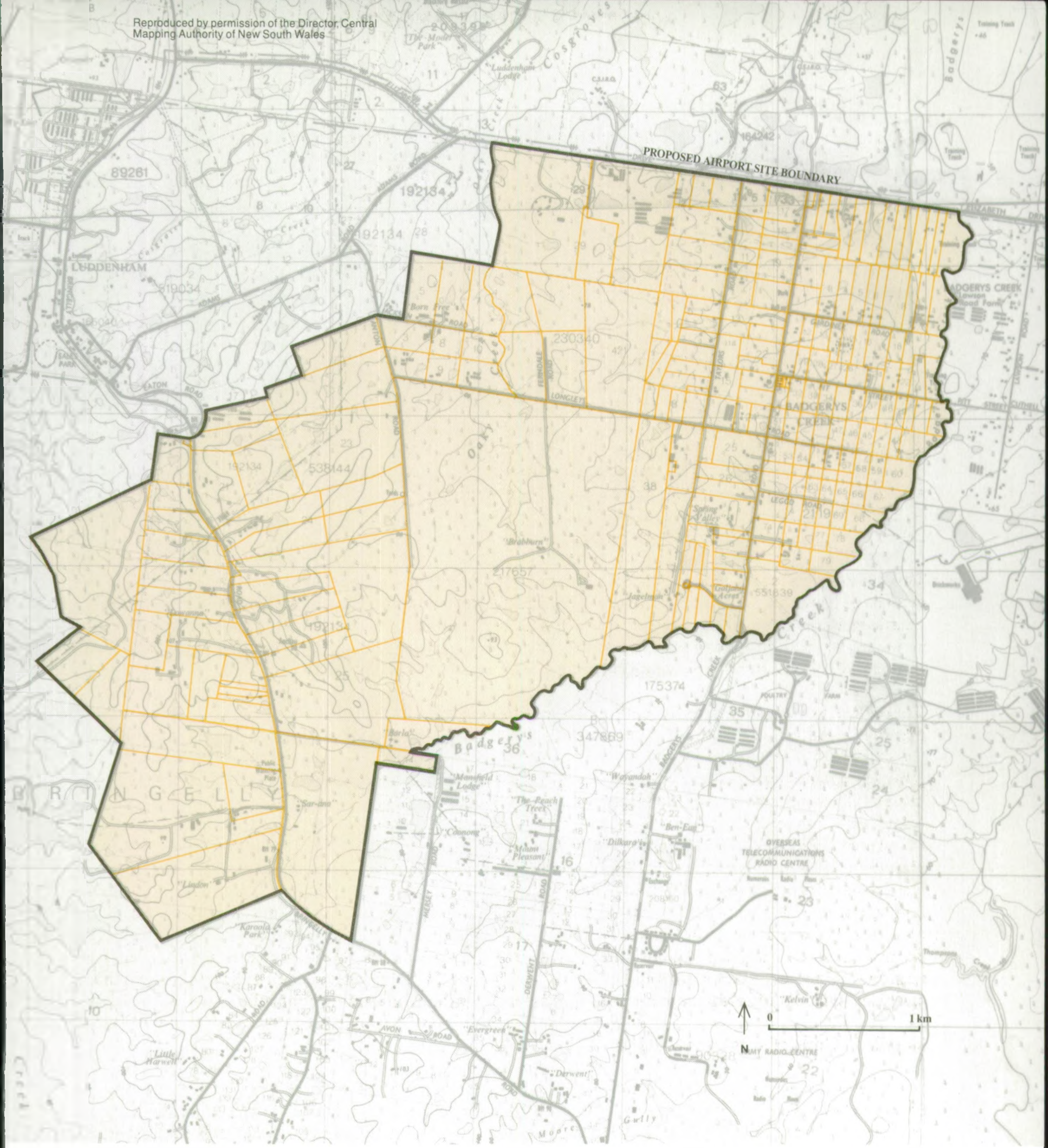
The market valuation of private land and improvements on the proposed Badgerys Creek site is estimated at approximately $31.5 million. However, this figure does not include consideration of special value to individual owners, injurious affection, disturbance, severance, costs arising out of court actions, or any other factors which might be important components of compensation for compulsory acquisition.

There are no proposals at this time to acquire land for road or rail access routes, or for airport related land uses outside the boundary of the site shown in Figure 9.1.1. However, in the longer term if the Badgerys Creek site were selected, comprehensive land use planning measures would be required to direct development in the noise affected areas in order to prohibit inappropriate uses, to identify land for future airport associated uses and to address the relationship of the airport to other issues in the Macarthur Region. It is proposed that the development of a strategic land use plan for the area in the proximity of the selected airport site would be included in the Macarthur Regional Environmental Plan. The Regional Environmental Study for the Macarthur Region is currently being prepared by the NSW Department of Environment and Planning and is scheduled for public exhibition in late 1985. Preparation of the Draft Regional Environmental Plan will commence following the exhibition. The study is examining the regional planning issues associated with the airport site selection and it is proposed that the plan will include appropriate strategic and regional planning controls.

9.1.2 Compulsory acquisition

As a first step in a compulsory land acquisition proposal, the Commonwealth would forward a Notice to Treat to each of the owners of the land and any other party known to have an interest in the land. This does not mean that the land has been compulsorily acquired, but serves as an early notification to property owners that the Commonwealth is interested in acquiring their land. The Notice to Treat invites people to negotiate with the Commonwealth for the sale of their property by agreement. If the Commonwealth cannot reach agreement with an owner for the purchase of the property, the Minister for Local Government and Administrative Services may, after twenty-eight days of the serving of the Notice to Treat, recommend to the Governor-General that the property be acquired by compulsory process.

Once compulsory acquisition is authorized by the Governor-General, a notice is published in the Commonwealth of Australia Gazette giving a full description of the land. Ownership of the property passes to the Commonwealth on the date of gazettal.



Approximate boundaries of existing titles within the proposed site

Area to be acquired by the Commonwealth

Figure 9.1.1
PROPOSED ACQUISITION AREA

The Minister for Local Government and Administrative Services must table before both Houses of Parliament a copy of the notice published in the Gazette. Either House of Parliament may pass a resolution that the acquisition is void and of no effect. If this occurs the land is deemed not to have been acquired by the Commonwealth.

Following gazettal, a formal Notice of Acquisition is sent to each party with an interest in the land, together with:

- a copy of the Notice of Gazettal;

- a diagram showing the total amount of acquired land and, where appropriate, the portions being acquired;

- a form on which to make a claim for compensation.

If a property is acquired by compulsory process, compensation is payable in accordance with the provisions of the Lands Acquisition Act 1955.

Authority responsible for compulsory acquisition

The process of compulsorily acquiring all properties within the designated Badgerys Creek airport site, including all negotiations with property owners (which includes co-owners, mortgagees, lessees, licensees, share farmers, easement holders — anyone with an interest in the land to be acquired), is carried out by the Commonwealth Department of Local Government and Administrative Services.

Parties entitled to compensation

Only people or organizations who own land or have an interest in land which is compulsorily acquired for public purposes have a right to compensation. 'Interest' here means a legal or equitable estate or interest in the land, or a right, power, or privilege over, or in connection with, the land. This generally includes owners, mortgagees and, under certain conditions, lessees, tenants or licensees. A lessee, for example, is usually entitled to reimbursement of removal expenses and may, especially in the case of a long-term lease, be entitled to substantial compensation for the acquisition of his or her interest in the land.

People from whom no land is acquired are not entitled to compensation, notwithstanding the fact that they may be affected by the public works carried out on the acquired land. People from whom some land is taken are entitled to claim compensation for the effect on their retained land. As the law now stands, people cannot be compensated for 'injurious affection' such as increased noise, pollution, loss of privacy, or increased traffic flows, unless part of their land is taken.

In assessing compensation for the acquisition, regard shall be had to any variation in the value of the retained land because of the taking of the acquired land. If the major portion, say including buildings, is acquired and the residue is of little use or value to the owner, the acquiring authority would probably consider acquiring the whole property.

Compensation payable

Under the Constitution, the Commonwealth Parliament is empowered to make laws for the 'acquisition of property on just terms'. The Lands Acquisition Act 1955 meets this requirement by providing that, in the event of a dispute on the amount of compensation payable, a court may determine compensation or make such order as is necessary to ensure that acquisition is made on just terms.

Generally stated, the main principle of compensation is that the dispossessed owner is compensated to the full money equivalent of what he or she has been deprived of, plus reasonable relocation and disturbance expenses. In the case of a commercial enterprise, this would include the market value of the property and such things as the provision of telephone, electricity supply, and other specialist services. Generally these can be determined fairly readily. In the case of an individual deprived of his principal and primary place of residence, compensation would include the market value of the property and such things as removal expenses and the residual value of floor coverings, blinds and light fittings, which cannot readily be transferred from dwelling to dwelling.

No compensation is payable, however, for such unquantifiable effects as loss of attachment, removal from a sympathetic socio-economic community or possible adverse effect on the education progress of school-going children, all of which involve a considerable element of subjective assessment.

The value of the property is determined as at the date of gazettal, i.e. the date at which the acquisition of the property is published in the Commonwealth of Australia Gazette which legally vests it in the Commonwealth. The market value of a property estimated by the Commonwealth valuers is based on evidence from sales of similar properties in a free market at the date of gazettal.

Compensation process

When copies of the Gazette are received from the Government Printer, the Department of Local Government and Administrative Services sends a copy to each party with an interest in the land, together with a Notice of Acquisition, a diagram or plan of the total land taken (where appropriate), and a compensation claim form. The Notice informs the former owner that the land has been acquired, and that he or she is consequently entitled to compensation, which must be claimed in accordance with the claim form, specifying the amount. The Department of Local Government and Administrative Services requests the Valuation Branch of the Australian Taxation Office to provide an assessment of the compensation in accordance with the principles set out in Section 23 of the Lands Acquisition Act 1955, taking into account any particular matters raised by the former owner in the claim. Negotiations over the amount of compensation are then commenced. Usually the negotiations are conducted in consultation with the valuers advising each party, and generally they result in an agreement, which must be confirmed by the Minister or his delegate. The Act provides for payment of statutory interest on the agreed compensation from the date of gazettal to the date of settlement. If agreement on compensation is reached between the Commonwealth and the property owner, the Director of Legal Services is instructed to attend to the final legal formalities and is provided with funds to effect payment of compensation.

If agreement has not been reached on the amount, further negotiations may take place, and both parties may obtain further valuations by qualified valuers if necessary. There are two courses of action open on the amount of compensation payable if final agreement cannot be reached:

- Either the property owner or the Commonwealth institutes proceedings for a court to determine the amount of compensation payable; this is the usual course of action. The courts also have the power to determine which of the parties involved in the court action is required to meet the costs of that action.

- The owner and the Commonwealth agree to submit the matter to arbitration, usually by a mutually agreed professional valuer.

Once all the compensation claims regarding a particular property have been determined, the Director of Legal Services has been satisfied as to title, and all appropriate documents have been executed and delivered, compensation including statutory interest is paid to the former owner. Where an unusual delay in the determination or payment of compensation is expected, an advance of up to 90% of the Commonwealth valuation may be paid to the claimant, provided the Director of Legal Services is satisfied as to title. There is no legal obligation on the Commonwealth to make that advance.

Assessment of compensation

Value of land
Before property value negotiations are initiated, the Department of Local Government and Administrative Services will request the Commonwealth Valuers to undertake property valuations. If no agreement on the value of a property can be reached between the owner and the Commonwealth, the property owner is usually advised to obtain a private valuation of the property from a registered valuer for use in the court or arbitration action. Reasonable valuation fees incurred by the property owner will be repaid by the Commonwealth as a compensatable item.

Legal fees
The Commonwealth also meets the cost of reasonable legal fees incurred by a property owner for legal advice and representation during negotiations.

Allowable expenses
The Commonwealth is required to compensate property owners for certain other costs incurred as a consequence of the acquisition process. These are:

- costs for title transfer documents and any other legal documentation;
- furniture removal costs;
- telephone reconnection charges;
- mail redirection costs;
- the cost of new school uniforms;
- incidental costs in buying a replacement property of the same standard, including the legal costs of conveyancing, survey fees, real estate agents' fees, and costs in connection with the transfer of any outstanding mortgage from the acquired property to the new property or with the raising of a new mortgage for a similar amount;
- the loss on a forced sale of stock and equipment;
- costs of notifying change of address to suppliers and customers;
- any other reasonable expenses and losses directly attributed to the acquisition as agreed by the Commonwealth.

Expenses not allowable
Certain expenses which may be associated with the acquisition process do not qualify as allowable expenses available to affected property owners. For example:

- If the price paid by a landowner for a replacement property is higher than the market price of the acquired property, no compensation will be paid to cover the price difference.
- Similarly, if legal or other costs associated with the purchase of a more expensive property are higher than those for a property of equivalent price to the previous holding, no compensation is available to cover the price difference.
- Nor is compensation allowable for:
  - increased rates and rent for a new property;
  - increased travelling costs;

- new furnishings, fittings and appliances over and above the existing valuation figure;

- losses incurred due to selling stock without taking prudent steps to obtain proper prices.

9.1.3 Acquisition by agreement

Under this alternative where acquisition of properties is effected by agreement, Notices to Treat may not be issued to land owners at the time of the announcement of the selected site; however, the site boundary would be appropriately publicized, complementary planning controls around the perimeter of the site to be acquired would be gazetted by the New South Wales Government, and land owners within the site boundary would be informed that the Commonwealth wished to enter into negotiations to acquire properties. The properties would then be progressively acquired by agreement between the owners and the Commonwealth.

It could be expected that a number of land owners may wish to enter immediately into negotiations with the Commonwealth leading to acquisition of their property, and to vacate their land on settlement. However, other owners may choose to continue living on their former properties after acquisition under negotiated arrangements until airport construction commences.

Other landowners may choose not to sell their properties immediately to the Commonwealth. Their land would therefore remain in private ownership until it was sold to the Commonwealth or compulsorily acquired. However, the Commonwealth would request the State Government to consider the implementation of land use controls over this private land to enable the site to be protected in accordance with Commonwealth requirements.

The Commonwealth's offer to purchase properties would remain open, and property owners would be at liberty to approach the Commonwealth to negotiate a sale at any time. Once a decision had been made to develop the site for airport purposes, the owners of remaining unacquired land would be issued with a Notice to Treat, and compulsory acquisition formalities would be initiated.

9.1.4 The effects of land acquisition

Three categories of effects are discussed:

- those social effects which might arise from the process of land acquisition and which cannot be ameliorated by monetary compensation;

- effects due to severance;

- 'planning blight'

Social effects

The period between the announcement on 18 September 1984 of Badgerys Creek as a short-listed site and the announcement of a selected site in 1985 may be one of extreme uncertainty for Badgerys Creek landholders. This concern will be related to the need for and timing of land acquisition, the basis for compensation, and issues associated with the subsequent relocation of the Badgerys Creek residents — how long people would have on their properties, and where they would move to. It is inevitable that worry about the future, and sadness about leaving established homes and properties will be experienced by these people, and the significance of this concern is unlikely to be diminished by assurances that fair and timely processes will be used by the Commonwealth.

In the event that the Badgerys Creek site were selected for acquisition for the second Sydney airport, the social effects, both beneficial and adverse, of relocation would be experienced sequentially over a period of years. Initial effects could include the worry about where to relocate to and the effort required to find a replacement or suitable property (for example, travelling to inspect property and checking on schools and other necessary community facilities).

Relocation could also result in changes to family and friendship patterns; this would be particularly pronounced if people were to relocate some distance away from where most of their family and friends lived. Not only might this factor be upsetting in itself, but people relocating might find difficulties in establishing new friendships and in replacing the support system that family and friends in close proximity offer for child-minding, and for help during family illnesses or crises and, on farms, with seasonal tasks when extra labour is needed.

Most of the land owners involved in the relocation process might state that they were relocating reluctantly, and expected to have difficulty in exactly replacing their Badgerys Creek properties and the amenities that this location offered. However, it is possible that some families would find the experience a challenge and, in retrospect, might consider the move to have been beneficial in social, economic, employment or other terms.

The social effects that Badgerys Creek residents could experience could also be related to their age, health and other personal factors that might influence their relocation decision and their ability to adapt to a new location, especially if this were some distance from their previous home. Their family and friends, if now living in the region, might also experience loss if Badgerys Creek residents moved out of the area.

Severance

The site boundary at Badgerys Creek has been drawn to minimize severance of properties. (Severance of property occurs when it is necessary to locate a site boundary line through a property rather than around the property boundary, thus cutting the property into two sections. An alternative form of property severance would be the establishment of an easement or reserve through a property, such as pipeline easements or road reserves.)

Property owners have the right to claim compensation from the Commonwealth for severance of land in accordance with provisions outlined in Section 23 of the Lands Acquisition Act 1955. Property owners whose land is affected by such severance are entitled to several forms of compensation, including payment for any extra fencing which may have to be erected, reimbursement for land value depreciation, and compensation for damage (if any) to property or fixtures.

Agreement on the amount of compensation is usually achieved through negotiation between the property owner and the Commonwealth. The Commonwealth official responsible for the negotiation of compensation matters is the Chief Property Officer attached to the New South Wales office of the Department of Local Government and Administrative Services.

If agreement cannot be reached on the amount of compensation payable for severance, the same two courses of action open to property owners claiming compensation for acquisition are available — either court proceedings or arbitration.

Although the Commonwealth is not obliged to purchase the balance of a property affected by severance, the Chief Property Officer may, under certain circumstances, recommend that the land not required be purchased as part of the negotiated property sale.

Planning blight

Planning blight may be defined as the condition that occurs when the value of a particular property is affected by a rezoning proposal associated with a major regional development. A property owner usually finds it impossible to sell the land at normal market value and is usually unable to compel the Government to purchase the land until a final decision has been made to proceed with the proposed development. Planning blight might also arise if land, once acquired, were neglected in the period between acquisition and commencement of construction. However, under present Commonwealth legislation no compensation is available to property owners affected by planning blight.

9.1.5 Safeguards and monitoring

The Department of Aviation is limited in the ways in which it can ameliorate the adverse social effects of uncertainty and loss arising from the process of land acquisition. However, there are two areas where uncertainty can be minimized: the timing of announcement of the selected site and the maintenance of communication with residents.

The Department of Aviation has maintained a very tight timetable for preparation and exhibition of the Draft Environmental Impact Statement consistent with the requirements for broad public and governmental consultation. To the extent possible, the Department will endeavour to complete all of its remaining technical obligations in the environmental assessment process in a timely manner.

The public consultation procedures adopted during production of the Draft Environmental Impact Statement (Chapter 18), including regional displays and the information 'hot line', will be maintained throughout the environmental impact assessment process up to the time of announcement of a selected site.

Provision for lease-back following acquisition

In the interim period between acquisition of the selected site and commencement of construction of an airport, the Commonwealth would ensure that the land acquired was managed in a responsible manner, and without adverse effect on surrounding land. The most effective way of achieving this objective is to retain the land in productive use. Two options are available to the Commonwealth, through the Department of Local Government and Administrative Services:

- to lease back the properties to the original owners;
- to lease the properties through the invitation of public tenders.

The Commonwealth's preferred course of action would be to lease land back to original owners, at fair market rental, in all instances where the original owner requested continued occupation of the property pending construction of the airport. Where a lease-back arrangement was not required, the property would be revenue-leased through the invitation of public tenders based on fair market rents. The term of each lease would have regard to the construction stages and timetables for the airport development, none of which is known at this time.

The Commonwealth would consider tenancy agreements on their merits. This would involve detailed inspections and valuations as well as the drawing up of lease documents. A periodic review and inspection of properties may be required to ensure that the properties are being managed and maintained to the standards required by the Commonwealth. The terms and conditions of the leases would prohibit redevelopment or extension of buildings on the leased land unless agreed to by the Commonwealth. Ultimately, such investments would have to be surrendered to the Commonwealth, without compensation, at the expiry of the lease term.

Environmental management programme

The Commonwealth, in co-operation with the New South Wales Government, would prepare a comprehensive environmental management programme for the acquired area for the period of time between acquisition and construction. The plan would deal with such issues as:

- mechanisms for consultation with site residents, the local community, special interest groups, and local and State government;
- maintenance of tenanted properties;
- control of noxious weeds and vermin;
- conservation of any flora, fauna or structures incorporated into the airport master plan;
- approval of alterations and additions to existing buildings or structures;
- responsibility for roads and drainage within the site;
- environmental controls and procedures for any pre-construction activity (for example, test drilling).

9.2 NOISE

Noise from aircraft is consistently identified as the most significant adverse environmental effect of existing airport operations. Social surveys undertaken for the Second Sydney Airport Site Selection Programme also identify noise as the major perceived disadvantage of a second Sydney airport. For these reasons, the examination of noise effects in this section relate almost entirely to possible future noise effects from aircraft operations under a set of worst case assumptions.

The basis of the worst case assumptions was a level of aircraft operations of 275,000 movements per year. While this level is appropriate for assessing the maximum possible environmental effects, it is nevertheless a level that is unlikely to be reached for many years, if ever.

For a given level and pattern of aircraft operations, the noise effects will depend on the position and orientation of the runways. An objective during the preparation of the preliminary master plan (Section 8.4) was to minimize the impact of aircraft noise on residential areas. To evaluate the success of the preliminary master plan in meeting this objective, the potential noise effects under the proposed north-east/south-west runway alignment were compared with those under an alternative north/south alignment originally shown in the Minister for Aviation's press release of 18 September 1984 announcing the short-listing of Badgerys Creek and Wilton.

9.2.1 Relevant government guidelines

In Australia there have been three major government investigations concerned with the effects of aircraft noise:

- the 1970 report of the Parliamentary Select Committee on Aircraft Noise which inquired into the effects of aircraft noise on people, properties, institutions and communities;

- a major socio-acoustic investigation of the impact of aircraft noise on residential communities undertaken by the National Acoustic Laboratories of the Commonwealth Department of Health (National Acoustic Laboratories 1982);

- the investigation by the House of Representatives Standing Committee on Environment and Conservation into the effects of aircraft operations on the environment surrounding airports, begun in 1982.

As far as practicable, the method of assessment of potential noise effects from airport development at Badgerys Creek is based on findings of the National Acoustic Laboratories study and subsequent official guidelines. These cover three fundamental aspects of the assessment of aircraft noise effects:

- methods of measuring aircraft noise exposure
- criteria for determining land use compatibility with different noise exposure levels
- reference data on subjective reaction to aircraft noise exposure levels.

However, the Terms of Reference of the House of Representatives Standing Committee covered several important matters outside the established guidelines and scope of the National Acoustic Laboratories study, including:

- the extent of the impact of aircraft noise on:

  - the health and welfare of people, institutions and communities
  - property and property values adjacent to major metropolitan airports;

- the effectiveness of administrative procedures and regulations (including curfews) designed to lessen noise, and the monitoring of such procedures and regulations;

- the extent to which aircraft noise should be taken into account in establishing priorities and programmes for the development of existing airports and the building of new airports within and adjacent to major urban areas;

- compensation schemes for aircraft noise operating in the United Kingdom and other countries and the effect of those schemes on airport planning and development;

- the constitutional powers of the Commonwealth, State and local governments to legislate for the adequate control of aircraft noise and ways of in these powers could be used for that purpose.

The Committee received over 3,000 pages of evidence and 600 submissions and technical documents. However, the Committee reported (13 September 1984) that it was unable to complete its inquiry within the term of the Parliament. Because membership of standing committees changes following an election, the Committee recommended that a Select Committee, with similar terms of reference to the former Committee, should be established by the new Parliament to carry on the work, and a Select Committee has recently been established. Thus, in this Draft Environmental Impact Statement, the assessment of noise effects and possible ameliorative measures is made within the context of uncertainties as to future government policies, guidelines and regulations, as well as the uncertainties surrounding the timing, scale and nature of future aircraft operations.

9.2.2 Methods of measuring aircraft noise exposure

Various measures of cumulative noise exposure have been developed internationally. The Noise Exposure Forecast (NEF) system, developed by the United States Federal Aviation Administration, was recommended by the 1968 Parliamentary Select Committee on Aircraft Noise for use in Australia as a guide to aircraft noise exposure, and was subsequently adopted. The NEF system involves construction of contours that link together points of equal cumulative noise exposure. The contours are generated from the following input data: airport flight patterns, number of daily aircraft operations by type of aircraft and time of day or night, noise characteristics of each aircraft during take-off and landing, and typical runway utilization patterns. The contours usually plotted were for 40, 35, 30, and 25 NEF units, the severity of noise effect increasing with the NEF value. These four contours, when overlaid on a map of land uses, defined those areas potentially subject to aircraft noise exposure levels that would be incompatible with existing land uses.

The appropriateness of the NEF system was generally confirmed by the study undertaken by the National Acoustic Laboratories, which compared various measures of noise exposure. However, this study identified the following ways in which the NEF index could be improved:

- The penalty applied to 'night' flights (between the hours of 10.00 p.m. and 7.00 a.m.) should be reduced. Under the NEF system, one flight during these hours is considered to be equivalent to about seventeen flights at other times; however, among the Australian populations studied, one night flight appears to be equivalent to about two 'day' flights in its effects.

- A penalty should be introduced for aircraft flying in the 'evening' (between the hours of 7.00 p.m. and 10.00 p.m.). One flight in these hours appears to be equivalent in its effect on residents to about four 'day' flights.

- Noise from aircraft that are at the airport itself rather than flying overhead should not be included in the calculation of the NEF.

With the publication of the National Acoustic Laboratories report in 1982, the Department of Aviation amended the method of calculating NEF contours for Australian airports to take account of that report's findings (Appendix C). The resultant index has been named the Australian Noise Exposure Forecast (ANEF) to distinguish it from the NEF index.

The ANEF computation is based on forecasts of air traffic movements on an average day. If the 20 ANEF contour were calculated day by day, its position would vary considerably according to traffic patterns, although this variation would be less in the case of the higher contours. Noise exposure on a particular day will also be affected by temperature, wind, humidity and meteorological conditions. Temperature differences from point to point and wind velocity can affect the speed at which sound travels by bending it from its normal straight line path.

If sound is propagated in a medium containing a temperature gradient, the sound waves are deflected towards the lower temperature region. Temperature generally decreases with elevation and therefore sound waves tend to bend upward. Since the ground retains heat in the daytime, the sound wave attenuation is greater than at night; when the earth cools at night, sound travels along the ground more readily.

Temperature inversions, which are quite common at Badgerys Creek (Section 10.3), can sometimes trap sound waves between the earth and the inversion layer, resulting in a 'sporadic bounce' effect. If the inversion layer is low, alternate sound shadow zones and intensification zones can be created, with the result that people farther from an airport may hear an aircraft more easily than others closer to it. Similarly, once aircraft descend below the inversion layer, the sound energy radiated upward will be partially reflected towards earth, producing a reinforced ground impact. Cloud layers have an effect similar to that of an inversion layer.

Humidity affects the absorptive quality of air, its effect increasing with the increasing frequency of the sound waves.

9.2.3 Land use compatibility

In the light of the National Acoustic Laboratories report, the Department of Aviation prepared land use compatibility advice for use by state and local governments when planning land uses for areas near airports. This advice (Appendix C) is summarized in Table 9.2.1.

The advice supports the use of the 25 ANEF contour as the appropriate criterion for limiting residential land use in the vicinity of airports, while recognizing that, as shown in the National Acoustic Laboratories report, some people with a higher sensitivity to noise may find noise exposure at the 20 ANEF level still unacceptable.

As it would not be feasible to apply the recommendations in Table 9.2.1 to land uses around existing airports where residential development has been established for some time, the principal applications for the criteria are in determining the appropriateness of new urban development around existing airports and guiding planning for suitable land uses around new airports.

Table 9.2.1 Land use compatibility advice by the Department of Aviation for areas in the vicinity of Australian airports

Land use	ANEF range			
	Below 20	20-25	25-30	Above 30
Residential	Yes	Yes (Note 1)	No	No
Hotels, motels, offices, public buildings	Yes	Yes	(Note 2)	No
Schools, churches	Yes	No	No	No
Hospitals, theatres	Yes	Yes (Note 2)	No	No
Commercial, industrial	Yes	Yes	Yes	(Note 2)
Outdoor recreational (non-spectator)	Yes	Yes	Yes	Yes

Notes:

(1) Some people may find the areas within the 20 to 25 ANEF contours to be unsuitable for residential use, and land use authorities may consider it appropriate to incorporate noise control features in the construction of residences in such zones.

(2) An analysis of building noise reduction requirements should be made by an acoustic consultant for such land uses within these ANEF contours and any necessary noise control features included in building design.

(3) The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variations in aircraft flight paths.

Source: Department of Aviation (see Appendix C).

The table may be used for the broad-scale evaluation of the effects of a new airport on noise sensitive land uses in conjunction with the National Acoustic Laboratories findings with respect to people's reaction to aircraft noise.

For non-residential land uses the table is used here as a source of recognized criteria for identifying schools, churches and other land uses that would be incompatible with the assumed level and pattern of aircraft operations.

9.2.4 Subjective reaction to aircraft noise

In a residential area subject to aircraft noise, the number of residents affected will depend on:

- the population density

- the ANEF level (e.g. if the ANEF level is 30 instead of 25, more people will be severely affected).

The National Acoustic Laboratories report contains research findings which allow an estimate to be made of the number of people exposed to noise levels over 20 ANEF who will be moderately or severely affected by noise. For that study, personal interviews were conducted with 3,575 residents around the commercial airports in Sydney, Adelaide, Perth and Melbourne, and the RAAF Richmond Base.

From the responses to the questionnaire, it was concluded that subjective reaction to aircraft noise could best be measured in terms of a 'general reaction' (GR) rating, which was a composite of a number of ratings of dissatisfaction, annoyance and fear as well as reports of activity disturbance and complaint disposition. GR is a single score with an 0-10 range which provides an accurate and reliable measure of an individual's overall subjective reaction to aircraft noise.

Figure 9.2.1 illustrates the points on the GR scale at which more than 50% of the respondents to the National Acoustic Laboratories survey reported a variety of negative opinions and behaviours related to aircraft noise reaction. The study report proposed that a score of 4GR or more be taken as indicating that a respondent was 'moderately affected' while a score of 8GR or more be taken as indicating that a respondent was 'seriously affected'.

This study also correlated GR scores with the locations of respondents within the 15, 20, 25, 30, 35 and 40 ANEF contours at each of the airport locations where surveys were conducted. The percentages of respondents who were seriously affected and moderately affected in relation to the noise to which they were exposed (in ANEF units) is shown in Figure 9.2.2.

In areas with a noise exposure level of 20 ANEF, almost half the residential population were at least moderately affected and 12% of residents were seriously affected by aircraft noise. On this basis, the National Acoustic Laboratories report judged that to describe 20 NEF as an 'excessive' amount of aircraft noise would be to offer a reasonable interpretation of the scientific relationship between aircraft noise and subjective response.

The relationships shown in Figure 9.2.2 have been used to estimate the number of existing and potential future residents of areas likely to be exposed to ANEF levels of 20 or more under the worst case assumptions who would be seriously or moderately affected by aircraft noise.

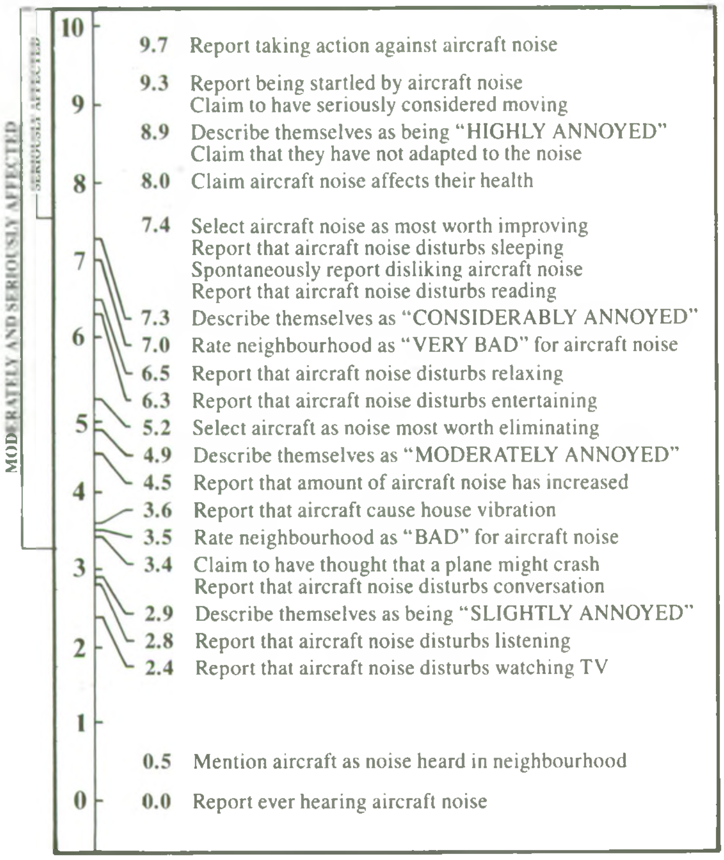


Figure 9.2.1
POINTS ON THE GR SCALE AT WHICH 50% OF RESPONDENTS TO NAL SURVEY QUESTIONS REPORTED VARIOUS REACTIONS

Source: Adapted from National Acoustic Laboratories, 1982

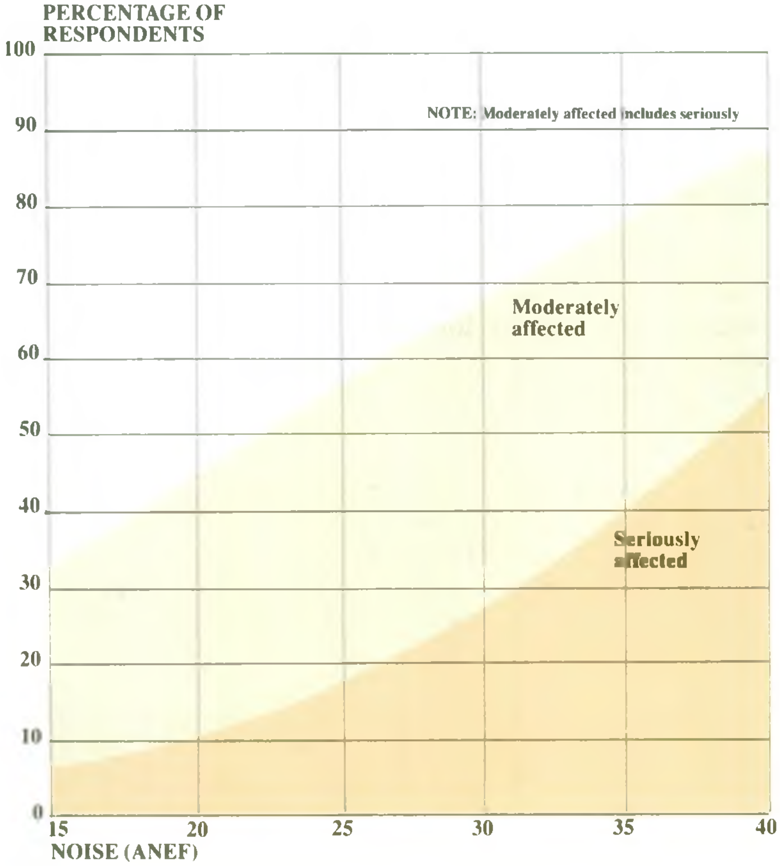


Figure 9.2.2
RELATIONSHIP BETWEEN NOISE EXPOSURE FORECAST LEVEL AND COMMUNITY REACTION IN RESIDENTIAL AREAS

Source: Draft Australian Standard Acoustics:
Aircraft Noise Intrusion Building Siting and Construction
(Revision 8 AS 2021 – 1977) adapted from NAL reports

9.2.5 Method of assessing effects

A worst case for the purposes of calculating ANEF contours for a second Sydney airport was defined as follows:

- the airfield was assumed to operate at a maximum capacity of 275,000 annual aircraft movements, with these movements divided into the following aircraft types:
  - B747 type: 37,500 movements
  - A300 type: 87,500 movements
  - F27 type: 60,000 movements
  - General aviation: 90,000 movements (60% single engine piston, 30% multi-engine piston, 10% business jet);
- evening operations (7 p.m. to 10 p.m.) were assumed to comprise 15% of the general aviation and F27 movements and 20% of the A300 and B747 movements;
- night operations (10 p.m. to 7 a.m.) were assumed to comprise 5% of the general aviation and F27 movements, and 10% of the A300 and B747 movements;
- flight paths for aircraft movements were assigned as shown in Table 9.2.2 and Figure 9.2.3.

The resulting ANEF contours were then used to estimate the maximum future numbers of residents likely to be seriously or moderately affected under the worst case assumptions. Estimates were made for both the proposed north-east/south-west and the alternative north/south runway alignments, which involved the following steps:

- superimposition of the ANEF contours on maps of existing land use zoning in the region;
- estimation by reference to maps and aerial photographs of the extent and nature of any existing subdivision less than the prevailing minimum subdivision size;
- estimation of the maximum number of allotments that could result from further subdivision under existing zoning controls (the unlikely prospect of areas within the 20 ANEF contour other than nominated urban release areas being rezoned to permit urban residential development was not considered);
- application of an average household size for the area from the 1981 Census (3.6 persons) to the maximum number of allotments, in order to derive the maximum population that could be expected within each ANEF contour;
- estimation of the population within each ANEF contour likely to be seriously or moderately affected by aircraft noise based on the findings of the National Acoustic Laboratories study;

This analysis was carried out for the north/south and the north-east/south-west runway alignments at Badgerys Creek. The effects of noise on agricultural activities are described in Section 9.7.

9.2.6 Comparison of noise effects of proposed and alternative runway alignments

Figure 9.2.4 shows the 20, 25, 30 and 40 ANEF contours for the proposed (north-east/south-west) and alternative (north/south) runway alignments at Badgerys Creek. In both cases a total area of approximately 6,360+ ha outside the proposed airport boundary could potentially be subject to noise exposure levels in excess of 20 ANEF under the worst case assumptions.

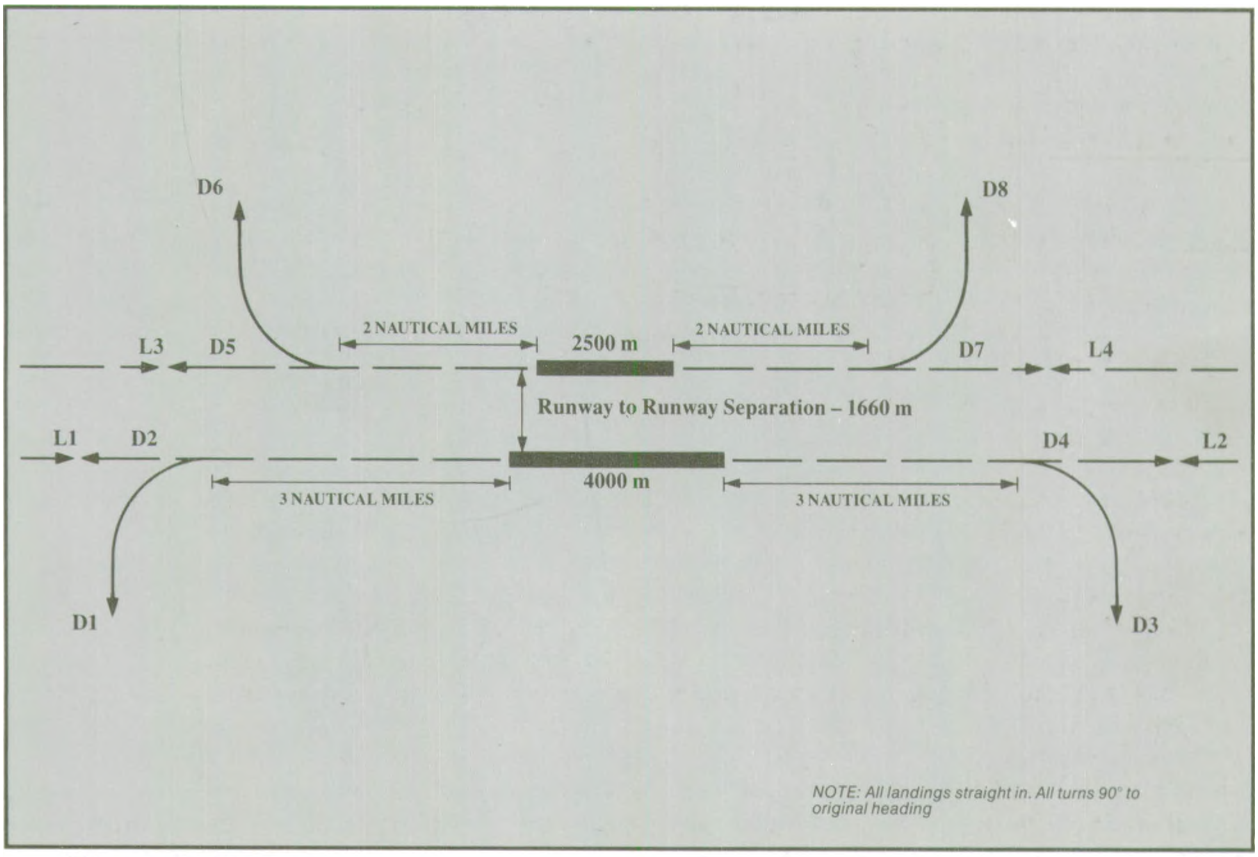


Figure 9.2.3
FLIGHT PATHS

Table 9.2.2 Flight path assignment

Flight path	Percentage operation by class							
	General aviation		F27 type		A300 type		B747 type	
	Day	Ev/night	Day	Ev/Night	Day	Ev/night	Day	Ev/night
L1	8	0	8	0	30	7	35	15
L2	8	0	8	0	30	8	35	15
L3	32	10	32	10	5	7	0	0
L4	32	10	32	10	5	8	0	0
% Total daily landings	80	20	80	20	70	30	70	30
D1	4	0	4	0	7	3	5	4
D2	4	0	4	0	20	6	30	4
D3	4	0	4	0	7	3	5	4
D4	4	0	4	0	20	6	30	4
D5	20	5	20	5	4	3	0	4
D6	12	5	12	5	4	3	0	3
D7	20	5	20	5	4	3	0	4
D8	12	5	12	5	4	3	0	3
% Total daily departures	80	20	80	20	70	30	70	30

Proposed alignment (north-east/south-west)

Noise-affected land
Table 9.2.3 gives a breakdown, by zoning category and ANEF level, of the area outside the airport but within the 20 ANEF contour. Present zoning controls already limit the possible future extent of land uses incompatible with the worst case level of airport operations. Land zoned with a minimum permitted subdivision size of 40 ha accounts for 78% of the off-site noise-affected area, while only about 4% of the area is zoned for urban residential use or with a minimum subdivision size of 2 ha. Areas covered by Special Uses (CSIRO) and County Open Space zones together account for 8% of the total noise-affected area.

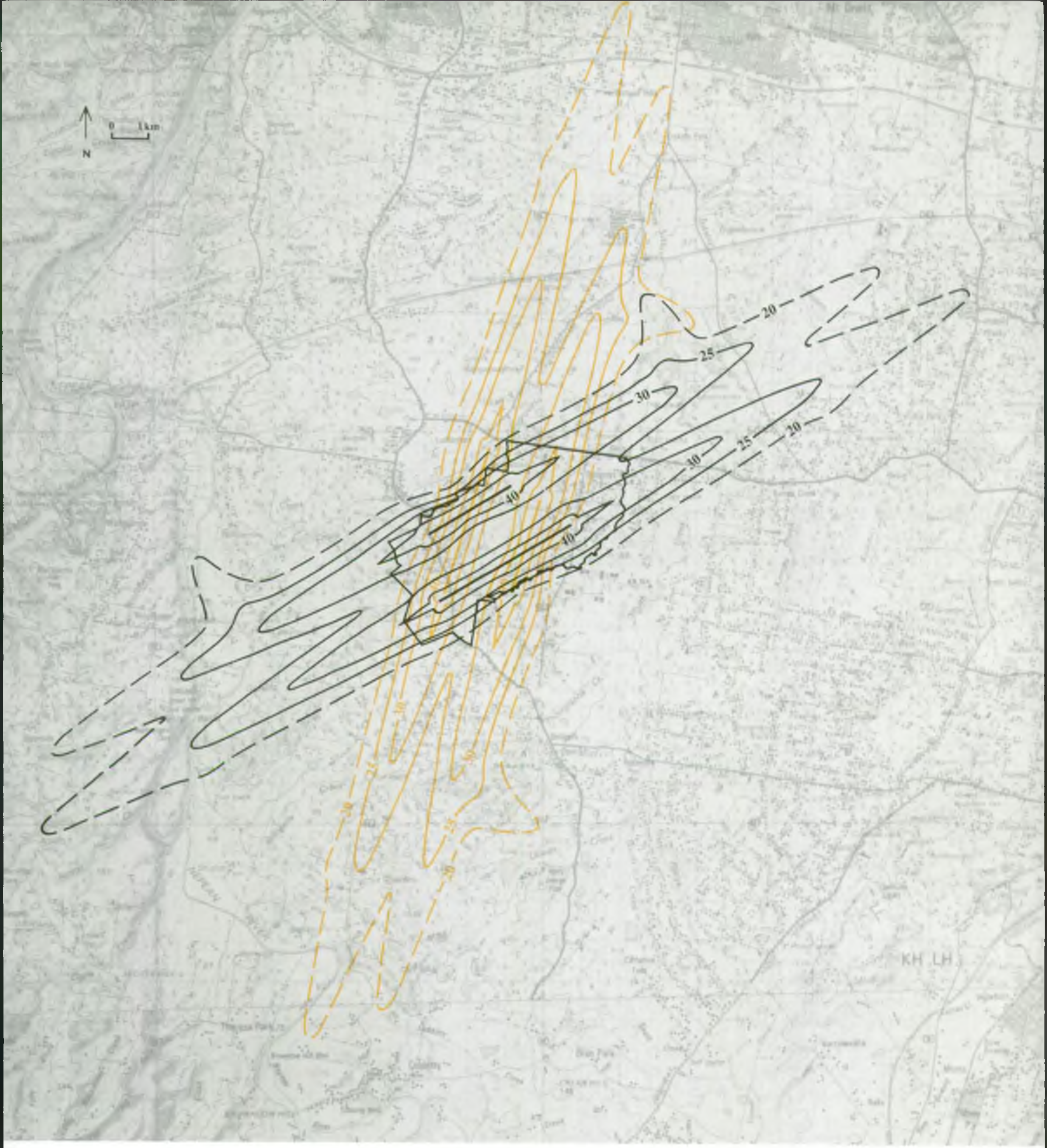
The principal off-site areas within the 30 ANEF contour would be the area east of Badgerys Creek and south of Elizabeth Drive. This area has already been subdivided below the minimum subdivision size of 40 ha permitted under current zoning regulations, and approximately three-quarters of the allotments have houses established on them. At the south-western end of the airport site are two small areas where noise levels may be in excess of the 40 ANEF contour. At present there are no dwellings established within these two small pockets, but allowance has been made for the notional development of one dwelling within this potentially noise-affected area.

About two-thirds of Bents Basin State Recreation Area (zoned County Open Space) lies within the noise-affected area, including 20 ha within the 25-30 ANEF contour. However, not even this 20 ha that would have the highest potential noise exposure could be considered to be a conflicting land use based on the Department of Aviation's land use compatibility advice. One reason why there is a higher acceptable ANEF exposure for recreation areas than for residential areas is that recreation areas are not generally used at night and therefore do not have the night-time noise sensitivity that residential areas have; the ANEF computation includes a weighting for night flights which is not appropriate for assessing daytime recreation areas.

To the north-east of the site boundary, much of the potentially noise-affected area would be in a Special Uses zone occupied by two agricultural research operations: a CSIRO field station and the University of Sydney's McGarvie Smith Farm. The potential effects of aircraft noise on agricultural activities are discussed in Section 9.7. In addition to these effects, teaching activities at the McGarvie Smith Farm would be affected; however, in the case of the CSIRO facilities, reasons other than aircraft noise may make relocation necessary (Section 9.8). East of the Special Uses zone and north of Elizabeth Drive, the 40 ha minimum subdivision zoning prevails until the 20-25 ANEF contour crosses into the City of Fairfield, where the minimum subdivision size is 2 ha. Within the 40 ha minimum area is the Fleurs Radio Observatory and Fleurs Airstrip. However, possible noise effects on these facilities need not be considered here because, at the level of aircraft operation assumed for noise purposes, the facilities would be inoperable for reasons of electronic interference (Section 9.8).

There are no schools, hospitals or other recognized noise-sensitive uses covered by the Department of Aviation's land use compatibility advice (Table 9.2.1) located within the 20 ANEF contour.

Maximum future noise-affected population
Table 9.2.4 provides a summary of the projected number of people who could potentially be affected by aircraft noise under the worst case assumptions for aircraft operations and assuming dwellings are built on all existing or future subdivisions. It is estimated that in the future there could be about 1,950 people living within the 20 ANEF contour. Potentially up to approximately 215 people could live in areas affected by noise levels in excess of 30 ANEF, a level considered incompatible with all forms of residential development. The future population within the 20 ANEF contour potentially seriously or moderately affected by aircraft noise in terms of the National Acoustic Laboratories GR index is shown in Table 9.2.5, and has been calculated from the information given in Table 9.2.4 and Figure 9.2.2.



— 25 — ANEF Contour for proposed runway alignment (north-east/south-west)

— 25 — ANEF contour for alternative runway alignment (north/south)

Figure 9.2.4
ANEF CONTOURS FOR BADGERYS CREEK, PROPOSED AND ALTERNATIVE RUNWAY ALIGNMENTS

Table 9.2.3 North-east/south-west alignment: potential noise-affected areas (ha)*

Zoning category**	ANEF				Total
	20-25	25-30	30-40	40+	
Urban/urban release	7	-	-	-	7
2 ha minimum	259	-	-	-	259
16 ha minimum	408	170	7	-	585
20 ha minimum	-	-	-	-	-
40 ha minimum	2,815	1,455	690	23	4,983
CSIRO	106	34	5	-	145
Defence	-	-	-	-	-
University	6	41	95	-	142
Open space	214	33	-	-	247
Total	3,815	1,733	797	23	6,368

* Within the 20 ANEF contour and outside the airport site boundary.

** The land use zoning categories are derived from information on local planning schemes supplied by the Department of Environment and Planning. The urban/urban release category relates to land included in village zones or shown in the NSW Urban Development Programme (Department of Environment and Planning 1983) as existing urban land or urban development programme release areas. The 2 ha minimum category relates to Rural 'D' (Future Urban) and Non-Urban 1(c) zones having a minimum allowable subdivision size of 2 ha. The 16 ha minimum category relates to a non-urban zone having a minimum subdivision size of 16 ha. The 20 ha minimum category relates to land to which Interim Development Order No. 54 City of Penrith applies, having a minimum subdivision size of 20 ha, while the 40 ha minimum category relates to Non-Urban 'A1', Non-Urban 'D' and Rural 'A1' zones having a minimum allowable subdivision size of 40 ha. The CSIRO, Defence and University categories relate to Special Uses zones reserved for those users; they do not necessarily represent limits of land ownership. The open space category relates to land zoned County Open Space or Open Space — Existing Recreation. The zones in the planning schemes do not necessarily correspond to existing land uses.

Table 9.2.4 North-east/south-west alignment: potential noise-affected population within 20 ANEF contour

Zoning category**	ANEF				Total
	20-25	25-30	30-40	40+	
Urban/urban release	252	-	-	-	252
2 ha minimum	466	-	-	-	466
16 ha minimum	92	38	4	-	134
20 ha minimum	-	-	-	-	-
40 ha minimum	529	342	198	4	1,073
CSIRO	10	3	-	-	13
Defence	-	-	-	-	-
University	-	4	9	-	13
Open space	-	-	-	-	-
Total	1,349	387	211	4	1,951

** See note to Table 9.2.3 for explanation of these zoning categories.

Table 9.2.5 North-east/south-west alignment: number of people potentially noise-affected, by ANEF level and how much affected

Population	ANEF contour				Total
	20-25	25-30	30-40	40+	
Estimated maximum future population	1,349	387	211	4	1,951
No. seriously affected	189	89	84	2	364
No. moderately affected*	702	244	165	4	1,115

* Includes those seriously affected.

Noise effects of alternative alignment (north/south)

Noise-affected land

Table 9.2.6 gives a breakdown, by zoning category and ANEF level, of the total area within the 20 ANEF contour around the alternative runway alignment.

As with the proposed north-east/south-west alignment, present zoning controls already limit the possible future extent of land uses incompatible with the worst case level of airport operations. Land zoned with a minimum permitted subdivision size of 40 ha accounts for some 84% of the noise-affected off-site area, while only about 7% of the area is zoned for urban residential purposes or with a minimum subdivision size of 2 ha. Special Uses (CSIRO, Department of Defence and Sydney University) account for 6% of the noise-affected off-site area.

The Department of Defence land that would be affected is a small peripheral portion of the large Orchard Hills RAN Armament Depot and RAAF Central Ammunition Depot, and only a very small portion of the noise-affected land would be subject to noise exposure of over 30 ANEF. Effects on the CSIRO property and the adjoining University of Sydney's McGarvie Smith Farm would be equivalent to those described above for the preferred north-east/south-west alignment.

According to the University of Sydney, its property at Bringelly would need to be relocated; however, as none of the site would be subject to noise levels over 30 ANEF, there is doubt as to whether any research activities being undertaken at the time the worst case level of airport operations was reached would or would not be affected.

It is also possible that the facilities will eventually have to be relocated even without these airport because of urban development and traffic increases in the Bringelly area.

Maximum future noise-affected population

Table 9.2.7 provides a summary of the projected number of people who could potentially be affected by aircraft noise in the surrounding areas. It is estimated that there could be approximately 4,400 people living within the 20 ANEF contour, while there could be up to about 270 people living in areas affected by noise levels in excess of 30 ANEF. The future population potentially seriously or moderately affected by aircraft noise in terms of the National Acoustic Laboratories GR index is shown in Table 9.2.8 below, and has been calculated from the information given in Table 9.2.7 and Figure 9.2.2.

Table 9.2.6 North/south alignment: potential noise-affected areas (ha)*

Zoning category**	ANEF 20-25	25-30	30-40	40+	Total
Urban/urban release	64	-	-	-	64
2 ha minimum	390	4	-	-	394
16 ha minimum	-	-	-	-	-
20 ha minimum	193	-	-	-	193
40 ha minimum	3,054	1,588	693	9	5,344
CSIRO	19	24	81	2	126
Defence	36	9	2	-	47
University	93	90	9	-	192
Open space	-	-	-	-	-
Total	3,869	1,715	785	11	6,360

* Within the 20 ANEF contour and outside the airport site boundary.

** The land use zoning categories are derived from information on local planning schemes supplied by the Department of Environment and Planning. The urban/urban release category relates to land included in village zones or shown in the NSW Urban Development Programme (Department of Environment and Planning 1983) as existing urban land or urban development programme release areas. The 2 ha minimum category relates to Rural 'D' (Future Urban) and Non-Urban 1(c) zones having a minimum allowable subdivision size of 2 ha. The 16 ha minimum category relates to a non-urban zone having a minimum subdivision size of 16 ha. The 20 ha minimum category relates to land to which Interim Development Order No. 54 City of Penrith applies, having a minimum subdivision size of 20 ha, while the 40 ha minimum category relates to Non-Urban 'A1', Non-Urban 'D' and Rural 'A1' zones having a minimum allowable subdivision size of 40 ha. The CSIRO, Defence and University categories relate to Special Uses zones reserved for those users; they do not necessarily represent limits of land ownership. The open space category relates to land zoned County Open Space or Open Space — Existing Recreation. The zones in the planning schemes do not necessarily correspond to existing land uses.

Table 9.2.7 North/south alignment: potential noise-affected population within 20 ANEF contour

Zoning category**	ANEF 20-25	25-30	30-40	40+	Total
Urban/urban release	2,304	-	-	-	2,304
2 ha minimum	702	7	-	-	709
16 ha minimum	-	-	-	-	-
20 ha minimum	35	-	-	-	35
40 ha minimum	587	450	260	4	1,301
CSIRO	2	2	8	-	12
Defence	3	-	-	-	3
University	8	8	-	-	16
Open space	-	-	-	-	-
Total	3,641	467	268	4	4,380

** See note to Table 9.2.6 for explanation of these zoning categories.

Table 9.2.8 North/south alignment: number of people potentially noise affected

Population	ANEF contour				Total
	20-25	25-30	30-40	40	
Estimated maximum future population	3,641	467	268	4	4,380
No. seriously affected	510	107	107	2	726
No. moderately affected*	1,893	294	209	3	2,399

* Includes those seriously affected.

A comparison of the proposed and alternative alignments

Table 9.2.9 compares the north/south and north-east/south-west alignments.

Table 9.2.9 Comparison of Badgerys Creek runway alignment alternatives in terms of noise-affected population

Population criterion*	Number of people potentially affected	
	North-east/south-west alignment	North/south alternative
Population within 40 ANEF contour	4	4
Population within 30-40 ANEF contour	211	268
Population within 25-30 ANEF contour	387	467
Population within 20-25 ANEF contour	1,349	3,641
Total population within 20 ANEF contour	1,951	4,380
Total population seriously affected	364	726
Total population moderately or seriously affected	1,115	2,399

* In each case, the maximum future population estimate is based on the assumption that existing zoning arrangements will continue.

The alternative north/south runway alignment at the Badgerys Creek site would affect twice as many people in the areas between the 20 and 25 ANEF contours as the alternative north-east/south-west alignment, principally because the northern end of the north/south noise contours extends into existing and future urban residential areas in the St Marys—Orchard Hills areas. The difference in the number of people potentially affected within the 25 ANEF contour is much less, although the north/south alignment would still affect approximately 23% more people.

As substantially more people could be affected by noise if the north/south alignment were adopted (more than twice as many could be seriously affected or moderately affected than for the proposed north-east/south-west alignment), the north-east/south-west alignment is the Department of Aviation's preferred choice and the basis of the preliminary master plan (Section 8.4).

However, in the event that Badgerys Creek were the selected site, it is possible that the final runway alignment adopted could vary from the north-east/south-west alignment shown in Figures 9.2.4 by up to 7°. The need for this variation could arise from:

- the incorporation of views put forward by the public as a result of exhibition of this Draft Environmental Impact Statement;
- resolution of airspace conflicts described in Chapter 8;
- adjustments to airfield layout arising from detailed engineering design at the time of project implementation.

The most probable direction of this variation would be a counter-clockwise rotation.

9.2.7 Evaluation of noise effects of the proposed alignment

The ANEF contours for the proposed north-east/south-west alignment are shown on a 1:25,000 scale fold out map at the rear of this report (Appendix U).

The noise effects of the proposed alignment may be evaluated by comparison with those of existing major Australian airports. Table 9.2.10, which compares the future maximum population within the 20 ANEF contour around Badgerys Creek with the existing populations within the 20 ANEF contours around four major Australian airports, shows the numbers likely to be seriously or moderately affected by noise to be much lower than at the existing airports. This is despite the following worst case assumptions:

- a level of aircraft operations that is 62% higher than the level at Kingsford-Smith Airport;
- a continued population increase within the 20 ANEF contour around Badgerys Creek up to the maximum allowable, given existing zoning controls;
- no allowance for possible beneficial effects from any future modifications to aircraft or operating practices, or both, to minimize noise impacts.

Nevertheless, should the worst case eventuate, the noise effects on those few people seriously affected would be severe, as illustrated by the GR index in Figure 9.2.1.

Prior to the stage at which worst case levels were reached, and possibly long before, adverse effects of noise could be felt in two ways:

- direct noise effects of a lower order of magnitude
- effects on property values.

Past studies of the effects of aircraft noise have not been conclusive. A review of thirteen empirical studies of airport noise and property values (Nelson 1980) concluded that the weight of evidence was that two houses with different noise environments but otherwise identical would differ in value in proportion to the noise level difference. However, the studies related mainly to properties exposed to 30 ANEF or more; also, the 'otherwise identical' basis for the conclusion leaves open the possibility that at a second Sydney airport the negative effects of airport noise will be outweighed by the positive effects of increased demand for residential properties created by airport employment opportunities.

Since for a given airport location and scale of development the increased land demands are constant whatever the noise impacts, a situation such as that which would apply at Badgerys Creek (where noise impacts would be slight compared with those at other airports) makes it more likely that the adverse effects of noise would be outweighed by the effects of increased land demand.

For individual properties potentially subject to high noise levels, this generalization may not hold. Even in these cases, however, decisions by the State Government with respect to new road and rail works (Section 10.4) and land use zoning (Section 9.2.8) could have a more significant influence on property values.

Table 9.2.10 Comparison of populations within 20 ANEF contour

Airport	Average number of aircraft movements*		Number of people within 20 ANEF**			
	Per day	Per night	Seriously affected by noise	Moderately+ affected by noise	Others	Total population
Badgerys Creek, NE/SW alignment	371.2	135.6	364	1,115	836	1,951
Sydney, Kingsford-Smith	218.1	76.3	62,198	141,436	67,374	208,810
Melbourne, Tullamarine	166.0	55.0	2,238	8,188	6,374	14,562
Adelaide	49.3	21.5	10,005	31,586	19,347	50,933
Perth	27.6	24.4	3,438	9,812	9,234	19,046

* F27 size and over; day - 7 a.m. to 7 p.m; night - 7 p.m. to 7 a.m.

** For Badgerys Creek, numbers are estimated future maximum populations assuming continuity of existing land use zoning and construction of dwellings on all existing subdivisions; for major Australian airports, numbers are 1981 estimates.

\+ Includes seriously affected.

Source: Numbers for Badgerys Creek have been estimated by methods described in the text; numbers for other airports have been calculated from data contained in the National Acoustic Laboratories report, 1982. Although this data relates to NEF 3,6 contours which differ from ANEF contours, these differences are not significant. Aircraft movements for Tullamarine are as provided by the Department of Aviation.

9.2.8 Ameliorative measures

The principal ameliorative measures that may be considered for application to potentially noise-affected areas are:

- source operational controls
- land use controls
- building controls.

Source operational controls

The current generation of jet aircraft, which are expected to be operational to at least the year 2000, incorporate advanced engine technology that has significantly reduced noise output. It is unlikely that further significant engine noise reductions could be achieved without a major step forward in the technology of engine design.

There are also some operational and administrative controls which could be introduced to minimize the number of people affected by airport noise. They include the method of using the runways and the flight paths that aircraft use. It is possible that new technology may allow use of new techniques that lead to a reduction of noise effects.

However, none of the above controls can be counted on to significantly reduce the estimates of the maximum noise-affected population under the worst case assumptions.

Land use controls

Stringent land use controls over potentially noise-affected areas can be used to prevent the number of people who could be seriously or moderately affected by aircraft noise reaching the maximum levels estimated above for the worst case conditions. As the Commonwealth has no power to implement and maintain the necessary land use controls, the present practice of the Department of Aviation for protecting airport environs is to issue the relevant land use control authorities with an ANEF contour map along with its land use compatibility advice. Directions made in 1983 under Section 117(2) of the NSW Environmental Planning and Assessment Act, 1979, restrict the powers of councils to rezone land in areas where the ANEF level advised by the Department of Aviation exceeds 20.

The Department of Environment and Planning is currently investigating interim planning measures to control and protect the two sites short-listed for Sydney's second airport and the surrounding areas that may be noise-affected. It is proposed that the interim planning measures would take effect at the time of the public release of the Draft Environmental Impact Statement and that, upon announcement of the selected site, they would be revoked for the site not selected. The interim measures would relate to the ANEF noise contours map for the north-east/south-west alignment, included as a fold-out map in Appendix U of this report.

After a site has been selected, more comprehensive land use planning measures will be required in order to direct development in the noise-affected areas, to prohibit inappropriate uses, to identify land for future airport associated uses and also to address the relationship of the airport to other issues in the Macarthur Sub-Region. It is proposed that a strategic land use plan for the area in the proximity of the selected airport site will be included in the Macarthur Regional Environmental Plan (Section 9.8).

In the long term, when future aircraft numbers, types and flight paths become less uncertain, it is likely that revised ANEF maps will be issued by the Department of Aviation showing less extensive potential noise effect.

Building controls

In parallel with the above land use controls, those local councils with areas affected by aircraft noise should also implement building standards such as those set out in the draft Australian Standard for Acoustics: Aircraft Noise Intrusion - Building Siting and Construction (revision of AS 2021-1977). This draft standard, like the Department of Aviation's land use compatibility advice, is based on the findings of the National Acoustic Laboratories report on aircraft noise in Australia. It defines building site acceptability by ANEF zone (Table 9.2.11), and provides recommendations on appropriate building construction techniques to ensure that desired indoor sound levels can be achieved.

Table 9.2.11 Building site acceptability for noise reduction assessment

Building type	Building site acceptability based on ANEF zones		
	Acceptable	Conditional	Unacceptable
Houses, home units, flats	Less than 20 ANEF (Note 1)	20-25 ANEF (Note 2)	Greater than 25 ANEF
Hotels, motels, hostels	Less than 25 ANEF	25-30 ANEF (Note 3)	Greater than 30 ANEF
Schools, universities	Less than 20 ANEF (Note 1)	20-25 ANEF (Note 3)	Greater than 25 ANEF
Hospitals, nursing homes	Less than 20 ANEF (Note 1)	20-25 ANEF (Note 3)	Greater than 25 ANEF
Public buildings	Less than 20 ANEF (Note 1)	20-25 ANEF (Note 3)	Greater than 25 ANEF
Commercial buildings	Less than 25 ANEF	25-30 ANEF (Note 3)	Greater than 30 ANEF
Light industrial buildings	Less than 30 ANEF	30-35 ANEF	Greater than 35 ANEF
Heavy industrial buildings	Acceptable in all ANEF zones		

Notes:

1. The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight paths.
2. Some people may find the areas within the 20-25 ANEF contour to be unsuitable for residential use. Land use authorities may consider that the incorporation of noise control features in the construction of residences is appropriate.
3. An analysis of building noise reduction requirements should be made by an acoustic consultant and any necessary noise control features included in the design of the building.

Source: Draft Australian Standard for Acoustics: Aircraft Noise Intrusion - Building Siting and Construction (revision of AS 2021-1977).

The classes of building site acceptability specified in the draft Standard are:

- Acceptable: If the building site is classified as 'acceptable', there is usually no need to provide protection specifically against aircraft noise in the building's construction.
- Conditional: If the building site is classified as 'conditional', both the maximum aircraft noise levels for the relevant aircraft and the aircraft noise attenuation to be expected from the proposed construction should be determined. (The procedure for making these determinations is set out in the draft Standard.)
- Unacceptable: If the building site is classified as 'unacceptable', construction of the proposed building(s) should not normally be considered.

Acquisition of potentially noise-affected land

Section 51(XXXI) of the Australian Constitution confers on the Australian Parliament the power to make laws for 'the acquisition of property on just terms from any State or person for any purpose in respect of which the Parliament has power to make laws'. However, there is some doubt about the validity of acquiring land that is not required for a specific public purpose; in other words, if the Commonwealth Government acquired land and then disposed of it subject to restrictions on noise-sensitive development, such action might be challenged. The proposed acquisition boundaries outlined in this Draft Environmental Impact Statement are therefore based on those areas required for aircraft operations and related activities, and do not include the acquisition of additional areas which could be affected by aircraft noise. Nevertheless, the principle of purchasing buffer zones was considered in detail by the House of Representatives Standing Committee on Environment and Conservation in the last Parliament, and it may be that there could be changes in practice after the Select Committee in the present Parliament has reported.

Compensation for injurious affection

There is no provision under the Lands Acquisition Act 1955 or other Commonwealth legislation for the payment of compensation for injurious affection such as may be caused by aircraft noise.

9.2.9 Construction noise

Construction noise likely to be heard beyond the boundaries of the site would be that associated with the major earthworks required for the runways and terminal areas.

This phase of construction could be expected to last for two to three years. Typical equipment would include scrapers, front-end loaders, bulldozers and heavy haul trucks.

The source noise levels of this machinery are in the range 70-100 dBA, depending on equipment type and operating load. Given the quantities of earth to be moved (and hence the number of vehicles required), it could be expected that construction noise levels (L_{10}) of 55-60 dBA could be experienced for periods at points along the boundary of the site depending upon when and where earthworks were in progress. This noise level could be 10-15 dBA higher than background levels which would be noticeable and would cause nuisance to nearby residents.

9.3 ARCHAEOLOGY

This section discusses the results of the archaeological assessment of the proposed airport site and its surrounds. The principal objectives of this assessment were to determine the nature and distribution of Aboriginal archaeological sites in the area, to assess their significance, and to evaluate the effects of airport development on these sites.

In achieving these objectives, the following methods were used:

- Previous archaeological investigations relevant to the area were reviewed.
- A concise, environmentally based predictive statement was prepared based on this archaeological review and on environmental information, geological and topographic maps, and air photos.

- This information enabled appropriate fieldwork methods to be devised, which were then refined in the field to take account of any limitations on access to private property and of site conditions affecting archaeological visibility such as ground surface visibility and exposure.

- In considering the results of the field survey of each area, the following points were addressed:

  - the representativeness of the survey in determining the nature and distribution of the archaeological resource, and in particular the degree to which the field results fitted the expected patterns;

  - the significance of the archaeological sites located, and of the archaeological resource as a whole.

9.3.1 Existing site data

Environmental setting

The proposed airport site and the surrounding area are dominated by a single environmental zone: moderate to gently undulating hills on Wianamatta Shale (Figure 9.3.1). There is only one major creek within the area: Badgerys Creek, on the eastern boundary of the proposed airport site. The entire area has been subject to intensive agricultural land use, and almost all of the original vegetation cover has been removed, to be replaced in most cases by introduced pasture grasses.

Previous investigations

A number of archaeological surveys have been conducted in the region. These have examined landforms similar to those found in the vicinity of the proposed airport site, and also the sandstone gorges of the Nepean River to the west. One survey of the area within the proposed airport site was carried out by Haglund in 1978, as part of a preliminary assessment of the archaeological sensitivity of locations being investigated by the Major Airport Needs of Sydney Committee as possible sites for a second Sydney airport. She identified several archaeological sites to the east of the proposed site presently being considered. These include stone artefact scatters bordering Kemps Creek, and edge-ground artefacts and grinding grooves at South Creek. Another survey conducted by Haglund (1979) at Kemps Creek did not reveal any archaeological material.

Koettig (1981) located a site which comprised two scatters of stone artefacts on a hill-slope at West St Clair. This site was subsequently excavated by Dallas (1981a). The test trench revealed artefacts of silcrete and chert, including cores and retouched flakes and fragments of ground artefacts. These stone artefacts occurred primarily within the top 5 cm of soil.

Several surveys were also carried out near Mulgoa, 10 km to the north-west of the airport site (Dallas 1981b; Brayshaw 1982, 1983; Greer and Brayshaw 1983). These surveys demonstrated a consistent pattern of site distribution, with stone artefact scatters being located along creek-lines and on the crests and upper slopes of hills. These artefact scatters were sparse, with most sites having fewer than five artefacts. The sites which were located in close proximity to creeks generally had greater densities of artefacts than those on hillslopes.

Of the seventeen sites recorded within a 10 km radius of Badgerys Creek, all but two consisted of scatters of stone artefacts. Raw materials used for making stone artefacts found in these sites included silcrete, chert and indurated mudstone.

A site located on the flats of South Creek to the east of the proposed airport site comprised two exposed sandstone blocks into which a number of grinding grooves had been incised. Thirty-eight grooves, of a size suggesting the shaping of edge-ground hatchet heads, were found on the two blocks.

A number of elaborately carved trees were located on the Greendale property to the south-west of the airport site earlier this century, and were removed to the Australian Museum. They were believed to mark the sites of Aboriginal graves, but these were not located at that time.

9.3.2 Archaeological survey

Predictive statement

Based on the results of these earlier investigations and on other relevant information, predictions were developed concerning the likely nature, location and frequency of occurrence of prehistoric archaeological sites in the area of the proposed airport site and its surrounds. The predictions made were as follows:

- The most commonly occurring prehistoric archaeological sites around Badgerys Creek will be scatters of stone artefacts bordering watercourses and on the crests of hills. Although the size and extent of previously recorded artefact scatters in the region have often been dictated by the conditions of surface visibility and exposure, artefact scatters in close proximity to creeks could be expected to be larger than those distant from creeks.

- The size and quantity of artefacts in archaeological sites are often dependent on the proximity of the source of the stone used in making the artefacts. Localized outcrops of stone suitable for flaking are often exposed along creek-lines, and could be expected to have led to more stone working activities near creeks, which in turn would be reflected in higher artefact densities at these sites.

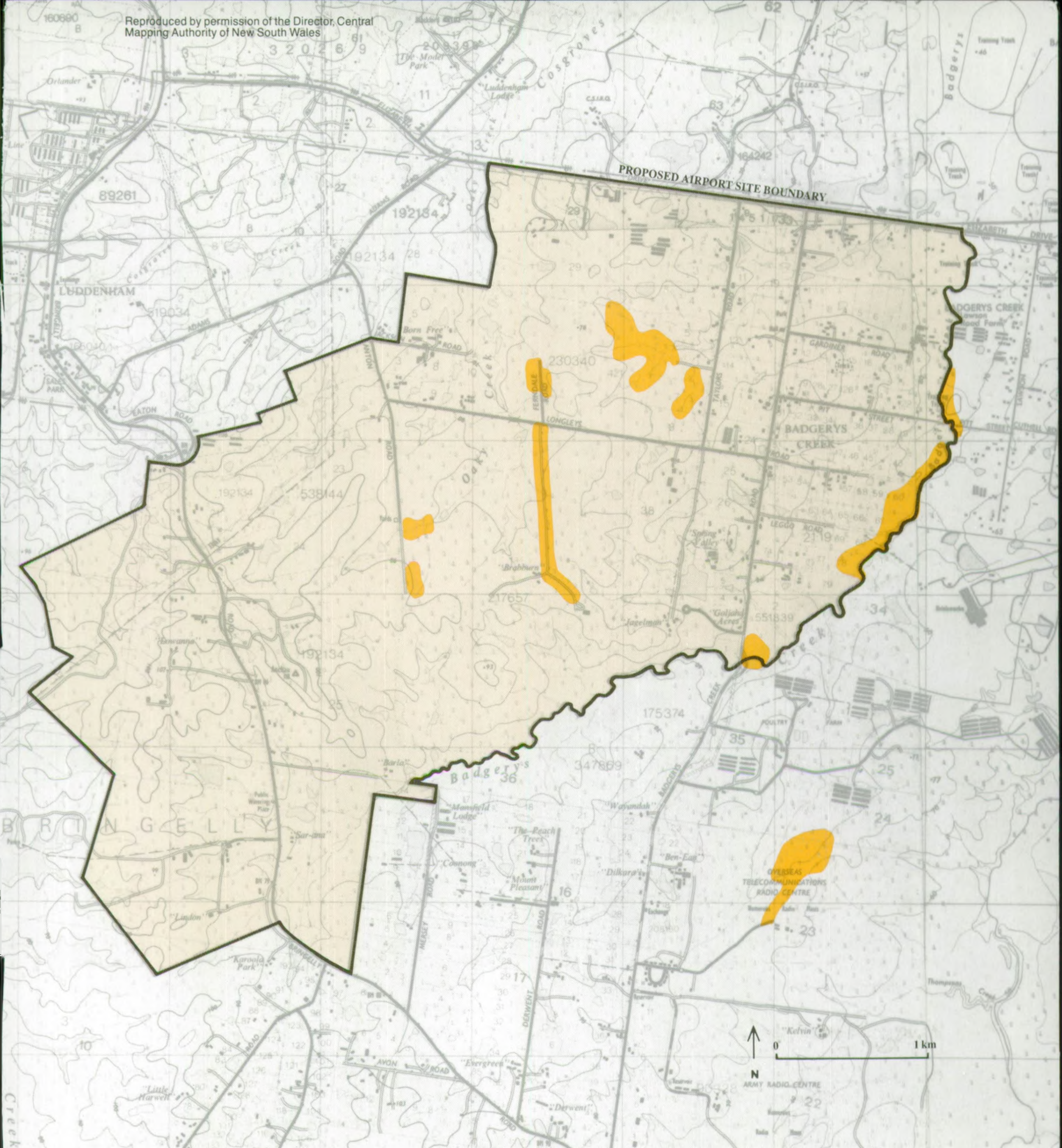
- The location of scarred and carved trees cannot be equated with environmental features in the same way as artefact scatters or grinding grooves. The concentration of Aboriginal activities near watercourses may result in a greater number of scarred trees being found in these locations, although they may occur in any environmental setting. However, given the extensive clearing which has been undertaken in this area, it is unlikely that any scarred or carved trees would have survived.

Fieldwork strategy

On the basis of the previous archaeological investigations in the area and generalizations on site distribution, the survey strategy was structured to concentrate on areas in which prehistoric archaeological sites were considered most likely to occur. Thus, several creek-lines within the boundaries of the proposed airport site were examined to test the proposition that sites are most likely to occur near creeks, while several areas of gently undulating country away from the creeks were also examined. In addition to these areas that were examined in detail, spot checks were made in other locations where conditions of surface visibility and exposure would have allowed the detection of artefacts if they had been present. The sample survey areas examined during the field study are shown on Figure 9.3.1.

Results of the field survey and assessment of archaeological sensitivity

Only one archaeological site was located during the field survey. This was found on ploughed and devegetated ground beside Badgerys Creek, and consisted of a scatter of five silcrete flakes and flaked pieces.



Sampling locations

ENVIRONMENTAL ZONE

ZONE	LANDFORM AND GEOLOGY
	Moderate to gently undulating hills on Wianamatta Shale

Figure 9.3.1
ABORIGINAL ARCHAEOLOGICAL ZONES AND SAMPLING LOCATIONS

NOTE: Specific locations of sites are not shown in order to ensure their protection

There was relatively little exposed ground bordering those creeks examined in the area. However, it is probable that there are other artefact scatters which are obscured by vegetation along the banks of larger creeks. There was only limited exposure on hillslopes distant from the creeks but none of the exposures had any artefactual material.

As expected, the extent of clearing of native vegetation has resulted in the removal of almost all trees of sufficient age to have been living when Aborigines using traditional subsistence practices were in the area. No trees bearing scars of Aboriginal origin were located.

Although only a small portion of the area within the proposed airport site was examined, the uniformity of landforms and the low density of sites reported in similar locations suggest that the paucity of sites is a reflection of the archaeology of this location rather than simply a function of poor surface visibility. This was confirmed by examination of several areas outside the boundaries of the proposed airport site: these were found to correspond to conditions within the site in terms of the extent of vegetation cover and the general absence of archaeological material.

9.3.3 Assessment of effects and safeguards

The archaeological assessment of effects is confined to the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further investigation once the locations for these facilities were determined.

From the results of this present survey and from the earlier investigations, it is evident that the only sites likely to have survived in this area are stone artefact scatters. While these sites can be of high scientific significance, they are generally of low heritage significance. Artefact scatters which have been little disturbed are the most useful for research purposes and therefore their scientific value is dependent upon their condition. However, as the extensive land use in the Badgerys Creek area would already have resulted in destruction or disturbance of such archaeological sites, it is considered that most sites in the area would now be of little scientific importance. The exception to this would be any sites that occur on the banks of Badgerys Creek itself, which in some areas appear to have incurred only minor surface damage and disturbance.

Any archaeological sites not located by fieldwork to date but occurring within areas proposed to be cleared for airport development would be disturbed or destroyed by construction work. Airport construction would not affect the stone scatter that has been found adjacent to Badgerys Creek, as fencing delineating the proposed airport boundary would be located at least 10 m from the creek.

Because of the relatively low sensitivity of the proposed site, no further archaeological work is proposed. However, if any additional information concerning the archaeological sensitivity of the site and areas likely to be affected by future airport development becomes available prior to the commencement of construction, the Department of Aviation would review the need to appoint a qualified archaeologist to monitor the development during ground disturbance.

All Aboriginal sites in New South Wales are protected under the National Parks and Wildlife Act, 1974, and come under the jurisdiction of the National Parks and Wildlife Service. Before any site can be destroyed, permission must be obtained from the Director of the Service. National Parks and Wildlife Service policy also requires that developers consult with the local Aboriginal people to ascertain whether a site affected by development is of significance to them.

9.4 CONCERNS OF ABORIGINAL PEOPLE

The principal aim of this section is to describe the views and concerns of Aboriginal people who may be affected by the acquisition proposal or by future airport development at the Badgerys Creek site. Contact was made by the Anthropological Consultant with the Western Metropolitan Regional Land Council, whose members discussed the project and referred it to the Gandangara Local Aboriginal Land Council, within whose area Badgerys Creek is located (Figure 9.4.1). The Anthropological Consultant also attended a meeting of the Local Aboriginal Land Council, at which the appointment was made of an Aboriginal liaison officer, to be assisted by the Local Aboriginal Land Council Co-ordinator.

In addition to general discussions with members of these two land councils, the Anthropological Consultant conducted twenty-nine written interviews with Aboriginal residents of fourteen different suburbs within the local Aboriginal land council area (Figure 9.4.1). The estimated total Aboriginal population of this land council area is 4,800 (based on Commonwealth Department of Aboriginal Affairs Community Profiles), of which the twenty-nine people interviewed represent approximately 0.6%. While this is a small proportion of the total Aboriginal population of the area, it is a significant sample of those who have involved themselves with the Gandangara Local Aboriginal Land Council since it was formed early in 1984. The average age of those interviewed was forty-five, and their average time of residence in the land council area was fourteen years.

Those interviewed were asked for their views on airport development, and what knowledge they had of the area concerned, particularly with regard to places of significance to Aboriginal people. In this regard, a distinction was made in this assessment between:

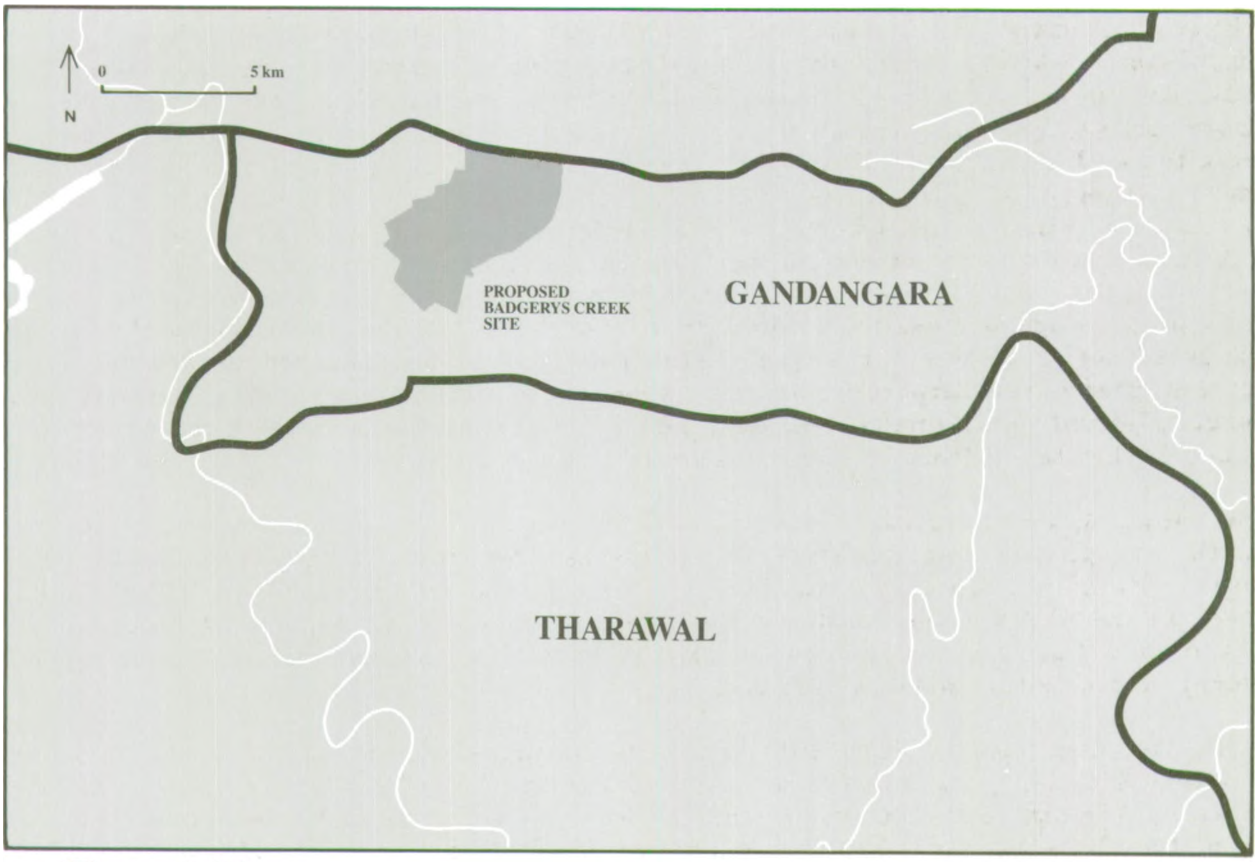


Figure 9.4.1
LOCAL ABORIGINAL LAND COUNCIL AREAS

- an archaeological survey which is concerned with the physical evidence of past human activity;

- an anthropological survey which is concerned with observable and written evidence of past and present human activity. Thus, it encompasses the significance of a particular area in historical and contemporary terms, both as part of a people's cultural expression and as an influence on lifestyles.

The fact that Aboriginal people currently living within the Gandangara Local Aboriginal Land Council area may not, until recently, have had access to information about the history and traditions of the area is not considered significant in presenting their contemporary perspectives. There are various ways in which a people hand down or receive cultural facts over generations. Facts which are able to be discerned through anthropological studies of the past and present become cultural facts of significance to contemporary Aboriginal people once they are absorbed into Aboriginal consciousness. Direct oral or written transmission through the generations of particular local descent groups is not a prerequisite. The heavy emphasis which tends to be placed by non-Aboriginal people on tangible physical objects as being indicative of past Aboriginal activity obscures these cultural aspects of past and present associations with particular areas.

9.4.1 Description of existing conditions

The Aboriginal people of the area include those who have been born and brought up there as well as those (the majority) who have resettled in the area from other parts of New South Wales over the past twenty-five years. All those interviewed considered the area as their home, whether or not they had spent their childhood there.

There was a great deal of interest expressed by those interviewed in acquiring further information about the traditional life of the Gandangara people, although relatively little detail is available owing to development of the area and displacement of Aboriginal people early in the history of European colonization. As a result, Aboriginal people set great value on such historical information and on sites which are known to have had particular significance to their people in the past. Many sites of archaeological significance in the general Gandangara area are known by land council members, both personally and by word of mouth, although none of these sites is within the proposed airport site. There is concern to make sure that further destruction of the Aboriginal heritage does not occur, particularly in view of the little that does remain intact.

Many of those people interviewed were familiar with the general area of Badgerys Creek. Several drive through it frequently, and others visit local farms for produce and for recreational pursuits (such as horseriding). It is described by them as a valued rural environment which is uncluttered and very peaceful, and which has attractive bushland and clean air and water.

9.4.2 Assessment of effects

The anthropological assessment of effects is confined to the effects of the proposed acquisition and future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further consultation once the locations for these facilities were determined.

The archaeological site survey (Section 9.3) indicates that there are no sites of archaeological significance within the boundaries of the proposed site. However, any sub-surface archaeological sites which might be there would be irretrievably lost if the site were selected and development proceeded. None of the twenty-nine people interviewed was able to identify any sites of archaeological significance to Aboriginal people within the proposed airport site. Nevertheless, concern was expressed in broad terms about the possibility of environmental impact on sites of archaeological and anthropological significance to Aboriginal people that were outside the boundaries of the proposed site but which might be affected by noise or other emissions from the airport or from airport related activities.

Generally, there was considerable opposition to the concept of airport development in the area and fears were expressed about the changes to Aboriginal lifestyles which this would cause. The major points raised were as follows:

- Airport development was seen as destructive of an attractive rural environment which is enjoyed by many Aboriginal people in various ways. Several have commented that they have moved from city areas because they like the more peaceful country atmosphere. Others have moved from country areas to obtain employment, preferring this quieter area to the inner city suburbs. These benefits would be lost through airport development, which would affect land and housing values in the area.

- Noise and air pollution are regarded as major problems associated with such a development, and are seen as having an effect on mental and physical health, general lifestyles and morale.

The following additional views were expressed:

- One Gandangara resident living near Badgerys Creek who keeps horses was concerned for the effects on these animals.

- There were fears that pollution could damage the rare eucalypts in Bents Basin.

- Another airport was regarded as unnecessary, as there is already the Hoxton Park Aerodrome in the area.

- The airport was unlikely to provide any employment for local people, especially Aboriginal people.

- If the Badgerys Creek area were to be developed at all, it should be for much needed recreational space rather than as an airport.

- The area was regarded as having characteristics which would have made it of significance in the traditional life of Aboriginal people of the pre-colonial past and, as such, it should be retained in as natural a state as possible.

- There was concern regarding the increased possibility of aircraft accidents in the area.

- There was also concern that the survey of Aboriginal opinion was merely another government 'token gesture', this time on the part of the Department of Aviation, and that there was no guarantee that Aboriginal people's wishes would be heeded.

Further to the opposition expressed by the Aboriginal people interviewed, the Gandangara Local Aboriginal Land Council unanimously supported the following motion at a meeting held on 26 November 1984:

> That the Gandangara Local Aboriginal Land Council strongly oppose the development of an airport at either Badgerys Creek or Wilton and that land council officers be instructed to lobby to prevent airport development in both these areas.

9.4.3 Environmental safeguards and monitoring

If the Badgerys Creek site were selected for the second Sydney airport, and if in the interim period between selection of the site and commencement of construction any sites of archaeological significance or of significance to Aboriginal people were identified, steps would be taken where possible by the Department of Aviation to salvage any artefacts or relics, or to protect the sites.

In the event that the proposal for acquisition proceeds, it could be expected that the officers of the Gandangara Local Aboriginal Land Council would act to claim and ensure protection of any sites of historical or cultural importance in the area to be acquired or in any other affected area, in accordance with the provisions of the National Parks and Wildlife Act, 1974, and/or the Aboriginal and Torres Strait Islander (Interim) Heritage Protection Act 1984.

In addition, the Gandangara Local Aboriginal Land Council feels strongly that the Department of Aviation should adopt the following courses of action:

- Contractors should be made aware that sites containing Aboriginal relics or remains of any kind are protected under the National Parks and Wildlife Act, 1974, and any sites, relics or skeletal remains uncovered during construction work must immediately be reported to the National Parks and Wildlife Service.

  In the event of such finds, any plans for mitigation work should be checked with the National Parks and Wildlife Service and the local Aboriginal land council prior to such plans being put into effect. This process should be clearly understood in contracts entered into with the Department of Aviation.

  The Gandangara Local Aboriginal Land Council, or the regional or State land councils may invoke the Commonwealth Aboriginal and Torres Strait (Interim) Heritage Protection Act 1984, should they be dissatisfied with action taken which may damage such finds.

- An Aboriginal Sites Officer should be employed for the duration of site clearance work to enable the identification and reporting of any artefacts or relics uncovered. Any site officer so appointed must have completed the Sites Officer Training Course (organized by Tranby College, Glebe) and be appointed after consultation with the local Aboriginal land council.

- The Gandangara and Tharawal local Aboriginal land councils should be contacted with a view to selecting an appropriate name for the airport in the Dharawal language, the Aboriginal language of this area (Eades 1976).

- An appropriate commemorative tribute to the Aboriginal people of the area should be included in the airport design. This should be decided upon in conjunction with the Gandangara and Tharawal local Aboriginal land councils and may take the form of a special park, and/or a feature wall display case including appropriate artefacts illustrative of local Aboriginal history.

- An Aboriginal curator of the display items specified above should be appointed by the airport management committee or some other appropriate body.

It should be noted that the time available for preparation of this Draft Environmental Impact Statement was insufficient to enable the normal negotiating processes required for full consultation with Aboriginal communities to be followed.

9.5 EUROPEAN HERITAGE

The proposed site and its surrounds have experienced a long and complex pattern of European settlement dating back to 1813. This section discusses the results of an inquiry into what elements of European heritage, if any, may still remain within the area as a result of this long occupation. The primary research objectives were:

- to determine the dominant strands of European historical development;

- to make a prediction of the archaeological potential, based on an assessment of the remains likely to be found given that continuing land use and development have possibly substantially altered or destroyed the archaeological resource;

- to locate physical elements representative of the history, and/or significant heritage items;

- to assess the potential effects of airport development on the historical resources, and determine appropriate safeguards.

There have been no previous surveys of the European historical archaeology of the proposed site. Archival research of both primary and secondary sources and titles searches were therefore carried out to determine the primary historical developments within the site and its surrounds. Also, in order to provide a context for the site survey and the investigative research, heritage groups and local people were contacted. These discussions with the local community were directed towards identifying areas around and within the proposed site that might be potentially sensitive. Registers of historic sites were also examined to find out whether any listed sites occurred within the proposed site or within the 25 ANEF contour.

9.5.1 Environmental setting

The proposed site is located in an area of gently to moderately rolling hills on Wianamatta Shale with relatively good agricultural soils. Water is readily available from a number of creeks, streams and ponds, and the supply has been augmented by the construction of a considerable number of dams. Rainfall is generally reliable and adequate. The land has been extensively cleared, so that small stands and light scatters of timber over the entire area are now all that remain, whereas in the early nineteenth century the stands of timber would have been extensive.

These environmental conditions have been conducive to settlement from the earliest days, encouraging building for permanent habitation and the use of land for grazing and particularly for agriculture. Relative proximity to Sydney, ease of access, and such historical circumstances as the failing agricultural soils around Sydney and Parramatta (which necessitated the early settlement of outlying areas to augment the colony's food supply), have all been factors leading to the early and widespread settlement of the proposed site and the surrounding regions.

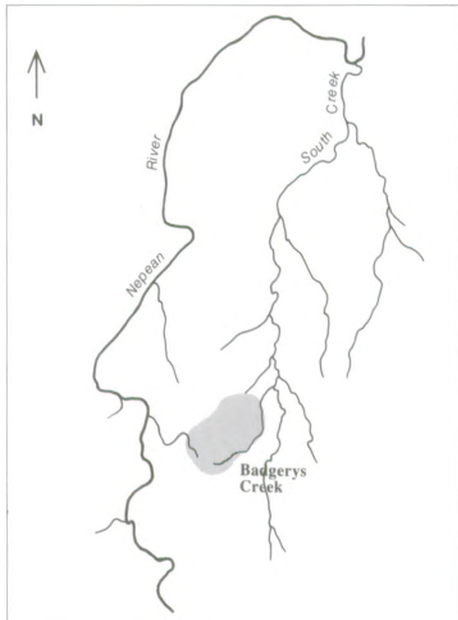
9.5.2 Historical themes of development

The proposed site, lying within the Parish of Bringelly in the County of Cumberland, encompasses six early nineteenth century Crown grants:

- Portion No. 1: 6,710 acres given to John Blaxland, 30 November 1813;
- Portion No. 2: 1,200 acres given to Darcy Wentworth, 8 October 1816;
- Portion No. 5: 700 acres given to William Gore, 2 June 1815;
- Portion No. 7: 1,500 acres given to John Piper, 20 June 1816;
- Portion No. 16: 350 acres given to Edward Wright, c.1820-1821;
- Land grant of 300 acres given to Darcy Wentworth, 17 August 1819.

Figure 9.5.1
DEVELOPMENT HISTORY OF BADGERYS CREEK

Location of proposed airport site

	PRE-EUROPEAN SETTLEMENT	Phase 1 INITIAL EUROPEAN SETTLEMENT (1813-1851)
		
NATURAL RESOURCES	Water, chert, basalt, bush, wildlife	Water, timber, good soils, cleared crop and grazing land
SOCIAL STRUCTURE	Tribal and community living	Settlement families establishing on crown grants
TECHNOLOGY AND INDUSTRY	Stone implements, axes, blades, spears, fire	Logging, dairying, grazing, cropping, milling, brewing, dam, threshing machine
TRANSPORT	Walking via creeks and ridges	Dirt tracks, horse and buggy, bridges, teamsters and carriers
SETTLEMENT PATTERN	Scattered campsites along creeks	Isolated homesteads related to first land grants and cleared land. Frontage to Nepean River
ECONOMY AND RELICS	Substance living (isolated artefact scatters)	Agrarian economy based on cropping, grazing, timber, milling and brewing (Archaeological sites related to cropping and outbuildings)

Four main historical themes of development (Figure 9.5.1) may be perceived from archival research and historical survey:

- **Phase 1:** European settlement, initiated by the granting of large portions of land in the early nineteenth century;

- **Phase 2:** Subdivision of these grants throughout the mid to late nineteenth century, as a result of land speculation pressures;

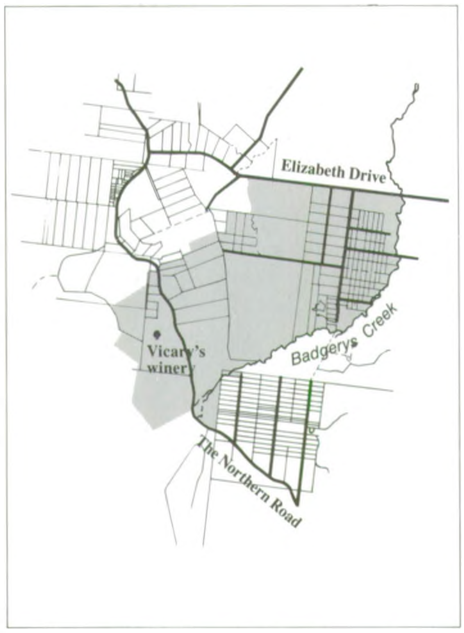
- **Phase 3:** Rural consolidation during the late nineteenth to mid twentieth century, involving further subdivision and the subsequent development of small farms and associated housing;

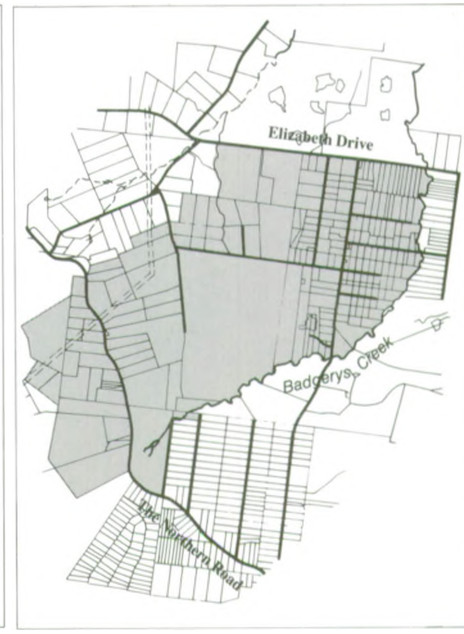
- **Phase 4:** Intensification of agricultural enterprises during the 1960s and 1970s, with the growth of horse studs, grazing and dairying, battery hen farms and market gardens, and the construction of rural residential housing.

Phase 1

The pattern of land use inferred from historical accounts involved early clearing of the native vegetation to allow for agricultural development and stock grazing, and exploitation of the natural resources to facilitate enterprises such as milling and brewing.

ase 2	Phase 3	Phase 4
AND SUBDIVISION (1851-1880)	RURAL CONSOLIDATION (1890-1940)	AGRICULTURAL INTENSIFICATION AND RURAL RESIDENTIAL DEVELOPMENT (1950 to date)





nd	Water, established cropping and grazing land	Water, land, improved pastures, good cropping soil
sent landlords	Tenanted farms, churches, halls, schools	Social affluence and mobility, village groups and rural residential lifestyle
opping and grazing in decline	Land development, orcharding and vineyards	Intensive farm management, mobility, mechanization and automation
avel roads, horse and buggy	Formed roads, automobiles	Formed road network, automobiles, trucks
bdivision of initial land grants into smaller rtions	Development of small farms and homesteads, some land consolidation	Mixed agriculture and rural residential development
nd speculation, crop diseases, recession	Orchards and vineyards (Vicary's winery)	Market gardening, battery hen farms, dairying, grazing, horse spelling and training

The greater part of the site is contained within John Blaxland's grant of 1813; and the historical developments that occurred on Blaxland's estate were typical of developments on all the other grants, which fringed his property. Blaxland cleared his property and developed it extensively for agricultural and stock use. He also set up light industries in the form of milling and brewing establishments, the latter on land outside the proposed site. When the estate passed to his sons on his death in 1845, the property and its improvements were worth a considerable sum. However, the estate had been mortgaged in 1842, and when the sons defaulted on the mortgage it was sold, in 1851, to Sir Charles Nicholson.

Phase 2

The sale of Blaxland's grant initiated the second major phase of development. Nicholson subdivided the former Blaxland estate into a number of lots which were gradually sold between 1860 and 1882. At about the same time, the surrounding properties began to be subdivided and offered for sale. This initial round of subdivisions was often simply a consequence of economic problems experienced by the families of the original property owners, but further rounds followed, motivated by interest in land speculation on the part of the new owners. The practice apparently became entrenched in the Badgerys Creek area, certainly until at least the 1880s. Repeated subdivision, by changing the nature of the economic use of the land, tended to inhibit its physical development. In addition, general historical trends would have further depressed extensive development:

during the 1860s the area felt the effects of crop diseases and increased external market competition, while in the 1890s it was badly affected by the economic depression. The ever smaller subdivisions seem to have been a response to these factors.

Phase 3

The third phase of development spans the years between the late nineteenth and mid twentieth century. Further land improvements and developments were made, and small farms, orchards and vineyards were created. During the period from 1920 to 1940, there was a revival in the economy of the area, possibly partly as a result of the coming of soldier settlers. However, prosperity declined in the 1950s, perhaps as a consequence of pests or disease in the crops; certainly a number of vineyards in the surrounding districts were forced to relocate because crops were destroyed by pests.

Phase 4

The fourth phase of development is fairly recent, occurring mainly in the 1960s and 1970s. There was increased investment in agricultural enterprises such as horse studs, battery hen farms and market gardens, and in rural residential development that was not necessarily associated with any agricultural activity. During the 1980s, the situation has remained stable, with little new turnover or development of land.

Thus the settlement pattern and history of the acquisition site and surrounds derive mainly from activity in the late nineteenth and early twentieth century, with a recent revival of enterprise in the 1960s and 1970s.

9.5.3 Assessment of the archaeological evidence

Prediction of potential archaeological evidence

On the basis of the research undertaken, the following predictions of the kind of archaeological evidence that might be extant from each phase were developed:

- **Phase 1:** The main developments had considerable effect on the existing landscape, particularly the industrial buildings associated with the mill and brewery, the drainage modifications and land clearing. Secondary developments such as the building of fences, cattle pens, small sheds and huts, additional clearing of native vegetation for dam and pond construction, and tillage of land for agricultural purposes would also have substantially affected the landscape.

- **Phase 2:** The repeated subdivision of the land, continuing through the second half of the nineteenth century, would necessarily have caused the dereliction or removal of much of the evidence of Phase 1. Archival evidence indicates that there was very little new development discernible in the area between the 1850s and the 1880s.

- **Phase 3:** The next development of the area during the late nineteenth and early twentieth century was in the form of small houses, farms and outbuildings, with their associated improvements of fencing, access routes, water supply and communications systems; and possibly in community developments such as small churches or halls, dumping grounds and general stores.

- **Phase 4:** The renewed interest in development during the 1960s and 1970s was characterized by larger houses, not necessarily associated with agriculture or farming, and by the intensification of large-scale agricultural enterprises.

Principles for determining significance

The significance of an area or of individual elements within an area in terms of heritage value may be estimated according to relevant historical, scientific or cultural criteria.

However, the key determinant must always be that the element selected is either unique or rare or else is an outstanding example of the particular type of heritage that it exemplifies. Furthermore, the significance of the item or area should be considered within the local, regional and national contexts.

Therefore, for the purpose of this study, each area or item considered was analysed to determine whether it exemplified or illustrated:

- in terms of historical value:
  - strong association with acknowledged important figures or events;
  - a significant or determining effect on local, regional or national history;
- in terms of scientific value:
  - excellence, rarity or uniqueness in technical, industrial or creative achievement;
  - potential for future scientific, archaeological, architectural or environmental investigation;
- in terms of cultural and/or aesthetic value:
  - a way of life, an ethnic group, or a set of customs that are unique, rare, or of particular interest;
  - a notable townscape, landscape or individual setting that contributes to the area or is illustrative of the development of the locality.

Results of field survey and assessment of archaeological sensitivity

The detailed programme of identification and evaluation did not extend beyond the boundaries of the proposed site itself. Inspection of heritage registers revealed no sites or buildings of heritage value that were registered or recorded within the 25 ANEF contour.

Within the proposed site, no physical evidence of Phase 1 was located during the field survey. Aerial photographs do show what appear to be old crop marks and possible traces of some outbuildings, but evidence of these outbuildings is far from certain. The sites of the mill, brewery and dam are located outside the proposed site and 25 ANEF contour.

As far as any physical evidence with heritage significance originating in the mid to late nineteenth century is concerned, the only remains located were a slab shed near Gardiners Road and a woolshed in Vicary's Winery on The Northern Road, both of which are inside the proposed site (Figure 9.5.1). Some dams and fence lines may also date back to this period.

The primary evidence of past development on the site and within the 25 ANEF contour relates to Phase 3, and dates from 1917 to about 1940. The majority of the small fibro and weatherboard cottages and outbuildings and the two churches date from this time. There are also a few larger properties of this phase, in particular Vicary's Winery, vineyard and house, established in 1917.

Numerous commercial enterprises from Phase 4 are still in business on the site and within the 25 ANEF contour area, in particular many battery hen sheds and horse studs. There are also many large houses, evidence of the development during this phase, but none is of particular heritage significance.

The landscape contained within the proposed airport site and 25 ANEF contour has some cultural value in terms of local importance, as it illustrates the economic and social development of the locality. However, only one site was determined to be of heritage value — Vicary's Winery and associated house, vineyard and outbuildings. This complex is a good example of early twentieth century rural, domestic and commercial development, and the buildings have both architectural and industrial merit. The complex has some regional significance too, as it exemplifies a particular industry that was once important to the locality but has since been relocated.

The land within the proposed site has national historical value because of its strong associations with a pre-eminent early colonial family, one of whose members — Gregory Blaxland — was in the first party to cross the Blue Mountains. The departure point for this journey is in this locality. There is also some possibility of finding archaeological remains from Phase 1, although the disturbance of the area arising from the continuing land use would make this unlikely. However, should such a find be made, it would be of considerable scientific value for future research and of regional and national significance.

9.5.4 Assessment of effects and safeguards

This discussion is confined to the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further investigation once the locations for these facilities were determined.

The conclusions reached as a result of the field survey and documentary research are that the majority of the standing historical structures are of only local importance and of minimal heritage value, and that similar patterns of development could be expected to be found outside the area. Hence, even though airport construction would remove any extant evidence of occupation during earlier periods, generally it could not be considered a significant impact in historical terms. However, Vicary's Winery is an exception, as it is a resource of regional importance. In addition there is a possibility that some archaeological material may be under the surface of the site; if this dated from Phase 1 (the first half of the nineteenth century), it would be of national interest and heritage value.

If the proposed site were acquired, the Department of Aviation would appoint a qualified archaeologist to investigate and recommend appropriate conservation measures regarding Vicary's Winery. If any additional information concerning the archaeological sensitivity of the site came to light prior to the commencement of construction, the Department of Aviation would review the need to appoint a qualified archaeologist to monitor the development during ground disturbance, and to retrieve and record material that might be revealed. During airport operation, the Department of Aviation would assess the possibility of any adverse effects of aircraft noise on any items of heritage significance that might have been subsequently identified within the 25 ANEF contour.

9.6 ECONOMIC EFFECTS

This section assesses the economic effects of acquisition of the proposed site, and of future construction and operation of an airport there. There is also discussion of the likely changes to the social and economic characteristics of the region in which the proposed airport is located. In the case of airport operation, the assessment relates to a worst case of 13 million passenger movements per year and the maximum additional employment that could be expected with this level of airport operations. The effects are considered at three spatial levels:

- the regional level (i.e. the Sydney Region);
- the sub-regional level (i.e. the economic sub-region around Badgerys Creek defined for study purposes as comprising the cities of Liverpool and Penrith);

- the airport locality (i.e. the immediate locality of the site defined for study purposes by reference to the boundaries of the Census Collection District most closely corresponding to the site boundary).

The boundaries of these areas are shown on Figure 9.6.1. Also shown on Figure 9.6.1 is the Kingsford-Smith economic sub-region, defined for study purposes as being the same as the Department of Environment and Planning's Botany Bay Sub-Region. This sub-region was used when analysing the economic effects of Kingsford-Smith Airport, the results of which were a guide to the assessment of the possible effects of an airport at Badgerys Creek.

9.6.1 The existing economic effects of Kingsford-Smith Airport

As a guide to the possible scale and nature of the economic effects of a second Sydney airport, a detailed study of the employment characteristics and economic effects of Kingsford-Smith Airport was undertaken.

The study involved two stages:

- The economic activities directly related to the operation of the airport, or closely associated with it, were identified and measured. The directly related activities were grouped into five categories: international airlines; domestic airlines; general aviation; airport commerce (commercial services including fuel supply, security, parking, retailing, car rental, catering and banking); and airport administration. The closely associated activities, which comprise activities such as freight forwarding, accommodation and transport, were treated as a single group. The level of output and employment for each of these categories was estimated following detailed surveys.

- The indirect or flow-on effects of these activities were calculated on an industry sector basis using input-output tables for the Sydney Region and the Kingsford-Smith economic sub-region. These input-output tables set out the estimated total dollar value of transactions between industry sectors, from which multipliers were calculated for both the Region and the sub-region.

Results

The results of this study in respect of employment are summarized in Table 9.6.1. Direct employment in the airport industry at Kingsford-Smith Airport was estimated to be about 12,900 people in 1983, with airport associated employment estimated to be about 1,400. Using the multipliers, the flow-on employment in the Sydney Region was estimated at 14,200, of which 4,500 was estimated to occur in the sub-region. In total, Kingsford-Smith Airport accounts for approximately 28,500 employees in the Sydney Region, comprising 18,800 in the sub-region and approximately 9,700 in the remainder of the Sydney Region.

Table 9.6.1 Summary of the employment effects of Kingsford-Smith Airport

Employment	Sydney Region	Kingsford-Smith sub-region	Rest of Sydney Region
Initial effect*	14,300	14,300	Nil
Flow-on effect	14,200	4,500	9,700
Total effect	28,500	18,800	9,700

* Direct employment plus airport associated employment.

Sectoral distribution of employment effects

An important finding from the study of Kingsford-Smith Airport was that the employment effects are concentrated in a relatively few industry sectors (Table 9.6.2). Some 47% of the employment effects on the sub-region are in the manufacturing sector (Sectors 4A to 4F), and a further 24% are in the trade sector (Sector 7). Employment effects on the transport and communications, finance, building and construction, and public administration sectors are comparatively unimportant. The implications of this finding for a second Sydney airport are that the scale of its employment effects on its sub-region will be largely determined by the industrial structure of the sub-region. Although it may be argued that the development of a second Sydney airport would lead suppliers to locate in its vicinity, the Industry Incidence Survey (Planning Workshop 1978) undertaken for the Major Airport Needs of Sydney Study suggests that this is unlikely to occur, mainly because of the small proportion of the total revenue of suppliers that is attributable to airport business. A similar view was expressed by a number of airline purchasing officers at Kingsford-Smith Airport who indicated that suppliers are often national suppliers selected through a competitive tendering process.

Table 9.6.2 Sectoral distribution of flow-on employment effects of each segment of airport industry at Kingsford-Smith Airport — Sydney Region and Kingsford-Smith economic sub-region

Sector classification**		International airlines		Domestic airlines		Airport commerce		Airport associated		Airport administration		Total airport activity	
		Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)
1	Animal industries	*	*	*	*	*	*	*	*	*	*	*	*
2	Other agriculture	*	*	*	*	*	*	*	*	*	*	*	*
2B	Forestry, fishing	*	*	*	*	*	*	*	*	*	*	*	*
3A	Coal mining	*	*	*	*	*	*	*	*	*	*	*	*
3B	Other mining	*	*	*	*	*	*	*	*	*	*	*	*
4A	Food manufacturing	4.1	5.0	3.4	3.9	3.3	3.2	3.2	3.1	3.1	3.1	3.8	4.4
4B	Wood, paper manufacturing	3.1	3.1	3.0	3.3	6.6	9.8	5.8	9.2	3.8	5.4	3.4	4.2
4C	Machinery, equipment	4.0	4.2	4.0	4.0	7.6	11.2	5.0	5.8	6.4	7.5	4.4	4.8
4D	Metals, metal projects	1.9	2.2	2.0	2.2	1.8	2.6	1.2	1.3	1.4	2.0	1.9	2.1
4E	Non-metallic minerals	*	*	*	*	*	*	*	*	*	*	*	*
4F	Other manufacturing	27.9	34.6	34.6	41.8	7.0	7.8	5.5	5.3	5.4	5.4	25.9	31.1
5	Electricity, gas	2.6	2.0	2.6	1.9	3.7	3.0	3.4	3.2	12.7	15.7	3.6	3.6
6	Building, construction	1.3	*	1.4	1.0	1.9	1.6	1.7	1.2	2.5	3.5	1.5	1.2
7	Trade	25.1	23.9	21.9	21.4	28.6	27.8	26.1	23.3	26.0	25.8	24.6	23.9
8	Transport, communication	4.0	3.7	4.0	3.6	6.7	7.6	17.2	24.6	5.7	6.3	4.9	5.4
9	Finance	10.7	5.0	10.1	4.6	15.3	7.4	15.4	9.1	17.4	9.7	11.5	5.8
10	Public administration	1.3	*	1.2	*	1.8	*	1.7	*	1.8	1.1	1.4	*
11A	Community services	3.8	4.4	3.4	3.7	4.8	5.1	4.5	4.4	4.5	4.9	3.8	4.4
11B	Personal services	8.5	9.0	6.6	7.1	9.4	11.4	7.8	8.0	7.8	8.7	8.0	8.6
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* Less than 1%.
** Based on Australian Standard Industrial Classification.

Airport role

Other findings from the Kingsford-Smith Airport study suggest that the flow-on employment effects per million dollars of output at a second Sydney airport would in some respects be relatively insensitive to the airport's function (as distinct from its level of operations). For example, there is comparatively little difference at Kingsford-Smith Airport between the flow-on employment effects per million dollars of output of international airlines and those of domestic airlines (Table 9.6.2).

9.6.2 Existing social and economic characteristics

The economic and social characteristics of Badgerys Creek are predominantly those associated with rapid population growth in an area not far beyond the present limits of Sydney's urban expansion.

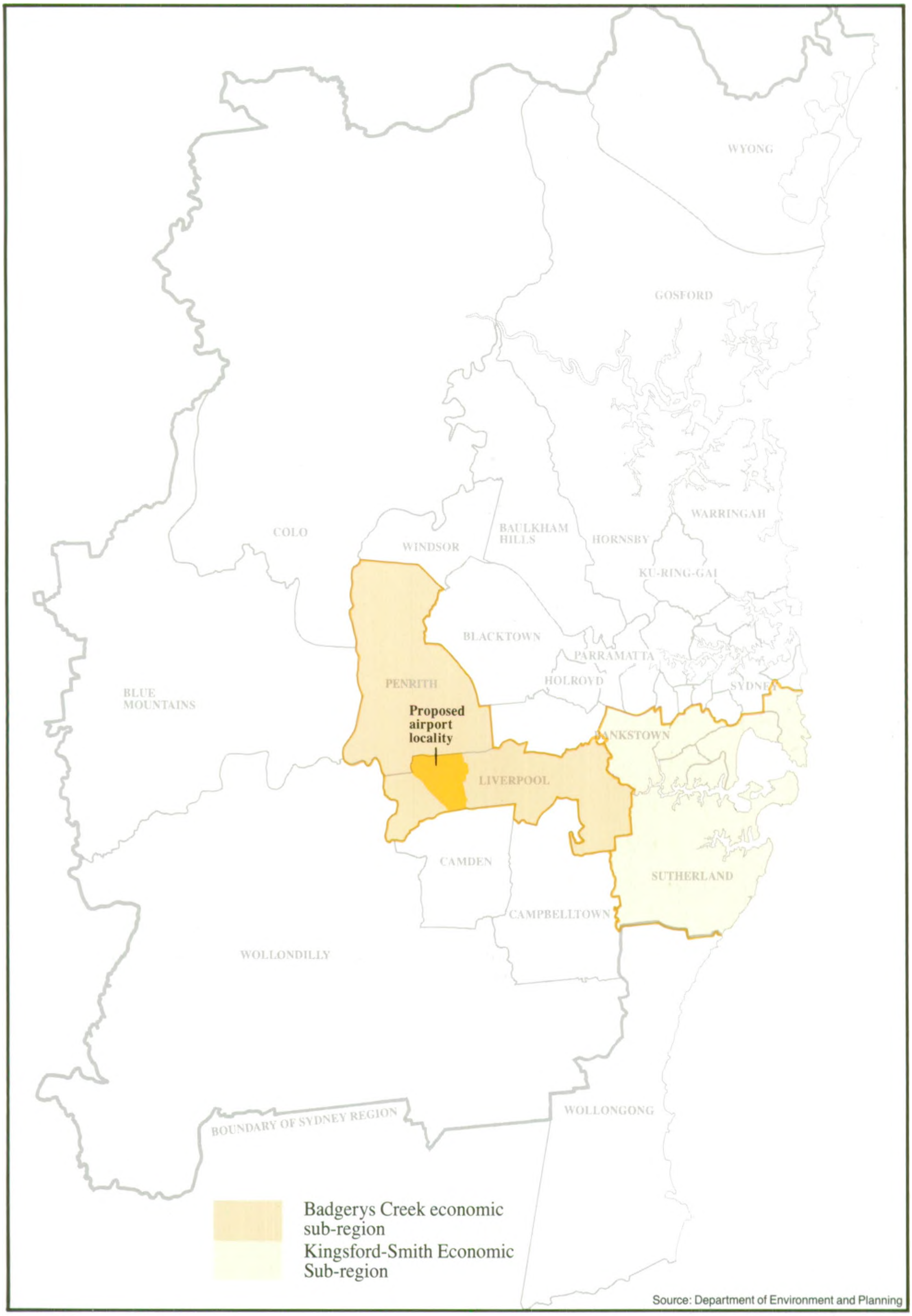


Figure 9.6.1
ECONOMIC EFFECTS STUDY AREAS – BADGERYS CREEK

Social characteristics

Table 9.6.3 presents key social indicators for Badgerys Creek derived from the 1981 Census. While on some social indicators Badgerys Creek was comparable to the averages for the Sydney Region, it had the following distinguishing features:

- only 42% of the 1981 residents had been there in 1976
- 34% of residents were aged under 15
- the 1981 population was 64% higher than the 1976 population.

Table 9.6.3 Social indicators, 1981

Indicator	Badgerys Creek	Badgerys Creek sub-region	Kingsford-Smith sub-region	Sydney Region
Percentage of people in same dwelling as in 1976	42	45	52	52
Percentage of people aged under 15	34	30	20	24
Average no. of people per household	3.6	3.5	3.0	3.0
Percentage population growth, (or decline) 1976 to 1981	64	17	(7)	4
Percentage of people born overseas	27	24	34	26
Percentage of households owning or purchasing home	72	67	67	67

Source: Australian Bureau of Statistics, 1981 Census.

Economic characteristics

Table 9.6.4 presents key economic indicators for Badgerys Creek derived from the 1981 Census. These indicate important differences in the local economy compared with those of the Kingsford-Smith sub-region and the Sydney Region. These economic differences, which were mainly related to the area's distinctive social features, were as follows:

- the overall participation rate (the number of employed plus unemployed expressed as a percentage of the population aged 15 and over) was comparatively high;

- the unemployment rate was comparatively high in the sub-region as a whole but low in Badgerys Creek itself;

- the proportion of the labour force working locally (i.e. within the same local government area as their place of residence) was comparatively high, although this partly reflects the geographic extent of the cities of Liverpool and Penrith;

- local jobs tended to be held by local residents to an above average extent;

- agriculture was the major economic activity in terms of employment;
- at the sub-regional level, manufacturing employment was proportionately more important than in the Sydney Region as a whole, but less than in the Kingsford-Smith sub-region;
- employment in community services and entertainment was proportionately less important than in the Sydney Region and Kingsford-Smith sub-region.

Table 9.6.4 Economic indicators, 1981*

Indicator	Badgerys Creek**	Badgerys Creek sub-region	Kingsford-Smith sub-region	Sydney Region
Participation rate (%)	70.4	66.0	62.1	62.3
Unemployment rate (%)	3.6	6.6	4.5	4.9
Ratio of labour force to employment	n.a.	1:0.74	1:0.71	1:1
Proportion of labour force employed locally (%)+	44	39	29	31
Residents employed locally, as a proportion of total local employment (%)	n.a.	53	41	31
Employment in agriculture (% of total employment)	42	2	<1	1
Employment in manufacturing (% of total employment)	25	27	32	23
Employment in trade (% of total employment)	9	21	21	20

* The indicators are calculated direct from data in 1981 Census tables, without any adjustments for such factors as underenumeration, absence on Census night, and responses not given.

** Apart from the participation and unemployment rates, the Badgerys Creek figures relate to the Badgerys Creek journey to work zone, which covers a larger area than the Census Collection District.

\+ Within the same local government area.

n.a. Not applicable.

Source: Australian Bureau of Statistics, 1981 Census.

If these differences were to persist into the future, they would influence the employment and other economic effects of airport operations at Badgerys Creek. For example, the lesser importance of manufacturing in the Badgerys Creek sub-region when compared with the Kingsford-Smith sub-region would result in lower multiplier effects than those of Kingsford-Smith Airport.

The employment opportunities within the local area are relatively limited. The major opportunities are in the agricultural sector, particularly chicken farming, and at the nearby communication centres. Service industries in the locality are restricted to some minor retailing activities. The contractions in the regional labour market since 1981 would suggest that unemployment in the sub-region is likely to have increased markedly from the 1981 figure of 6.6%. The June 1984 unemployment rates for the Liverpool and Penrith local government areas are 13.3% and 11.1% respectively, in comparison with the Sydney estimate of 11.0%.

The major trend in employment in the area since 1976 has been a reduction in the percentage of the labour force involved in agriculture. The 1976 figure of 28.9% probably reflected the more rural nature of the area at that time, which has since altered with the increase in hobby farms and other land uses.

9.6.3 Future social and economic characteristics without airport development

The Badgerys Creek economic sub-region would have undergone substantial changes by the time an airport at Badgerys Creek became fully operational. By 2001, the 1981 population is forecast by the Department of Environment and Planning to have increased by 82% in the City of Penrith (from 110,500 to 201,000) and by 54% in the City of Liverpool (from 94,200 to 145,000). The areas of urbanization in the short-term are mostly located on the urban fringes closest to the proposed site. In the medium and longer term (to beyond 2001), rapid population growth could take place in some or all of the potential areas identified by the Department of Environment and Planning for urban development (Bringelly, Cecil Park, Londonderry, Marsden Park, Rouse Hill, Riverstone and Schofields). However, of these areas, only Cecil Park and Bringelly are close to the proposed site.

While the scale of population increase makes it difficult to predict future social characteristics, three changes seem likely:

- it is probable that local employment will grow at least as fast as the population and, while it will not reach the level in the Kingsford-Smith sub-region, it will increase the prospects of significant multiplier effects in the sub-region as compared with the situation at present;

- even without the airport, Badgerys Creek will lose some of its remaining rural characteristics;

- the continued rapid population increase will help maintain some of the social characteristics associated with rapid population growth, although the age structure will become closer to the average for the Sydney Region as the existing residents age, and the labour force participation rates can be expected to stay high.

9.6.4 Effects at acquisition stage

The social and financial consequences of acquisition for the residents of the site are discussed in Section 9.1. However, in addition to those immediate effects there is a range of possible economic effects of acquisition on the sub-region to be considered.

Effects of compensation payments

A project involving extensive land purchase can sometimes have significant effects on a sub-region through funds paid to existing land owners for the purchase of land. However, as land purchases per se constitute a transfer transaction rather than an economic transaction, they contribute to the local economy only if vendors reinvest their sale proceeds in productive processes in the sub-region. There is no reason to think that this would occur to any significant extent, and therefore it is presumed that the economic effect of land purchase on the sub-region would be insignificant.

Displacement of existing economic activity

Prior to airport construction, it is possible that the land acquired by the Commonwealth might be used for economic activities that are less productive than those for which the land is presently being used. Any such loss of production would have negative regional flow-on effects in the local region and in the Sydney Region as a whole. While the extent of these flow-on effects on an absolute basis is not known, it is likely to be only very small or even non-existent given the Commonwealth's proposals for management of the land following acquisition (Section 9.1).

Effect on land prices

The acquisition of 1,770 ha could affect the local land market by increasing the demand for similar properties. However, this possibility would be reduced by the Department of Aviation's intention to lease back acquired properties to those owners who wished to continue under such an arrangement. Even if demand for similar properties were to increase, it would only be one of many factors affecting the property market in the sub-region and the effect would thus not be significant.

Expenditures associated with land acquisition

It is anticipated that any expenditure associated with the land acquisition process, such as for surveying and legal fees, would be inconsequential in terms of economic effects on the sub-region.

Effects on council income from rates

Prior to airport development, acquired properties would be leased back to the present owners or, where this was not required, leased by public tender (Section 9.1). In either circumstance, the Commonwealth would make ex gratia payments to the shire in lieu of rates.

9.6.5 Effects at construction stage

Construction of an airport at Badgerys Creek at the level of development described in the preliminary master plan would have significant economic effects on the locality, the sub-region, and the Sydney Region.

Displacement of existing economic activity

Construction would mean the displacement of the existing economic (predominantly agricultural) activities on the site, which would be accompanied by negative flow-on effects in the sub-region. These effects are assessed in Section 9.7.

Estimating the direct economic effects

On the basis of data from recently constructed airports, it is estimated that airport construction at Badgerys Creek would require approximately 7,000 person-years of work, with the construction workforce in the peak year reaching about 1,600 people.

Estimating the economic multiplier effects

Since it is not practicable to construct input-output tables for the future economy of the Badgerys Creek economic sub-region at a construction date not yet determined, it is difficult to specify accurately the employment flow-on or multiplier effects on the sub-region of airport construction. Nevertheless, using the multiplier for the building and construction sector of the Kingsford-Smith sub-region, it is possible to postulate a range of employment multipliers for airport construction (Table 9.6.5). This range of multipliers was defined as follows:

- high multipliers: accepting without alteration the Kingsford-Smith sub-region multipliers;

- medium multipliers: discounting by 30% the Kingsford-Smith first-round effects (direct purchases from other industrial sectors) and industrial support effects (further industrial flow-on effects triggered by the purchases in the first round), in order to reflect the simpler economic structure of the Badgerys Creek sub-region; and discounting the consumption induced flow-ons by 20% to reflect the higher leakages of expenditure from the sub-region for the Badgerys Creek case;

- low multipliers: as for medium multipliers, but discounting by 50% and 40% respectively.

Table 9.6.5 Construction sector employment multipliers

Effect*	No. of employees per thousand dollars of construction output			
	Kingsford-Smith sub-region	Badgerys Creek sub-region		
		High	Medium	Low
Initial	0.018	0.018	0.018	0.018
First round	0.006	0.006	0.004	0.003
Industrial support	0.002	0.002	0.001	0.001
Consumption induced	0.006	0.006	0.005	0.003
Total effects**	0.031	0.031	0.028	0.025
Total effects divided by initial effect** (= multiplier)	1.71	1.71	1.53	1.39

* The initial effect is the initial stimulus (i.e. the construction activity) , the effect of which is being measured. The first-round effect refers to the direct purchases from other sectors to produce the construction output. The industrial support effect refers to the further industrial flow-on effects triggered by the purchases in the first round. The consumption-induced effects stem from the spending of household income received as payments for labour used in producing the additional output.

** Because of rounding, these numbers do not check precisely with numbers above.

Applying these multipliers to the Badgerys Creek sub-region indicates that the peak year employment of 1,600 would generate employment flow-ons in the sub-region of between about 600 and 1,100 jobs. ← 848 using medium multiplier

An employment flow-on in the Sydney Region of about 1,800 jobs was calculated by applying the Sydney Region building and construction multiplier from the Sydney Region input-output table (Jensen et al. 1985) to the estimated peak year construction workforce. This figure of 1,800 jobs for the Sydney Region includes the 600 to 1,100 jobs in the sub-region.

9.6.6 Effects at operational stage

Direct employment

The maximum direct employment levels that could be associated with a second Sydney airport operating at a level of 13 million passengers per year were estimated by reference to the present numbers of employees per million passengers and per thousand aircraft movements at Australian airports (Table 9.6.6) and assumptions as to the maximum likely ratios of employment to traffic in the future. The result of this exercise was an estimated maximum direct employment of 10,500.

Table 9.6.6 Ratios of employees to air traffic at three Australian airports, 1983

Airport sector	Ratio	Airport		
		Kingsford-Smith	Tullamarine	Brisbane*
International airlines	Employees per million passengers	3,393	563	285
Domestic airlines	Employees per million passengers	472	1,113	665
Airport commerce	Employees per million passengers	95	113	133
Airport administration	Employees per million passengers	185	249	198
	Employees per thousand aircraft movements**	15.8	20.1	16.0
General aviation	Employees per thousand aircraft movements	1.9	n.a	2.3

* 1981 data.

** Excluding commuter and general aviation aircraft movements.

n.a. Not applicable.

Source: Department of Aviation statistics and surveys.

The employment ratios used and their derivations from Table 9.6.6 were as follows:

. **Airlines:** A maximum ratio of 540 employees per million passengers was assumed. Although there are normally more international airline employees per million passengers than domestic airline employees, a single ratio had to be assumed because the balance between domestic and international traffic at a second Sydney airport is not known at this stage. Also, in the case of both domestic and international airlines, the number of employees per million passengers is strongly influenced by the location of major airlines' headquarters and maintenance bases.

  Thus the high number of international airline employees per million passengers at Kingsford-Smith Airport is a consequence of the airport being the location of the headquarters of Qantas, as well as of most of its maintenance activity, its Australian Flight Catering Centre, and the home base of most of its flight and cabin staff. Similarly, the high number of domestic airline employees per million passengers at Tullamarine reflects the location there of the headquarters of the two major domestic airlines, as well as of most of their maintenance activities and home bases for flight and cabin staff.

It was considered possible that a second Sydney airport could be the base for a major domestic or international airline. The future number of employees per million passengers would also depend on the extent to which productivity improvements had been achieved in the airline industry by the time the airport reached its maximum traffic level. The ratio of 540 airline employees per million passengers can thus be taken as representing either of two possible situations:

- no improvement in airline productivity and limited maintenance activity;

- significant improvement in productivity but a high level of maintenance activity.

. **Airport commerce:** A ratio of 60 employees in airport commercial activities per million passengers was assumed. This is less than the ratios at Kingsford-Smith, Tullamarine and Brisbane airports to allow for some economies of scale for a larger airport. Economies of scale largely explain the lower Kingsford-Smith Airport ratio. In estimating the maximum likely employment, it was considered that no allowance should be made for future economies of scale or economies through improved layout of facilities, as present ratios for airport commerce are less likely to change than those in other airline industry sectors. This is because the nature of the activities in this sector, especially the catering and retail activities, limits the possibilities of significant productivity improvements, particularly given the marked productivity changes already achieved in these activities over the last twenty years. Also, any move to 'no-frills' flights is likely to lead to increased retail and catering facilities at the terminal as passengers substitute pre-departure purchases for goods such as food and magazines previously provided in-flight. Thus, the effects on employment of productivity improvements would be offset by the effect of greater sales.

. **Airport administration:** A ratio of 180 employees per million passengers in airport administration was assumed.

. **General aviation:** A ratio of 4 employees per thousand aircraft movements was assumed for general aviation. This is more than at Kingsford-Smith Airport, but Table 9.6.5 does not include data for Bankstown, by far the most important general aviation airport in the Sydney Region, which has an estimated 7.6 employees per thousand aircraft movements. The more important the general aviation airport, the higher the employment ratio is likely to be. Compared with Kingsford-Smith Airport, a second Sydney airport would both have more traffic (under the worst case assumptions) and be without the physical constraints on accommodating ground facilities for general aviation.

Airport associated employment

Airport associated employment is employment that is directly related to the operation of the airport, and required to be in close proximity to it but not necessarily on site. It includes those people employed in car rental firms, passenger transport and accommodation, and the air freight industry. In the case of Kingsford-Smith Airport, it was estimated that 1,400 people are employed in the airport associated sector, with 900 of this total being employed in the air freight and customs clearance industry.

However, it would seem unlikely that airport associated employment would reach this level at a second airport. This is because, although it is difficult to gauge the magnitude of employment in the freight sector, especially given the dependence of the industry on Australian Customs Service regulations, it seems unlikely that freight forwarders and customs agents would duplicate their operations at a second airport. The more likely outcome would involve either some minor warehousing operations at a second airport or the transfer of freight directly from the aircraft for bulk removal to a central processing point elsewhere.

Thus, it is assumed that airport associated employment would total between 500 and 900 people.

Airport induced employment

Airport induced employment is employment in firms attracted to an area by the presence of an airport, but not necessarily connected with it. Although it has been suggested that airports attract substantial amounts of industry to the surrounding area, the little empirical evidence that is available suggests that these effects have been greatly exaggerated (Fordham 1970; Hoare 1979). This evidence, together with the decentralized location at Badgerys Creek, suggest that it is unlikely that any significant airport induced employment would occur. Thus a maximum induced employment level of 100 people is assumed.

Multiplier effects

The multiplier or flow-on employment effects of a second airport are the impacts resulting from expenditure by those firms included in the direct and airport associated employment sectors and from the expenditure by the employees in these sectors. A starting point for the multiplier estimates for a second airport are the estimates of the multiplier for the Kingsford-Smith sub-region outlined in Section 9.6.1. However, this multiplier value will overestimate the second airport multipliers for two reasons.

First, unlike the Badgerys Creek area, the Kingsford-Smith sub-region has a large and highly developed manufacturing base.

Second, the Kingsford-Smith sub-region multiplier will overestimate the proposed airport flow-on effects because the consumption induced flow-ons (i.e. the flow-ons associated with the expenditure of employees) will be smaller in the case of a second Sydney airport. This is because there would be a greater leakage of wage and salary payments out of the Badgerys Creek sub-region and a greater propensity to import goods and services into the sub-region. It is not possible to specify accurately the multipliers for a second airport without an input-output table for the sub-region, but an estimate can be made by discounting the components of the Kingsford-Smith Airport multipliers.

Applying the Kingsford-Smith sub-region multipliers to the maximum direct employment estimates without modification would give estimates of flow-on employment that are unlikely to be reached. However, for the purposes of arriving at a maximum estimate, the Kingsford-Smith multipliers were discounted only to reflect the absence of an oil refinery in the Badgerys Creek sub-region. Under this assumption, the maximum flow-on employment in the sub-region would be approximately 2,300.

Assuming that the Sydney Region flow-on multiplier for the proposed airport was identical to the Kingsford-Smith Airport case, the flow-on employment for the Sydney Region resulting from the operation of a second airport at full capacity would be about 10,500.

2300 / 10500 x 1.01

Effects on rates

As the Commonwealth Government does not normally pay rates to local councils on Commonwealth land used for airports, the City of Liverpool would suffer a loss of rate income. In 1982, rates levied accounted for 61% of the City's income. However, as airport development would reduce the number of rateable properties in the city by less than 1%, the loss to the City would be very small. As against the loss of rate income in respect of existing properties and uses, the city of Liverpool would gain through the ex gratia payments that the Commonwealth normally makes in lieu of rates for those sections of land within the airport that are revenue earning, e.g. concessionaire operations, airline facilities, leased car parks, and other facilities leased to commercial operators. The City would also gain rate income from property development resulting from multiplier effects within the City.

9.7 AGRICULTURE

This section describes the nature and extent of agricultural activities now being undertaken within the proposed Badgerys Creek site and the 25 ANEF contour. Data were collected by visiting farms in the area and by speaking with their owners or managers; information was also provided by personnel from the NSW Department of Agriculture, the Soil Conservation Service, the Moss Vale Pastures Protection Board, the NSW Dairy Corporation and the Australian Bureau of Statistics. In addition, use was made of recent aerial colour photographs of the area.

9.7.1 Description of the existing environment

The total area of the proposed airport site is estimated to be 1,770 ha. Of this, approximately 1,405 ha are used for agricultural activities, with the remainder being used for non-agricultural purposes, mainly housing and roads. The additional area outside the proposed site but within the 25 ANEF contour is estimated to comprise 2,553 ha, 1,898 ha of which are used for agricultural purposes, while the remainder consists of rocky outcrops, timbered areas, water storages or land used for housing and roads.

The principal agricultural activities in terms of land use in the area are beef cattle grazing, dairying, horse agistment, thoroughbred horse spelling and the training and spelling of trotting horses. Other agricultural activities include intensive livestock industries such as the raising of pigs and poultry (broilers and layers), and intensive cropping industries such as vegetable growing (particularly tomatoes) and nurseries. Part of a CSIRO research station as well as part of the University of Sydney's McGarvie Smith Farm, both of which are located on Elizabeth Drive, are within the 25 ANEF contour.

In terms of gross value of production, thoroughbred horse spelling, egg production and the training and spelling of trotting horses are the principal activities. Dairying and thoroughbred horse spelling are the principal agricultural activities in terms of net value of production.

Rural land capability

Both the Soil Conservation Service and the Department of Agriculture have adopted systems for classifying land according to its suitability for agricultural use.

The Soil Conservation Service has developed a standard eight-class rural land capability classification system which ranks the potential safe use of land for general rural purposes. This classification system, which is set out in Table 9.7.1, consists of a hierarchical sequence based on the type and intensity of land management practices necessary to prevent soil erosion and maintain the productivity of the land.

The Department of Agriculture uses a five-class system, set out in Table 9.7.2, which ranks land according to a number of factors. These include the general productive capacity of the land, as well as the effects of climate, topography and soil characteristics in limiting the suitability of land for agricultural use.

Most of the land within the proposed site and within the 25 ANEF contour occurs in association with soils derived from the Wianamatta Shale. Table 9.7.3 shows the rural land capability of these areas as classified by both the Soil Conservation Service and the Department of Agriculture.

Most of the land, about 80%, falls within Classes II and III of the Soil Conservation Service's classification system and within Class 3 of the Department of Agriculture's classification system. This is a reflection of the potential use of the land and its current or potential agricultural productivity. About 79% of the land within the site is currently used for agriculture, and about 74% of the land within the 25 ANEF contour but outside the proposed site. Figure 9.7.1 shows the rural land classifications as they relate to the proposed airport site and the area within the 25 ANEF contour.

Table 9.7.1 Rural land capability classification (Soil Conservation Service)

	Land classification and soil conservation practices	Interpretations and implications
Suitable for regular cultivation		
I	No special soil conservation works or practices.	Land suitable for a wide variety of uses. Where soils are fertile, this land has the highest potential for agriculture, and may be cultivated for vegetable and fruit production, cereal and other grain crops, energy crops, fodder and forage crops, and sugar cane in specific areas. Includes 'prime agricultural land'.
II	Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotation.	Usually gently sloping land suitable for a wide variety of agricultural uses. Has a high potential for production of crops on fertile soils similar to Class I but increasing limitations to production due to site conditions. Includes 'prime agricultural land'.
III	Structural soil conservation works such as graded banks, waterways and diversion banks, together with soil conservation practices such as conservation tillage and adequate crop rotation.	Sloping land suitable for cropping on a rotational basis. Generally used for the production of the same type of crops as listed for Class I, although productivity will vary depending upon soil fertility. Individual yields may be the same as for Classes I and II, but increasing restrictions due to the erosion hazard will reduce the total yield over time. Soil erosion problems are often severe. Generally fair to good agricultural land.
Suitable for grazing		
Occasional cultivation		
IV	Soil conservation practices such as pasture improvement, stock control, application of fertilizer and minimal cultivation for the establishment or re-establishment of permanent pasture.	Land not suitable for cultivation on a regular basis owing to limitations of slope, gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Comprises the better classes of grazing land of the State and can be cultivated for an occasional crop, particularly a fodder crop or for pasture renewal. Not suited to the range of agricultural uses listed for Classes I to III. If used for hobby farms, adequate provision should be made for water supply, effluent disposal and selection of safe building sites and access roads.
V	Structural soil conservation works such as absorption banks, diversion banks and contour ripping, together with the practices as in Class IV.	Land not suitable for cultivation on a regular basis owing to considerable limitations of slope, gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Soil erosion problems are often severe. Production is generally lower than for grazing lands in Class IV. Can be cultivated for an occasional crop, particularly a fodder crop, or for pasture renewal. Not suited to the range of agricultural uses listed for Classes I to III. If used for hobby farms, adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads.
No cultivation		
VI	Soil conservation practices including limitation of stock, broadcasting of seed and fertilizer, prevention of fire and destruction of vermin. May include some isolated structural works.	Productivity will vary due to soil depth and soil fertility. Comprises the less productive grazing lands. If used for hobby farms, adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads.
Others		
VII	Land best suited for green timber. Generally stock should be excluded.	Generally comprises areas of steep slopes with shallow soils. Clearing of timber from these sites is not recommended. Where clearing has occurred, the area should be allowed to revert to timber.
VIII	Cliffs, lakes or swamps.	Land unusable for agricultural or pastoral uses. Recommended uses are those compatible with the preservation of the natural vegetation, namely: water supply catchments, wildlife refuges, national and State parks, and scenic areas.
U	Urban areas.	
M	Mining and quarrying areas.	

Source: Soil Conservation Service 1982.

Table 9.7.2 Guide to agricultural suitability classification (Department of Agriculture)

Suitability classes	Horticulture				Field crops				Grazing: Pasture			
	Vegetables		Tree crops		Regular		Rotation	Occasional	Improved		Native	
	Irrigated	Rain-fed	Sensitive	Tolerant	Irrigated	Rain-fed			Irrigated	Rain-fed	Seasonal	Rough
Class 1: Land capable of regular cultivation for cropping (cereals, oilseeds, fodder, etc.) or intensive horticulture (vegetables, orchards). It has a very good capability for agriculture, and there are only minor or no constraints to sustained high levels of production. It includes irrigated areas with high production.	**	*	**	*	*	*	*	*	*	*	*	*
Class 2: Land suitable for cultivation for cropping, but not suited to continuous cropping or intensive horticulture. It has good capability for agriculture, but constraints limit the cropping phase to a rotation with improved pastures and thus reduce the overall level of production.	+	**	+	*	**	**	*	*	**	*	*	*
Class 3: Land suitable for grazing — well suited to pasture improvement and can be cultivated for an occasional cash crop or forage crop in conjunction with pasture management. The overall level of production is moderate as a result of high environmental costs which limit the frequency of ground disturbance. Has a moderate capability for agriculture. Pasture land capable of sustained high levels of production, although conservation measures may be required.	+	+	+	**	+	+	**	**	+	**	*	*
Class 4: Land suitable for grazing and not suitable for cultivation. Agriculture is based on native pastures or improved pastures relying on minimum tillage techniques. The overall level of production is low. Environmental constraints make arable agriculture uneconomic.	++	++	++	+	++	++	++	++	++	+	**	*
Class 5: Land suited for only rough grazing or land not suited to agriculture. Agricultural production is very low or zero. Severe or absolute constraints to production are imposed by environmental factors.	++	++	++	++	++	++	++	++	++	++	++	+

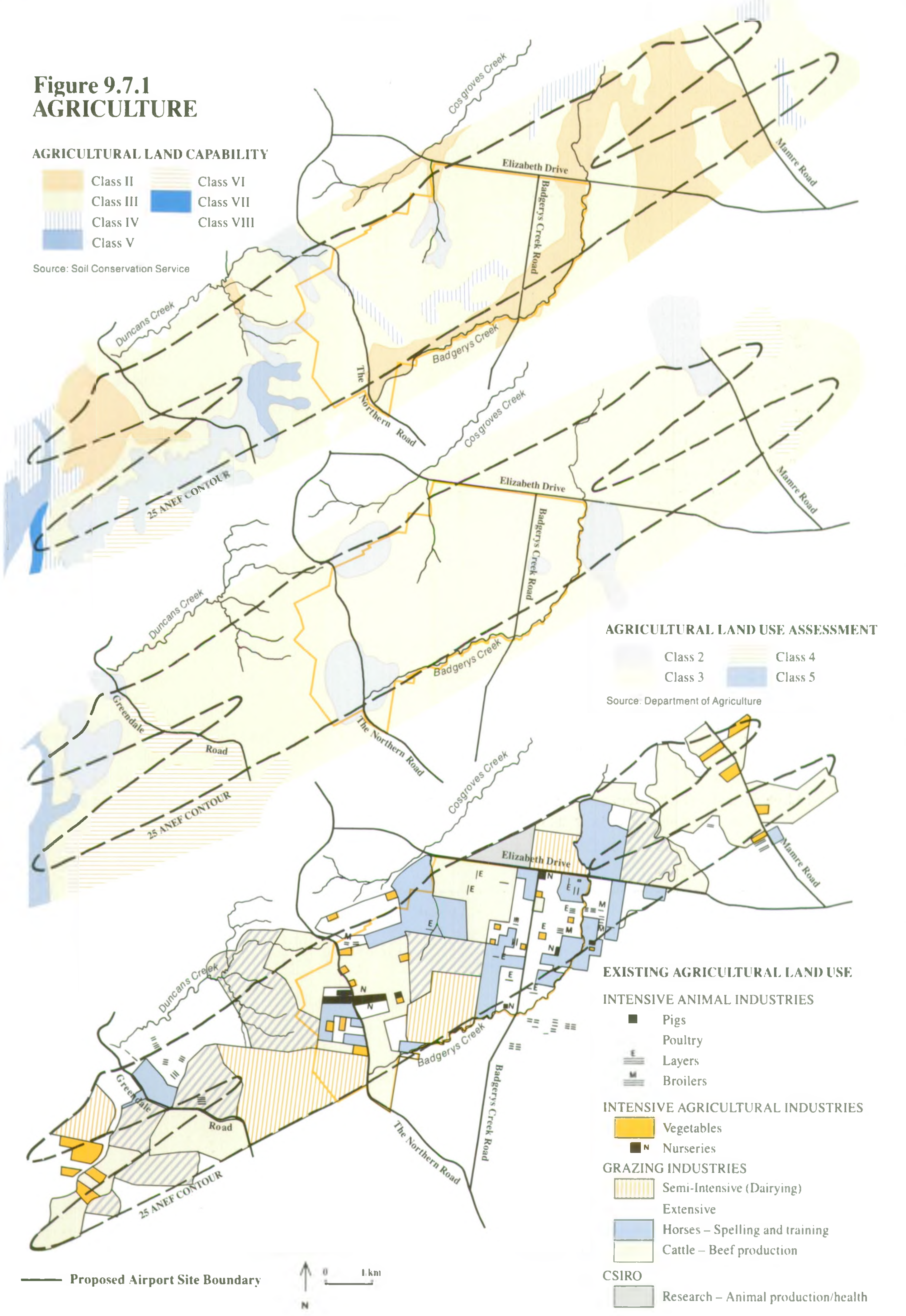
* Class having requirements in excess of those needed for sustained production from the land use.
** Class having the minimum requirements for sustained production from the land use.
\+ Class may be suited to the land use depending on the nature of the limiting factors to cultivation and crop production.
++ Class not suited to land use because of limiting factors to cultivation and/or production.

Table 9.7.3 Proportion of land within the proposed site and 25 ANEF contour, by capability class

<table>
<tr><th colspan="2">Land class</th><th colspan="4">Area (ha)</th></tr>
<tr><th rowspan="2">SCS*</th><th rowspan="2">Dept of Ag.**</th><th colspan="2">Airport site</th><th colspan="2">25 ANEF contour+</th></tr>
<tr><th>SCS</th><th>Dept of Ag.</th><th>SCS</th><th>Dept of Ag.</th></tr>
<tr><td>I</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>II</td><td rowspan="2">2</td><td>220</td><td rowspan="2">255</td><td>415</td><td rowspan="2">185</td></tr>
<tr><td>III</td><td>1,230</td><td>1,603</td></tr>
<tr><td>IV</td><td rowspan="2">3</td><td>180</td><td rowspan="2">1,515</td><td>70</td><td rowspan="2">1,860</td></tr>
<tr><td>V</td><td>75</td><td>310</td></tr>
<tr><td>VI</td><td>4</td><td>65</td><td>-</td><td>40</td><td>495</td></tr>
<tr><td>VII</td><td rowspan="2">5</td><td>-</td><td rowspan="2">-</td><td>5</td><td rowspan="2">13</td></tr>
<tr><td>VIII</td><td>-</td><td>110</td></tr>
<tr><td>Total</td><td></td><td>1,770</td><td>1,770</td><td>2,553</td><td>2,553</td></tr>
</table>

* Soil Conservation Service.
** Department of Agriculture.
\+ Excludes area within proposed site.

Figure 9.7.1
AGRICULTURE



Development of land uses

In the past, most of the proposed site area and its surroundings have consisted of native, semi-improved and improved pastures supporting extensive and semi-intensive grazing industries. The poultry industry has been important also, with a concentration of establishments around the Badgerys Creek township. Vegetable production has been restricted to the smaller pockets of better soil types. More recently, however, much of the area around the Luddenham and Badgerys Creek townships has been subdivided for housing, small hobby farms and trotting horse training and spelling establishments. A few nurseries have also been established.

Present agricultural land uses within both the proposed site and the 25 ANEF contour are shown in Figure 9.7.1 and summarized in Table 9.7.4.

Table 9.7.4 Present agricultural land use

Industry	Total area utilized			
	Within airport site (ha)	(%)	Within 25 ANEF contour (ha)	(%)
Intensive livestock industries				
Pigs	10	1	2	-
Poultry	14	1	15	-
Intensive cropping industries				
Nurseries	24	2	-	-
Vegetables	42	3	40	1
Grazing industries				
Semi-intensive				
. Dairying	285	20	442	30
. Trotting horse training/spelling	110	8	50	3
Extensive:				
. Beef cattle	522	37	817	41
. Thoroughbred horse spelling	130	9	155	7
. Horse agistment	268	19	317	15
CSIRO McMaster Research Station	-	-	60	3
Total	1,405	100	1,898	100

Note: Land owned by the University of Sydney at Badgerys Creek is classified either as 'dairying' or 'beef cattle'.

It can be seen from Table 9.7.4 that the grazing based industries dominate the present agricultural land uses, representing about 93% of the total area within the proposed airport site and about 99% of the area outside the site but within the 25 ANEF contour. However, in the absence of airport development, the area utilized for grazing is likely to decline in the future, as the trend towards further residential development (especially on the outskirts of existing townships) as well as subdivision for hobby farms would probably continue.

Continuing subdivision for hobby farms would also reinforce the trend towards an increasing number of horses in the area at the expense of cattle (B.E. Young, Secretary, Moss Vale Pastures Protection Board, pers. com.). Nevertheless, cattle are unlikely be completely replaced by horses on commercial properties, as cattle and horse grazing is complementary to a degree. This is because cattle can be grazed on small areas at high stocking rates for short periods of time to eat down rank growth which horses leave untouched and which would otherwise have to be cut with a slasher to maintain the pasture.

The extent of the area used for dairying is likely to remain much the same in the foreseeable future owing to the quota system which regulates supply.

In the Greater Sydney Region the poultry industry is closely integrated with the horticultural industry. Litter by-product from poultry is a valuable fertilizer, and it is used on most horticultural farms to improve the soil's physical and chemical characteristics. It is therefore advantageous for poultry farms and horticultural enterprises to remain in close proximity to each other.

9.7.2 Agricultural production

Agricultural activities in the area have been classified into three broad industry categories:

- intensive livestock industries
- intensive cropping industries
- grazing industries.

The current annual gross value of agricultural production is estimated to be $5.0 million for the area of the proposed site, and $3.3 million for the area outside the proposed site but within the 25 ANEF contour.

Intensive livestock industries

Piggeries
The three piggeries located within the proposed site are estimated to run a total of 125 sows, and there is one piggery within the 25 ANEF contour which is estimated to run ten sows. Two of the piggeries within the proposed site produce the major proportion of the income for the properties on which they are situated, while the other two enterprises are merely subsidiary to other farming operations. The pigs are raised for bacon and sold at the Homebush market.

The major components of feed used in these piggeries are breakfast cereal waste and stale bakery produce, which are slightly cheaper than alternative feedstuffs. However, the profitability of bacon production is declining owing to the high capital costs of piggery buildings and effluent disposal equipment. With encroaching urbanization, it would appear that pressures resulting from council and State Pollution Control Commission regulations will lead to piggeries being relocated to less populated areas.

The 'gross margin' (gross returns less variable costs) of a fifty-sow piggery has been estimated to be $8,960, or $179 per sow. The overhead costs of such an enterprise have been estimated to be $7,700 per annum, leaving a net income of $1,260, or $25 per sow.

Poultry
The poultry industry comprises both the broiler industry, which produces chickens for white meat, and the egg industry. Both these industries have a significant servicing sector dominated by large companies. These companies are vertically integrated and provide feed, day-old chickens or started pullets, and processing works for broilers.

- **Broilers:** The survey indicated that there are three establishments with an estimated combined capacity of 165,000 chickens located within the proposed site, and a further three establishments with an estimated combined capacity of 255,000 birds within the 25 ANEF contour.

Broiler chickens are raised under contract to processors who have plants in the near vicinity. They are grown on deep litter on a single-age batch basis, with the poultry sheds being fully stocked with day-old chickens over a very short period. They are then raised in the sheds for a 6-9 week period before being slaughtered. This takes between five and ten days and the sheds then remain unstocked for about fourteen days before delivery of the next batch of day-old chickens. On average, four to five batches are produced annually from each shed.

Proximity to large cities is important in broiler production, to ensure that the perishable meat is supplied to markets nearby and that a supply of labour is available. Owing to increasing transport costs, it is also desirable for farms to be close to the hatchery, feed mill and processing plant (100 km is the maximum recommended distance for the transport of poultry to processing plants).

The gross margin of a typical one-family broiler farm with a 45,000 bird capacity has been estimated to be $22,500, or $500 per 1,000 bird capacity. The estimated overhead costs of a farm of this size are $11,300 per annum, leaving a net return of $11,200, or $249 per 1,000 bird capacity.

- **Layers:** Eight establishments with an estimated combined capacity of 67,000 layers were found to be within the proposed site, while there were a further three establishments with an estimated combined capacity of 24,000 layers within the 25 ANEF contour. The egg industry is regulated by a quota system to ensure an adequate supply of eggs throughout the year to the local market. The industry is therefore reasonably static.

  Layers on average produce eggs over a twelve to fourteen month period before being sold to abattoirs. The average egg production over twelve months is approximately 240 eggs (20 dozen) per hen housed. Most eggs produced are sold to the Egg Marketing Board, which sets the wholesale egg price received by the producers. The estimated gross margin of a typical family farm with a 10,000 hen quota is $24,000, or $2,400 per 1,000 hen quota. The overhead costs of a farm of this size have been estimated to be $12,500 per annum, leaving a net return of $11,500, or $1,150 per 1,000 hen quota.

- **Poultry service industries:** Two companies, Ingham's and Hy-Line, which service both the broiler and laying industries, have portions of their operations situated in the Badgerys Creek and Luddenham areas. Ingham's Multiplication Farm, consisting of fifty-six sheds, each containing 8,000 hens, is situated just south of Badgerys Creek outside the limit of the 25 ANEF contour. This farm produces fertilized eggs which are sent to hatcheries, from where day-old chickens for either white meat or egg production are dispatched.

  The Hy-Line Nucleus Farm on Greendale Road comprises a total of sixteen sheds and is situated almost entirely within the 25 ANEF contour. Fourteen of the sixteen sheds on this property (each containing 5,000 hens, making a total of 70,000 hens) lie within the 25 ANEF contour and all the genetic work for the Hy-Line group is carried out on this property. Eggs are hatched here and the productivity of birds is measured to ascertain the genetic improvement of strains. Since the activities conducted on this property are part of the much wider operations of the Hy-Line group, no attempt has been made to put a monetary value on the production from this property.

Intensive cropping industries

Nurseries

There are five nurseries within the proposed site. Four of these are wholesale nurseries, selling their produce to retail shops or at the Flemington market, while the other nursery is a cut-flower enterprise.

An important characteristic in the siting of the larger nurseries is the good water catchment available to fill dams for irrigation purposes. The other major factors determining their siting are the low incidence of frosts, and their proximity to the Flemington market, which minimizes the deterioration of cut flowers and plants during transit. Nurseries are labour-intensive enterprises, and the availability of suitable labour is another consideration when choosing a site.

The returns from cut-flower production are assumed to be similar to those from the production of shrubs or indoor plants. A typical wholesale nursery of 4 ha is expected to produce a gross margin of $16,000 per annum, or $4,000 per hectare. The estimated overhead costs of such an establishment are $5,000 per annum, leaving a net income of $11,000 per annum, or $2,750 per hectare.

Vegetables

The survey indicated that there are eight properties growing vegetables on a commercial scale within the proposed site. It is estimated that vegetable growing is the major activity on five of these properties, and is combined with other activities such as poultry farming on the remaining properties. Within the 25 ANEF contour, the survey found that a further three properties had vegetable growing as their principal focus.

Most vegetable farms are family operations with very little outside labour employed except during harvest. Almost all the vegetables grown, with the exception of those sold at roadside stalls, are delivered to the fresh market at Flemington, where many of the larger growers have their own stalls. The major vegetable crop (tomatoes) represents about 80% of the total area producing vegetables within the proposed site and within the 25 ANEF contour. Other sizeable crops include cabbages, cauliflowers, lettuces, capsicums, cucumbers and zucchini.

The estimated gross margin of tomatoes is $4,363 per hectare, while for cabbages and zucchini it is $1,927 and $1,241 per hectare respectively. A typical vegetable farm comprises 10 ha, 5 ha of which are devoted to vegetable growing (4 ha of tomatoes, and 0.5 ha each of cabbages and zucchini). The returns from cabbages and zucchini are considered to be representative of the other crops grown in the area. The total gross margin of a vegetable farm of this nature is expected to be $19,036 per annum, or an average of $3,807 per hectare of vegetables grown. The overhead costs for such a property are estimated at $7,300 per annum, producing a net income of $11,736 per annum, or $1,174 per total hectare of the property.

The net income per hectare of such properties is relatively low compared with the gross margin per hectare of vegetables grown. This is because only about half the farm area is cropped at any one time, because of the need to leave ground fallow for a period and to rotate the type of vegetable crop planted, in order to reduce the incidence of disease in crops. The availability of water for irrigation and of labour can also restrict the area of vegetables grown in any one year.

Grazing industries

The grazing industries in the area have been divided into three categories: semi-intensive, extensive, and the CSIRO McMaster Research Station. The University of Sydney runs a commercial dairy and a beef enterprise on its land to the north of Badgerys Creek township, so these enterprises have been included in the respective classifications.

Semi-intensive grazing

This category includes dairying and trotting horse training and spelling:

- **Dairying:** A dairy farm located between Longleys Road and Badgerys Creek, and part of the large dairy complex situated along The Northern Road, are included in the proposed site. Most of the remainder of this latter farm, plus most of the

University of Sydney's McGarvie Smith dairy farm, lie within the 25 ANEF contour. All these dairying properties are based on whole milk production, with Friesian cows predominating because of their higher milk output.

Grazing is based on irrigated improved pastures and fodder crops, plus supplementary purchased fodder such as hay, grain and brewers' grain. The large dairy complex on The Northern Road uses a feedlot in conjunction with grazing. It is a very highly developed property in terms of irrigation, feeding equipment and pasture production, and its carrying capacity is consequently much higher than the other properties. This Northern Road property is managed in conjunction with another very large and intensively run dairy just south of Bringelly.

Milk production is regulated by a quota system to limit supply, but growers must also produce their quota every week of the year to retain their quota. Any milk supplied in excess of a farm's quota attracts a price of less than half that of quota milk, so most farmers aim to produce only 115% of their quota to give them a small safety margin.

The gross margin of a 129-cow dairy herd (i.e. where 100 cows are milked all year round) is estimated at $97,850, or approximately $758 per cow. It is estimated that a dairy cow herd of this size plus replacement stock would require a farm area of 141 ha. This would result in a stocking rate of 20 DSE (dry sheep equivalents), which assumes that part of the property would be irrigated over the summer. In calculating the gross margin, supplementary feeding has been assumed to take place to ensure a high milk production rate per cow.

Pasture maintenance costs have been estimated to be $59 per hectare annually, or $8,319 per annum for the dairy farm used as an example. The pasture maintenance cost is based on the cost of establishing an improved pasture and of resowing this on average every six years. Total overhead costs for this model dairy farm have been estimated to be $20,000 per annum, most of which is made up of rates ($8,400) and depreciation ($5,200).

- **Trotting horse training and spelling:** The survey indicated that there were eleven trotting horse training and spelling establishments located within the proposed site, and a further five establishments within the 25 ANEF contour.

  Although horse husbandry (with the exception of Clydesdales) is not considered to be an agricultural industry, the training and spelling of trotting horses is the major activity on the properties concerned within the area. There is a concentration of trotting training complexes in the Badgerys Creek district, and the capital investment in these properties in terms of stables, yards and training tracks indicates that they represent a commercial enterprise. Horses, usually belonging to city residents, are trained or spelled for a fee. Owing to the intensity of the activity, little area is generally available for grazing, and purchased fodder provides the bulk of the horses' feed requirements.

  The gross margin of an average establishment of 10 ha with thirty horses has been estimated to be $15,000, or $500 per horse. Annual pasture maintenance costs are estimated at $590, and overhead costs at $6,000 per annum. Net income per establishment is therefore $8,410, or $280 per horse.

Extensive grazing

This category covers beef cattle grazing, thoroughbred horse spelling and horse agistment.

- **Beef cattle:** There are numerous beef cattle properties within the proposed site and within the area bounded by the 25 ANEF contour. They include trading enterprises (where steers are fattened for slaughter) as well as breeding enterprises (where cows and calves are run, with the latter — except those heifers required as replacements — being sold as vealers when ten to twelve months of age). The breeding enterprises range from those running four to five cows (which are often beef-dairy crossbreds fed on powdered milk) to pure-bred cows of traditional beef breeds such as Herefords. Trading enterprises vary from those where beef-dairy crossbred steers are fed on powdered milk and sold as yearlings, to those where weaner steers are purchased in store condition and fattened ready for slaughter.

The gross margin of each enterprise is similar when expressed on a DSE basis over a twelve month period: around $10 per DSE. The gross margin for a breeding herd calculated at $185 per cow has been used to determine the returns from beef cattle grazing in the area.

The cost for establishing improved pasture has been estimated at $142 per hectare while the improved pasture maintenance costs have been estimated to be $59 per hectare annually. It has been assumed that improved pastures are resown every six years and, as there are only moderate levels of phosphorus available in the soil, these are topdressed annually with 250 kg/ha of superphosphate.

These improved pastures have been estimated to carry 15 DSE per hectare on a year-round basis which assumes no irrigation. A 100-cow beef herd with replacement stock would therefore require an area of 120 ha, for which the annual pasture costs would be approximately $7,080. The overhead costs of this property have been estimated at $10,600 per annum, the main component of which is rates ($60 per hectare, or $7,200 in total). Since the gross margin of a 100-cow beef herd has been estimated to be $18,500, the net income for a 120 ha beef cattle property is $820, or approximately $7 per hectare.

- **Thoroughbred horse spelling:** There are also numerous racehorse spelling enterprises within both the proposed airport site and the 25 ANEF contour. Many of these enterprises are run in conjunction with beef cattle grazing on improved pastures. While not traditionally classified as an agricultural industry, many of these operations are obviously run on a commercial basis.

  These enterprises vary from those where racehorses are spelled in paddocks to more intensive operations where horses are spelled in yards or housed in stables. Many properties use a combination of both systems of management, having some horses in paddocks and some in stables.

  The horses, usually belonging to city residents, are spelled for a fee. The charge for paddock spelling is around $50 per week; for stable accommodation where the horse's feed requirements are met entirely from purchased fodder the fee rises to around $100 per week.

  The estimated returns from thoroughbred horse spelling in the area are based on an average farm of 20 ha spelling forty horses at a time. The gross margin of such an establishment has been estimated to be $35,000, or $875 per horse. Annual pasture maintenance costs are estimated at $1,180 and annual overhead costs are estimated to be $10,500. The estimated net income per establishment is therefore $23,320, or $1,166 per hectare.

- **Horse agistment:** A significant area of land within both the proposed airport site and the 25 ANEF contour is used for the grazing or agistment of horses of all descriptions. They range from children's ponies to broken-down racehorses and those which are kept merely to keep the grass down. Such enterprises are based on unimproved pastures, generally on poorer soil types, and with a low level of management to minimize expenditure.

The gross margin of an area of 40 ha of unimproved pasture with twenty horses agisted at any one time has been estimated to be $3,000, or $150 per horse. Overhead expenditure (mainly rates) has been estimated to be $1,620, leaving a net income of $1,380, or approximately $35 per hectare.

CSIRO McMaster Research Station
Sixty hectares of the CSIRO's McMaster Research Station on Elizabeth Drive are estimated to lie within the 25 ANEF contour. No attempt has been made to quantify the production from this establishment (which is run by the Division of Animal Production) as its focus is principally research.

Significance of agricultural production

A summary of present agricultural production from the area of the proposed site and from within the 25 ANEF contour is presented in Table 9.7.5. Comparison of the data in this table with Australian Bureau of Statistics 1982-83 agricultural census data for livestock at the local, regional and State level indicates the relative importance of agriculture in the area.

The numbers of pigs, dairy cows and beef cows within the area of the proposed site and within the 25 ANEF contour represent between 10-30% of the combined numbers in the areas covered by the cities of Liverpool and Penrith. In turn, the combined numbers in these cities represent less than 10% of the numbers in the Sydney Subdivision, with the exception of dairy cows where the combined Liverpool and Penrith totals represent about 20% of those in the Sydney Subdivision.

Table 9.7.5 Present agricultural production from within the proposed site and 25 ANEF contour area

Enterprise	Within airport site			Within 25 ANEF noise contour		
	Total area (ha)	Livestock numbers	Annual production	Total area (ha)	Livestock numbers	Annual production
Intensive livestock industries						
Pigs (bacon production)	12	125 sows	**	2	10 sows	**
Poultry	14					
. Meat production		165,000 broilers	742,500 broilers	15	225,000 broilers	1,012,500 broilers
. Egg production		67,000 layers	**		24,000 layers	**
. Breeding stock		None			70,000 hens	**
Intensive cropping industries						
Wholesale nursery	24			0		
Vegetables	42*			40*		
. Tomatoes	(17)		680 tonnes	(16)		640 tonnes
. Cabbages	(2)		2,600 cartons	(2)		2,600 cartons
. Zucchini	(2)		20 tonnes	(2)		20 tonnes
Grazing industries						
Semi-intensive						
. Dairying	285	260 cows	1,209,300 litres	442	405 cows	1,883,720 litres
. Trotting horse training/spelling	110	330 horses	**	50	150 horses	**
Extensive						
. Beef cattle	522	435 cows	**	817	680 cows	**
. Thoroughbred horse spelling	130	260 horses	**	155	310 horses	**
. Horse agistment	268	135 horses	**	317	160 horses	**
CSIRO McMaster Research Station				60		
Total area	1,405			1,898		

* Only 50% of farms producing vegetables at any point of time.

** No statistics recorded.

There are an estimated 725 horses within the proposed site, and a further 620 horses within the area of the 25 ANEF contour. This compares with only 189 horses recorded by the Bureau in the 1982-83 agricultural census. The reason for this discrepancy is that many of the properties supporting two to three horses are probably not classified as rural holdings for the purposes of the census.

Milk production in the area under study represents only a very small proportion of the milk production in the Sydney metropolitan area.

Broiler production in the area represents about 30% of the combined Liverpool and Penrith production. The combined broiler production in these two cities represents approximately 20% of the production in the Sydney Subdivision, which in turn is approximately 60% of that in the State as a whole. Layer hen numbers in the area represent about 10% of the combined Liverpool and Penrith total. The number of breeding fowls within the 25 ANEF contour area represents about 10% of the total in the City of Liverpool, and the latter total is about 50% of the Sydney Subdivision total. The number in the Sydney Subdivision represents approximately 90% of the total number in the State.

The estimated area used for tomato growing in the proposed site and within the 25 ANEF contour totals about 66% of the area under tomatoes in the cities of Liverpool and Penrith. In turn, this latter area represents approximately 10% of the area of tomatoes grown in the Sydney Subdivision, which is about 20% of the area under tomatoes in the State as a whole.

It can therefore be seen that the production figures for broiler chickens and tomatoes are significant in comparison with the numbers in the wider region. The number of broiler chickens produced in the proposed site and surrounding area forms a significant proportion of that of the Sydney Subdivision, which in turn represents the majority of the production in New South Wales. The area under tomatoes in the proposed site and within the 25 ANEF contour is significant in terms of the tomato growing area in the cities of Liverpool and Penrith but is a less significant proportion of the area under tomatoes in the Sydney Subdivision.

Value of agricultural production

Estimates were made of the gross margins and the annual net incomes (after labour costs have been deducted) for the various agricultural activities surveyed and are shown in Tables 9.7.6 and 9.7.7. These estimates were then used to determine the value of agricultural production within the proposed site and within the 25 ANEF contour.

Table 9.7.6 Gross margins of enterprises in the study area

Enterprise	Gross income ($)	Variable costs including labour ($)	Gross margin ($)	Gross margin per unit ($)	Gross margin per DSE ($)	Gross margin per ha ($)
Intensive livestock industries						
Pigs: bacon production (50-sow unit)	92,590	83,630	8,960	179/sow	-	-
Poultry						
. Broilers: meat production (45,000 bird unit)	60,000	37,500	22,500	500/1,000 birds	-	-
. Layers: egg production (10,000 hen quota)	180,000	156,000	24,000	2,400/1,000 hen quota	-	-
Intensive cropping industries						
Wholesale nursery (4 ha)	100,000	84,000	16,000	-	-	4,000
Vegetables						
. Tomatoes (1 ha)	18,000	13,637	4,363	-	-	4,363
. Cabbages (1 ha)	5,200	3,273	1,927	-	-	1,927
. Zucchinis (1 ha)	6,000	4,759	1,241	-	-	1,241
Grazing industries						
Semi-intensive						
. Dairying (129-cow unit)	188,950	91,100	97,850	758/cow	35	-
. Trotting horse training and spelling (30 horses)	100,000	85,000	15,000	500/horse	50	-
Extensive						
. Beef cattle: veal production (100-cow unit)	24,180	5,680	18,500	185/cow	10	-
. Thoroughbred horse spelling (40 horses)	125,000	90,000	35,000	875/horse	88	-
. Horse agistment (20 horses)	4,000	1,000	3,000	150/horse	15	-

Table 9.7.7 Annual net farm income (after labour costs)

Enterprise	Total gross margin ($)	Pasture costs ($)	Overhead costs ($)	Net farm income ($)	Net income per unit ($)
Intensive livestock industries					
Pigs (50-sow unit)	8,960	-	7,700	1,260	25/sow
Poultry					
. Broilers (45,000-bird unit)	22,500	-	11,300	11,200	249/1,000 bird capacity
. Layers (10,000 hen quota)	24,000	-	12,500	11,500	1,150/1,000 hen quota
Intensive cropping industries					
Wholesale nursery	16,000	-	5,000	11,000	2,750/ha
Vegetables (5 ha on 10 ha farm)	19,036	-	7,300	11,736	1,174/ha
Grazing industries					
Semi intensive					
. Dairying (129-cow unit)	97,850	8,319	20,000	69,531	493/ha
. Trotting horse training & spelling (30 horses)	15,000	590	6,000	8,410	841/ha
Extensive					
. Beef cattle (100-cow unit)	18,500	7,080	10,600	820	7/ha
. Thoroughbred horse spelling (40 horses)	35,000	1,180	10,500	23,320	1,166/ha
. Horse agistment (20 horses)	3,000	-	1,620	1,380	35/ha

Tables 9.7.8 and 9.7.9 present estimates of the current value of agricultural production within the proposed site and within the 25 ANEF contour respectively.

Table 9.7.8 Current annual value of agricultural production within proposed airport site

Enterprise	Area or number	Gross value of production ($)	Variable costs including labour ($)	Aggregate gross margin ($)	Pasture costs ($)	Overhead costs ($)	Net value of production ($)
Intensive livestock							
Pigs (bacon production)	125 sows	231,475	209,075	22,400	-	19,250	3,150
Poultry							
. Meat production	165,000 birds	220,000	137,500	82,500	-	41,435	41,065
. Egg production	67,000 layers	1,206,000	1,045,200	160,800	-	83,750	77,050
Intensive cropping							
Wholesale nursery	24 ha	600,000	504,000	96,000	-	30,000	66,000
Vegetables	42 ha	325,920	245,970	79,950	-	30,660	49,290
Grazing							
Semi-intensive							
. Dairying	285 ha	381,920	184,140	197,780	16,815	40,425	140,540
. Trotting horse training and spelling	110 ha	1,100,000	935,000	165,000	6,490	66,000	92,510
Extensive							
. Beef cattle	522 ha	105,185	24,170	80,475	30,800	46,110	3,565
. Thoroughbred horse spelling	130 ha	812,500	585,000	227,500	7,670	68,250	151,580
. Horse agistment	268 ha	26,800	6,700	20,100	-	10,855	9,245
Total		5,009,800	3,877,295	1,132,505	61,775	436,735	633,995

As shown in these tables, the gross value of agricultural production from the 1,405 ha of land used for agricultural activities within the proposed site has been estimated to be around $5 million, while the net value of production (after all costs have been deducted, including labour and depreciation but excluding interest on capital) has been estimated to be approximately $634,000. Of this net value of production, the major component is thoroughbred horse spelling which contributes $151,000 or 24%, followed by dairying, which contributes $140,000, or 22%. The 1,898 ha of land within the 25 ANEF contour that support agricultural activities are estimated to produce goods to a gross value of $3.3 million, while the net value of production from this area has been estimated to be about $588,000.

Table 9.7.9 Current annual value of agricultural production within the 25 ANEF contour

Enterprise	Area or number	Gross value of production ($)	Variable costs including labour ($)	Aggregate gross margin ($)	Pasture costs ($)	Overhead costs ($)	Net value of production ($)
Intensive livestock							
Pigs (bacon production)	10 sows	18,520	16,725	1,795	-	1,540	255
Poultry							
. Meat production	225,000 birds	300,000	187,500	112,500	-	56,500	56,000
. Egg production	24,000 layers	432,000	374,400	57,600	-	30,000	27,600
Intensive cropping							
Wholesale nursery	-						
Vegetables	40 ha	310,400	234,255	76,145	-	29,200	46,945
Grazing							
Semi-intensive							
. Dairying	442 ha	592,310	285,575	306,735	26,080	62,695	217,960
. Trotting horse training and spelling	50 ha	500,000	425,000	75,000	2,950	30,000	42,050
Extensive							
. Beef cattle	817 ha	164,625	38,670	125,955	48,205	72,170	5,580
. Thoroughbred horse spelling	155 ha	968,750	697,500	271,250	9,145	81,375	180,730
. Horse agistment	317 ha	31,700	7,925	23,775	-	12,890	10,935
Total		3,318,305	2,267,550	1,050,755	86,380	376,320	588,055

Dairying, which contributes approximately $218,000, represents 37% of this net value of production, followed by thoroughbred horse spelling, which contributes $181,000 or 31%. The reason for dairying being the major contributor to the net value of production in both these areas is the relatively high proportion of land occupied by dairy farms, despite their relatively low returns per hectare compared with those of more intensive enterprises.

If the Badgerys Creek site is not selected for airport development, the value of production in this area over the next ten years is likely to remain much the same as at present, even with further subdivision for residential development. This is because such subdivision is likely to occur first on land now used primarily for grazing-based industries, especially for beef cattle, as these enterprises produce the lowest returns in relation to land values. Given these low returns and the minor contribution which beef cattle enterprises make to the total value of production from the area, their reduction will have little effect on the value of production.

Piggeries are also likely to be one of the first industries to move from the area once further urban development takes place. However, this will have little effect on the total value of production in the area as, again, bacon production contributes only a very small part of the total value of production.

As beef cattle and pig numbers continue to decline in the area, it is expected that the number of horses will increase. This will help to maintain the value of production from the area owing to the higher returns from horse enterprises in relation to the value of land.

9.7.3 Agricultural economics

The data presented in Tables 9.7.8 and 9.7.9 can be compared with the value of production data from the Australian Bureau of Statistics 1982-83 agricultural census to determine the relative magnitude of the value of production in the proposed site and within the 25 ANEF contour compared to that of the local cities, the region, and the

State as a whole. This comparison indicates that the gross value of production of $8.3 million from the proposed site and within the 25 ANEF contour represents around 17% of the combined value of production ($47.92 million) from the cities of Liverpool and Penrith. This latter figure represents about 15% of the value of production in the Sydney Subdivision, which in turn totals approximately 7% of the value of production from the State as a whole.

9.7.4 Assessment of effects and safeguards

If airport development were to proceed, agricultural land use within the proposed airport site could continue until the land was required for airport construction or would be progressively scaled down from the date of acquisition. The rate of such scaling down would be dependent on the desire of the owner to relocate and the time at which construction interfered with the agricultural activities. In some cases it may be feasible for agricultural use to be continued on a lease-back arrangement until the latter stages of construction. In the case of some agricultural activities, it is likely that the owners would opt to relocate outside the area associated with the airport. A lease-back arrangement would therefore provide them with time in which to develop a new complex elsewhere to which their operations could be transferred when airport construction affecting their property began.

Effects within the proposed site

Once the land for the proposed airport had been acquired, all future development of the land in terms of its agricultural functions (for example, buildings, irrigation layout and pasture improvement) would be halted while the owners of the land prepared either to relocate their operations or to cease production altogether.

During the survey, statements were made by many of the older landowners who had moved from areas closer to Sydney about six to seven years ago to develop new properties in the Badgerys Creek area that, if airport development were to proceed, they would relinquish their agricultural operations and either seek alternative employment or retire. In order to buy suitable land which they could afford, they felt that they would need to move considerably further away from Sydney, possibly to the west of the Blue Mountains. For vegetable growers and nurserymen, such a move would mean the loss of many of the advantages which they now have, such as proximity to the fresh market at Flemington and to the poultry industry for manure.

Proximity to the end user is also an important consideration for broiler producers and dairymen. If a broiler producer were to relocate his or her operations to an area considerably distant from major processors, it may be difficult for the producer to obtain a contract with a processor. Similarly, the NSW Dairy Corporation might not allow a producer to transfer his quota to a property further away from Sydney if other dairy farmers closer to Sydney could supply extra quota milk. Pig producers in the area who had to move further away from Sydney would probably have to change their pigs' feed source, as it could become uneconomical to transport the waste breakfast cereals and stale bakery produce the longer distances involved.

However, beef cattle production could easily be transferred to other parts of the State, as this is an unprofitable activity in relation to the value of the land in the proposed site, and this area holds no special significance for the beef industry. In terms of the horse industry, the major significance of the area is probably one of convenience to the owners of the horses rather than being related to economic factors. This activity could therefore be relocated elsewhere within the Sydney area, assuming that horse owners were prepared to continue paying sufficient fees to provide the landholders with an acceptable return.

As far as the intensive industries are concerned, it is possible that some of these could continue operating on a lease-back arrangement during part of the construction phase, given the small area of land which they require for their operations. For example, vegetables could continue to be grown within the airport site if the area involved were not in or near the construction activities. The same would apply to pigs, poultry and nurseries. However, dust from earthworks and traffic could affect the ability of nurserymen and vegetable growers to sell such produce on the fresh market. It is likely that all the grazing based industries, given the larger areas of land involved, would have to cease operations once construction began. This is because once some of the buildings on a horse establishment or dairy farm are demolished, for example, or fences on any grazing property removed, the entire operation is disrupted.

Generally, many of the landholders intending to relocate their operations would need a minimum of about three years, if funds were not a limiting factor, to develop a new property before moving to it in order to avoid reducing production. Many of the properties in the area have, for example, required six to seven years to reach their present fully developed stage, with the later stages of this development having been financed from cash flow produced in the preceding three years. Therefore, to avoid a reduction in a landowner's scale or size of operation, he or she would have to relocate to a property which was equally well developed. If this development involved the sowing of pastures, the construction of dams for irrigation and the construction of buildings and fencing, at least three years could elapse before the property was ready for intensive production.

Once the airport began operating, it has been estimated that the gross value of production that would be lost from the land now being used for agriculture within the airport site would be approximately $5.0 million. However, not all this production would be totally lost to the economy, as many current landholders would shift their operations elsewhere, while existing producers in other areas could increase their production to meet any shortfall.

In addition to the loss of production from within the proposed site, indirect effects would cause further production losses in the surrounding region. For example, in a situation where only part of a property was acquired, production could cease from the entire property, particularly if it were no longer viable to continue it or if the enterprise were relocated elsewhere to maintain its viability. Another indirect effect could be that new urban development that might have been built on relatively unproductive land either within the proposed site or within the 25 ANEF contour might instead have to be built on other land outside the 25 ANEF contour which might be more agriculturally productive.

Effects within the 25 ANEF contour

During both the acquisition and operational phases, there is likely to be a period during which future development of agricultural land within the 25 ANEF contour would stagnate pending the owners' decisions on whether to remain or to relocate their operations. Their decisions would be based on their perceptions of the effects that the noise would have on their enterprises or on themselves and of the likelihood that their land would be affected by urban development associated with the airport. If their present land were in demand for airport associated urban development, they may be able to obtain a relatively higher price for their land which would enable them to continue their agricultural enterprises in another location. If this were not the case, then their land may be worth less, since it is also unlikely to be in demand for conversion to urban land in the short term. In this latter situation, the landholders would have to continue their current operations, or, if they wished to move, either cease production altogether and seek alternative employment, relocate their enterprise or retire. Given the high level of capital required to establish intensive agricultural operations such as poultry production, and the amount of capital involved in many of the horse training and spelling establishments, it is unlikely that these property owners would relocate if they felt able to condition themselves to aircraft noise.

During the construction phase, it is unlikely that there would be a significant direct effect on production within the 25 ANEF contour, as activities would not be displaced by the airport. However, the need for areas for urban development associated with the airport could cause some displacement of agricultural uses. Also, those grazing-based enterprises situated partly within the proposed site and partly within the 25 ANEF contour could be affected. For example, the buildings on the large dairy farm situated along The Northern Road (which are in the proposed site) would be demolished and the operation of the farm, plus some facets of the associated farm south of Bringelly, would be affected. Even if the buildings were relocated to another part of the farm, the size and scale of the operation would have to be reduced considerably, which is contrary to the wishes of the present owners. Currently, these two dairy farms supply approximately one-third of the milk intake of United Dairies at Parramatta and any reduction of operations would affect the availability of milk to supply United Dairies. If the operations of the dairy farm along The Northern Road were to be relocated, it could take up to five years to fully develop a new property to ensure that the transfer of operations occurred with minimal loss of production.

However, these effects would not necessarily be associated with acquisition, and whether the same effects would be evident when demolition was required would depend upon the timing and staging of construction of the runway system and the nature of the operation of this farm (and its associated operations) at that time.

The major factor determining whether landowners within the 25 ANEF contour remained or relocated would be the economic effect of the airport's operations on their agricultural enterprises. The two factors of an airport's operation which could have an economic impact on agriculture are:

- aircraft exhaust emissions
- noise.

Aircraft exhaust emissions
There does not appear to be any evidence to suggest that the exhaust emissions from jet aircraft have any effect on vegetable production or on pasture growth. There are two vegetable gardens in close proximity to Kingsford-Smith Airport, and in other vegetable growing areas oil burners, which have similar emissions to those from aircraft, are sometimes used to prevent frosts. These factors suggest that such emissions do not reduce productivity in vegetable growing areas. No detrimental effect has been observed on the vegetable gardens adjacent to Kingsford-Smith Airport or on the grass growing at that airport. Pasture growth in the vicinity of Richmond Air Force Base also does not appear to be affected, nor does there appear to be any effect on the quality of milk produced by cows grazing pastures in that area.

Effect of noise on livestock
There has been very little research carried out in Australia on the effects of noise on livestock, and the little that has been done has been confined mainly to effects on sheep and cattle. Many of the studies and observations conducted overseas on the effects of aircraft noise on livestock relate to sonic booms. Although no sonic booms are expected in the site and surrounding area, the results of these studies are nevertheless presented, as it is suggested that if livestock have been found to be unaffected by sonic booms they are unlikely to be affected by noise in the vicinity of an airport. Considerable work into the effects of noise on poultry has been carried out overseas and these results are also discussed below.

- **Sheep:** At Hawkesbury Agricultural College, an increase in activity and restlessness in sheep has been observed when RAAF Hercules, Caribou and jet aircraft are taking off approximately 1.5 km away.

  Grandin (1983) reports that excessive noise can be stressful to livestock, and quotes the results of work carried out by Ames (1974) who exposed sheep to three different types of sound at either 75 dB or 100 dB. Ames found that sheep exposed to the 75 dB levels gained weight faster during a feed trial than either the sheep used as controls or the sheep exposed to 100 dB. The animals exposed to 100 dB appeared more stressed and had the lowest weight gains. An increase in heartbeat was observed also when animals were exposed to sudden noises which alarmed or frightened them.

- **Cattle:** Espmark, Falt and Falt (1974) report on behavioural reactions observed in cattle and sheep exposed to sonic booms and low-altitude subsonic flights. No adverse effects were observed, and behavioural reactions were considered minimal in both species. Both cattle and sheep were less disturbed towards the end of the test period of four days, thus indicating that adaptation had taken place. Ewbank (1976) reports that there were no signs of continued arousal or general panic in cattle subjected to sonic booms produced by military aircraft. He also reports that milk yield did not seem to be affected.

While a significant drop in milk production was reported for the first week after the Khancoban airfield was opened, the effect on milk production was observed to disappear within a month. There has also been little reported effect on milk production in the Richmond area, which indicates that the cows there have adapted to aircraft noise.

- **Pigs:** Kilgour and Dalton (1984) report that pigs have very good hearing and are easily panicked by sudden loud noises such as aeroplanes or thunder. Grandin (1983) reports on a study conducted by Webb (1966) in which a boar was exposed to a 120 dB recording of a thunderstorm. The boar crouched down, quivered and refused to move. However, Ewbank (1976) states that there have been no indications of economic loss where pigs have been subjected to sonic booms.

- **Horses:** It is suggested by Kilgour and Dalton (1984) that horses may be prevented from sleeping when they are stabled where noise is sporadic and strange to them. Ewbank (1976) suggests that horses may show a more violent response to impulse noises than is evident in other grazing species, and that horses confined in a building may show an exaggerated response as a result of either feeling trapped or being alarmed by the vibration of the building around them. He also suggests that thoroughbred horses may not adapt to sonic booms as well as sheep and cattle do.

However, investigations made by the Department of Agriculture in the vicinity of the Richmond Air Force Base indicate that, although noise does affect horses in the short term, they soon adjust to it. Racehorses brought on to a property under a flight path for spelling are probably the most likely to suffer damage through over-excitement in the first few days until they adjust. It has been suggested also that mares being brought to a stud under a flight path to mate and foal may also be affected. However, stallions and mares in permanent residence on such a property will adjust.

- **Poultry:** Ewbank (1976) concludes that poultry give the most pronounced responses to sonic booms, but that it has not been possible to demonstrate clearly that deaths, injury or loss of production have arisen as a consequence of sonic boom exposure. An article by Poole (1982) reviews overseas literature dealing with the effects of noise on poultry. He states that, while severe losses in the past have been attributed to poultry being frightened by noises such as low-flying aircraft or sudden car horns, there are nevertheless many highly successful poultry operations in the immediate vicinity of busy airfields or highways. He also states that most research reports consider sound as a stress factor, and observe the adverse effect that noise has on poultry when they are subjected to it in the short term. He quotes a Russian trial in which it was observed that a noise of 90 dB at any audible frequency range produced harmful physiological effects on the fowls, while three Yugoslavian trials quoted a sound intensity of 83 dBA as being a level where egg production was affected. However, this approach largely ignores the role that conditioning of poultry to sound would have on subsequent bird response.

By using taped flyovers of aircraft at a sound intensity of 96 dB inside an incubator, Stadelman (1958a) examined the effect of noise on the hatching of eggs and the quality of chicks produced. The conclusion of this study is that there is no measurable effect attributable to noise on egg hatching or on the quality of chickens produced.

A further trial by Stadelman (1958b) concludes that broiler chickens can be grown without loss or weight differences in areas subjected to sound levels in excess of 110 dB in the frequency range 20-10,000 cycles per second. From observations made in this study, Stadelman concludes that loss in a pen of broiler chickens is much more likely to occur from an isolated low-level flyover than from continuous noises resulting from close proximity to an airfield. Poole (1982) also quotes a German trial which found that subjecting broiler fowls and white Leghorn layers to engine noise of 100 dB for thirty minutes represented a stress on the birds. However, in a second trial where the poultry were subjected to the same noise for thirty minutes per day for seven days, an adaptation effect was noticed.

Poole (1982) concludes from the literature that once baby chicks have experienced sudden loud noises, they will tend subsequently to take these for granted. It is possible, therefore, to condition baby chicks safely to specific sounds during the first few days of life. However, the Department of Agriculture points out that it may take a broiler chicken another three days to reach slaughter weight if it is subjected to loud noises. This would increase variable costs by 7-8% given the extra feed and labour required.

If all agricultural activities within the 25 ANEF noise contour ceased once the airport commenced operations, the gross value of production lost from this area would be $3.3 million. However, it can be seen from the preceding discussion that the operation of the airport is unlikely to result in the cessation of agriculture within this area. While poultry and horse spelling industries would be the most likely to be affected, given the high capital costs required for setting up these establishments, they would be unlikely to relocate if the economic effects were only marginal. However, if all the poultry, trotting horse training and spelling, and thoroughbred horse spelling operations in the area were to cease, the gross value of lost production would be $2.2 million. Only a proportion of this would be lost entirely, as some of the present operators would relocate their operations elsewhere. Although land now used for these industries could be taken over by beef cattle grazing, this would have little impact on limiting the value of lost production because of the relatively low returns which beef cattle operations produce.

In the initial stages of the airport operations, some landholders such as dairy farmers, poultry farmers and pig farmers could suffer some short-term loss of production until such time as their livestock adapted to their new environment.

Safeguards

The previous section quotes research which indicates that most livestock become conditioned to noise if they are subjected to it consistently over a short period of time. However, while the few days required for conditioning are not significant in the lives of animals such as cattle and horses, it is a different proposition for poultry, as the economic life of broilers is only six to seven weeks and around fourteen months for layers.

Poole (1982) suggests that, in the case of replacement laying stock, it is desirable that the birds be raised from hatching under the same conditions with respect to sound that they will experience during their productive lives. As chickens can be conditioned to loud noise by exposure to it during their first three days, it would therefore be preferable for a layer or broiler farm located close to an airport to obtain its replacement stock from a source located under the same or similar conditions.

9.8 REGIONAL PLANNING AND DEVELOPMENT

This section considers the implications of the site acquisition and possible airport development at Badgerys Creek for the regional planning of the Sydney Region, and more particularly for the planning of those portions of the Macarthur and Sydney Western Sub-Regions adjoining the site. In the ensuing discussion, the main emphasis is on the probable effects of airport development on the potential for changes in land use in the two Sub-Regions. Some effects would restrict development in certain places, others would encourage it. These effects on land use relate mainly not to the acquisition of a site but to the possible development of the airport and to its noise effects (Section 9.2), economic and social effects (Section 9.6), and its access needs (Section 10.4). The appropriateness of any particular changes in land-use zoning will, however, also depend on the present policies of state and local planning authorities, and on changes in land use that may take place prior to airport development, as a result of metropolitan growth. For this reason, it is necessary to review both the recent history of planning in the Sydney Region and its likely future direction.

9.8.1 Recent history of Sydney's growth

Any assessment of the effects of airport development must take into consideration Sydney's size, as one of the fifty largest cities in the world, with a population (Sydney Region) estimated in 1981 at 3.28 million. Within the Sydney Region, which has an area of 12,407 km^2, the urban area extends almost uninterrupted from the city centre, 90 km westward to Katoomba, 75 km northward to Gosford—Wyong and 32 km southward to Heathcote. Recent development in the Cities of Liverpool and Fairfield has extended the urban area in those cities to a distance of 32 km from the city. The proposed airport site at Badgerys Creek is located in the City of Liverpool about 15 km west of these new urban areas and some 46 km west of the city centre.

Sydney Region Outline Plan

Planning for future urban expansion and development in the Sydney Region dates back to 1948, with the completion of the County of Cumberland Planning Scheme. This plan was given statutory effect in 1951 and remained the blueprint for development for the ensuing fifteen years; even so, substantial modifications were made to the principles of the plan as the population increased at an unexpected rate. In view of the higher rate of population growth, the Sydney Region Outline Plan, adopted in 1968 (State Planning Authority of New South Wales 1968), was intended to provide for an expected 5.5 million people in the year 2000.

Under the provisions of the Plan, urban development was intended to occur in linear sectors along communication corridors. This basic framework was established because of transport and other development in the Parramatta—Blacktown—Penrith corridor. New sectors added were the south-west sector focusing on Campbelltown, the Fairfield—Hoxton Park sector focusing on Wetherill Park—Bonnyrigg, the south sector focusing on Menai and the north-west sector focusing on the Rouse Hill—Maraylya area.

Sydney Region Outline Plan review

During the late 1970s the Sydney Region Outline Plan came under critical review and this culminated in the publication of a report in 1980 (NSW Planning and Environment Commission 1980). Undertaken at a time when economic conditions and population growth were somewhat different from those of 1968, and when greater emphasis was being placed on environmental issues, the review of the Plan concluded in relation to urban development and growth that:

- as was hoped when the Sydney Regional Outline Plan was prepared, the phasing plan for urban development had provided a reliable guide for the extension of sewerage and other reticulated services;

- however, it had also proved a guide to private investors in a time of land boom and thereby contributed to the increase in the price of housing land;

- there was thus a conflict between the need to restrain development in new areas until existing serviced lands were fully developed, and the need to subdivide and service new land on an extensive scale in order to create and maintain a continuing supply of low-priced residential land;

- the objective expressed in the Plan, of ensuring a wider and more balanced distribution of commercial activity and avoiding over-concentration of employment in the metropolitan centre, should be redefined in terms of developing a balance between homes and jobs, community facilities and services.

The Review concluded that the Phasing Plan contained in the Sydney Region Outline Plan should be discontinued and, in its place, it proposed that an inter-departmental committee should be established to manage the release of new urban land and the extension of reticulated services and community facilities in phase with changes in population. It was recognized that one task particularly appropriate to such a group would be to identify, co-ordinate and implement the necessary State Government funding for carrying out urban development.

This proposal was put into effect when the Urban Development Committee was set up in September 1980, under the Environmental Planning and Assessment Act, 1979, to advise the Government on all matters relating to urban development and in particular on the supply of residential land.

9.8.2 Future urban development in the medium term

The remaining areas identified for urban development under the Sydney Region Outline Plan will be insufficient to meet anticipated demand beyond about 1990, owing to the fact that much of the remaining land is subdivided into smallholdings and is unlikely within the time available to be further subdivided into residential lots.

The Urban Development Committee reported to the Government on the priorities for urban development beyond the areas earmarked in the Plan or otherwise already approved. Four broad areas were identified to meet Sydney's requirement for further urban development in the medium term, i.e. from 1990 into the early part of the twenty-first century; these were:

- North-West Sector
- Macarthur South
- Bringelly
- Central Coast.

These areas are discussed below.

North-West Sector

The North-West Sector includes several localities where there are no physical constraints precluding the possibility of urban development. After excluding the Scheyville airport site defined in the Major Airport Needs of Sydney Study, the following four possible localities for urban development were identified by the Department of Environment and Planning (1984):

- Riverstone—Rouse Hill—Marsden Park
- Londonderry
- Glossodia
- Dural.

These localities could be expected to provide facilities for an estimated population of 370,000. Basing its decision on an assessment of transport costs, social and physical infrastructure and other issues affecting residents and local governments, the Department of Environment and Planning concluded that the North-West Sector should have first priority for inclusion in the urban development programme. In July 1984 the Department of Environment and Planning completed the North-West Sector Regional Environment Study, and a Draft Regional Environmental Plan is expected to be exhibited in mid 1985.

Macarthur South

Macarthur South is a large area south of Campbelltown, lying mainly in the Shire of Wollondilly, and encompassing:

- land between Appin Road ridge, the Nepean and Cataract Rivers and Camden Park Conservation Area, including the catchments of Elladale, Oasedale and Mallaty Creeks;

- land at Menangle between the Nepean River and the railway line including Foot Onslow Creek catchment;

- land at Douglas Park between Picton Road and the Nepean River.

The initial plans for this area (State Planning Authority 1973) provided for an eventual population of 170,000, but in the medium term only an additional 50,000 were envisaged. The Department of Environment and Planning has recently decided to prepare a Draft Regional Environmental Plan for the whole of the Macarthur Sub-Region, comprising the local government areas of Campbelltown, Camden, Liverpool and Wollondilly, with the purpose of addressing major planning issues and determining future land uses.

Bringelly

The Bringelly area includes land near Kemps Creek and Cecil Park, and was initially assessed as eventually accommodating some 150,000 people. However, after investigation, the Department of Environment and Planning determined that, of the choices open to it, Bringelly was least suitable to meet requirements for medium-term urban development.

Central Coast

The Central Coast area, comprising the Gosford and Wyong local government areas, could accommodate about 280,000 people by 2001. However, there is continuing discussion between the Department of Environment and Planning, the Department of Mineral Resources, and the Wyong Council in relation to the conflicting requirements of coal-mining and urban development.

9.8.3 Future urban development in the long term

Following a study by the Department of Environment and Planning of potential areas for long-term urban development, the NSW Government in December 1982 requested the Department to prepare a metropolitan development strategy.

Sydney's population is expected to continue to expand over the next few decades and at present it is projected as reaching 4 million by about the turn of the century and 4.5 million by about 2011. However, rates of growth may increase or decline, in which case the populations of 4 million and 4.5 million may be reached sooner or later than these dates. Previously, the convention used in metropolitan planning has been to attempt to link proposed urban development with population growth on a time-scale, but the result has been confusing when the rate of population growth and hence the requirements for urban expansion have been either under or over-estimated. Because of these past experiences, the Department of Environment, while considering options for long-term urban development, does not discuss them in the context of any time frame.

The future strategic direction of metropolitan planning will depend on the optimization of a number of factors including:

- distribution of employment opportunities, including those related to the construction and operation of a second Sydney airport;
- provision of transport facilities;
- a range of social, demographic and economic factors.

The pattern of population distribution that is overall the optimum one is not likely to be the best pattern from any one perspective.

Potential areas for future urban development

The starting point for identifying potential areas for future urban development is the availability of land. Figure 9.8.1 shows which land within the Sydney Region is already being used for urban purposes or has been committed for urban development. Table 9.8.1 lists areas, including in this context the northern part of the Illawarra Region, that can be identified as possible sites for future urban development after taking account of environmental considerations and physical constraints. The rate of utilization of land will depend not only on the rate of population growth, but on whether the geographical pattern of growth is concentrated or dispersed.

Table 9.8.1 Potential areas for future urban development

Region/Sub-Region	Potential areas
Sydney	
Gosford—Wyong	Somersby, Warnervale
Sydney Northern	Belrose, Duffys Forest, Ingleside, Terry Hills
Sydney Western	
North-West sector	Arcadia, Kurrajong, Londonderry, Marsden Park, Rouse Hill, Scheyville, Schofields, Riverstone
Fairfield sector	Cecil Park
Macarthur	Appin, Bringely, Cawdor, Cobbitty, Douglas Park, Menangle, Wilton
Illawarra	
Wollongong	Helensburgh

Source: Department of Environment and Planning.

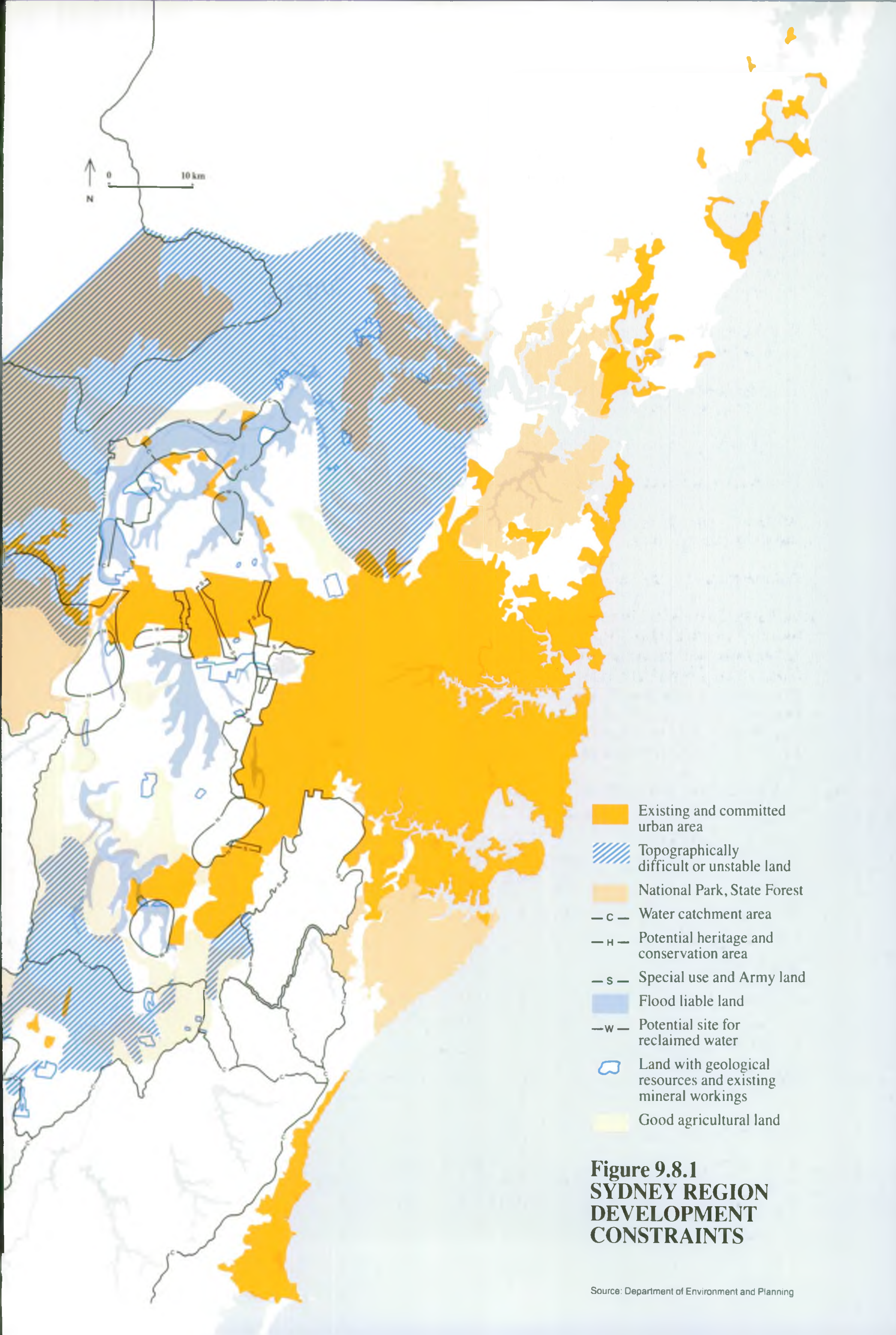


Figure 9.8.1
SYDNEY REGION DEVELOPMENT CONSTRAINTS

Source: Department of Environment and Planning

Geographical pattern concentrated

Assuming the population in existing urban areas does not decline, and a division of land in new areas into ten household lots per hectare (for the purpose of measuring residential density, a hectare includes residential land, local roads, local open space, local centres and schools), then the population increase to 4.5 million could be accommodated within the areas identified as suitable or possibly suitable for urban development in the Sydney Region Outline Plan (excluding Cobbitty and Kurrajong, which have been identified as suitable for urban development in the long term, but in which the capacity for urban development has not yet been firmly established). Beyond a figure of 4.5 million, the optimum sequence for new urban areas in terms of balancing homes and jobs and infrastructure investment would depend on the location selected for the airport.

Geographical pattern dispersed

If the population were dispersed more widely as it grew in numbers, more land would be required to accommodate the same 4.5 million people, and Cobbitty, Cawdor, Scheyville, Kurrajong and areas north and south of the Sydney Region would be drawn in. Such a dispersal assumes a population decline in the inner areas, a population decline in established and already released outer areas, and that in the areas still to be developed there will be fewer dwelling units per hectare, an average of only eight lots instead of ten. The consequence would be that decisions both as to the location of the airport and as to its construction would be required earlier if the pattern and sequence of urban development were to be optimized.

Distribution of employment opportunities

Several possible future distribution patterns for employment are being investigated by the Department of Environment and Planning in relation to urban development strategies. The distribution patterns fall within a range between two conceptual alternatives:

- One alternative presupposes a high degree of government influence on employment location and hence a relatively limited distribution of jobs outside suburban centres, industrial areas and Special Uses Zones (e.g. hospitals, universities and so on), and a concentration of new employment in suburban centres, especially in the west and south-west;

- The other alternative presupposes a low degree of government influence on employment location, with a lower level of concentration in centres and greater dispersal throughout the metropolitan region, and a continuing trend to seek locations in the northern suburbs.

The size of the workforce currently estimated by the Department of Environment and Planning for a population of 4.5 million, reached about the year 2011, is 1.8 million. As with the population figure of 4.5 million, of course, a workforce of 1.8 million could be reached before or after 2011. Of this 1.8 million, a maximum of about 22,000 jobs would be attributable to the second Sydney airport and that only in the event that the maximum employment estimate for a fully operational airport, and maximum estimate of flow-on employment for a 13 million passengers a year airport (Section 9.6) were to be reached by that date.

This figure of 22,000 jobs is made up of a maximum of about 11,500 people who would be located at or near the site (10,500 employed by airlines, the airport administration and airport commercial services, and 1,000 by airport associated and airport induced activities), and a maximum of about 10,500 flow-on jobs in the Sydney Region of which about 2,300 could be in the economic sub-region around Badgerys Creek (defined for the purposes of this study as comprising the local government areas of Penrith and

Liverpool). Thus, the future distribution of employment over the Sydney Region as a whole (as opposed to the future distribution of population) would be relatively unaffected by the location of the airport and the jobs located on or near it, as this employment would be less than 1% of total Region employment.

9.8.4 Effects of airport development that would encourage urban development

The immediate effect of acquiring a site at Badgerys Creek for a second Sydney airport would be to remove the necessity of restraining urban development near other candidate sites; in Chapter 1 it is estimated that some 200-300 km^2 of land within the Cumberland Plain is directly affected by the uncertainty associated with the location of a second airport site. At the sub-regional level subsequent airport development to handle 13 million passengers a year would, planning controls permitting, encourage residential development near the airport by reason of the airport's employment opportunities and associated infrastructure improvements. The airport would also encourage some commercial and industrial development. In order to discuss and assess the scale of these effects the categorization applied in the assessment of economic effects (Section 9.6) is followed here:

- airport associated employment
- airport induced employment
- employment related to the multiplier or flow-on effects of the airport.

These are discussed in turn below, along with the possible need to revise the priorities with respect to potential areas for urban development, in order to reduce the distance of the journey to work for the airport workforce.

Airport associated activities

Airport associated activities are those directly related to the operation of the airport and requiring to be in close proximity to it, but not necessarily on the site. They include car rental firms, transport facilities and accommodation for passengers, and air freight facilities. The preliminary master plan for Badgerys Creek (Section 8.3) provides 158 ha for these uses. Airport associated jobs are estimated at a maximum of 900, and 158 ha would be more than adequate to accommodate employment on this scale.

Airport induced activities

Airport induced activities are activities attracted to an area by the presence of an airport, but not necessarily connected with it. Some commentators have suggested that airports act as growth-attracting poles and generate substantial amounts of industry in the surrounding area. However, the small amount of substantive empirical evidence that is available suggests that these growth-attracting effects have been greatly exaggerated (Fordham 1970; Hoare 1974). Firms regularly utilizing airport services find their needs best met by a location that is within, say, 45 minutes' drive, but that also meets other locational requirements. Firms that do establish near an airport tend to be there because of the well developed infrastructure rather than because of the airport itself:

> Since airport development invariably requires major investments in infrastructure and public utilities, the surrounding area becomes a natural focus for urban development ... airports provide several essential ingredients that encourage urban growth: jobs, extensive roadway systems, a generally undeveloped setting where reasonably priced land is available, and public utilities which can be tapped by their users (US Department of Housing and Urban Development 1974).

This evidence, together with the non-central location of the site, suggests the unlikelihood of any activities (additional to airport associated activities) being attracted by the presence of an airport as distinct from the mere availability of serviced sites. Nevertheless, the NSW Government might decide to promote industrial and commercial development on sites near the airport for reasons of overall metropolitan strategy, and might decide to make infrastructure improvements beyond those strictly necessary for the operation of the airport.

Activities resulting from multiplier or flow-on effects

Activities related to the multiplier or flow-on effects of the airport are those resulting from the expenditures of organizations included in the airport and airport associated categories and the expenditures of employees in these sectors. The maximum likely sub-region flow-on employment for a level of airport operations of 13 million passengers a year has been estimated (Section 9.6) at 2,300. About half of the flow-on employment is likely to arise in activities requiring land zoned as industrial, and about half in activities usually associated with local, district or regional centres. Assuming that no flow-on employment is sited in existing developed areas, and assuming densities of twenty employees per hectare for industrial land and fifty per hectare for local or district centres, the land required would amount to 115 ha. As such employment could be created anywhere up to 25 km from the airport, there is no possibility of any land shortage arising from the flow-on effects of the airport.

Residential land for the airport workforce

When projects remote from established population centres are proposed, it is often necessary for additional housing to be built. In the case of a project in the Sydney Region, the planning objective is the broader one of maintaining and if possible improving the balance of homes and jobs by influencing the location and timing of new industrial, commercial, and residential development. By the year 2011 there would be an estimated 550,000 people living within 20 km of the Badgerys Creek site, and in the short and medium term there may well be insufficient jobs in the same area for all those in the workforce; hence airport development would not necessitate a revision of urban development priorities in order to accommodate the airport workforce. However, the NSW Government may decide that taking the Sydney Region as a whole, the best overall balance between homes and jobs would be achieved by accelerating residential development within easy commuting distance of the site; such a possibility cannot yet be definitely foreseen.

Consequences for regional planning

In so far as airport development was accompanied by additional urban development, or by changes in the location of future urban development, a wide and divergent range of possible consequences can be imagined. For example, depending on the locations of urban development, there might or might not be additional loss of agricultural land; however, it must be remembered that the main effect of the future airport would be to change the sequence in which the potential urban areas already identified were developed rather than to add to the total extent of urban development. The likely changes in sequence if airport development were to proceed quickly are indicated by the fact that, of the potential future urban areas identified by the Department of Environment and Planning (Table 9.8.1), the ones nearest to Badgerys Creek are Cecil Park and Bringelly. Along with other regional planning issues associated with airport site selection, the choices will be examined in the Macarthur Regional Environmental Study currently under preparation by the Department of Environment and Planning. Following public exhibition of the study, currently scheduled for late 1985, preparation of the Draft Regional Environmental Plan will commence. A strategic land-use plan will be included in this (both Wilton and Badgerys Creek sites fall within the Macarthur Sub-Region).

9.8.5 Effects of airport development that would restrict urban development

Some existing and potential land uses would be incompatible with aircraft operations at Badgerys Creek because of their sensitivity to aircraft noise, radar or some other aspect of airport operations. This incompatibility with aircraft operations would result in land-use effects at the time of site acquisition, and possible further effects might arise if aircraft operations later commenced. These effects might lead to changes in the present pattern of land-use zoning (Figure 9.8.2).

Effects at site acquisition stage

The immediate effect on land use of acquiring the site at Badgerys Creek would emerge as a need to limit, as far as practicable, further airport-sensitive development. At the time of public release of the Draft Environmental Impact Statement, the Department of Environment and Planning proposes to put in place interim planning measures in order to control development in potential noise-affected areas, and to protect the airport site. While the content of these interim planning measures is not known at the time of writing, they will not in any sense 'sterilize' land, since many of the land uses now permitted by the relevant planning schemes are compatible with the worst case noise levels (Section 9.2). None of the potentially noise-affected land is zoned exclusively for residential or other use that is sensitive to noise.

Effects at aircraft operations stage

Should construction of an airport subsequently proceed, there could be further land-use effects as the scale of operations increased, such as a long-term need to relocate existing land uses that are sensitive to noise, or other airport related effects. These existing land uses fall into two main categories:

- Dwellings;
- A range of research or other technical facilities located near Badgerys Creek that are highly sensitive to radar, navigation aids, radio transmissions, air pollution or other airport effects.

Under current Commonwealth and State practices it is unlikely that any potential noise-affected dwellings around Badgerys Creek would be relocated on account of aircraft noise. Under the worst case assumptions hardly any dwellings would be exposed to noise levels over 40 ANEF (Section 9.2), whereas the larger number of such dwellings around other existing Australian airports have not been relocated. As explained in Section 9.2, government policies may change, but even then the worst case noise levels are unlikely to occur for many years, if ever.

The need to relocate various research and technical facilities found near Badgerys Creek (Figure 9.8.2) on account of electromagnetic interference or noise is also subject to considerable uncertainty, because it is not known:

- what level of airport operations would render the facilities inoperable;
- whether or not the facilities would have become technically obsolete before the critical level of airport operations was reached;
- whether or not other sources of interference would emerge as a result of metropolitan growth that would render the facilities inoperable even without the existence of the airport.

The facilities believed to be inoperable if a high level of aircaft operations were to commence at Badgerys Creek, are as follows:

- **Fleurs Radio Observatory:** The Fleurs Radio Observatory houses an important radiotelescope and other scientific instruments operated by the School of Electrical Engineering of the University of Sydney. The University describes the radiotelescope as a high grade scientific instrument capable of mapping the distribution of radio astronomy sources in the southern sky with a resolution and sensitivity unequalled by any other instrument in the southern hemisphere. It is used by a number of organizations besides Australian universities, including CSIRO, the Anglo-Australian Observatory, and the Ionospheric Prediction Service of the Department of Science and Technology. The Ionospheric Prediction Service uses the telescope and other instruments to provide a wide range of organizations with forecasts of disturbances in the ionosphere, in the sun's radiation output and in the magnetic field of the earth.

- **Fleurs Airstrip:** Fleurs Airstrip is owned by CSIRO but is leased to the University of Sydney on a five-year lease, renewable for a further five years. It is the location of facilities used by the University's School of Electrical Engineering and by Interscan Pty Ltd for research into air navigation. Interscan Pty Ltd states that co-existence of their facilities with an airport at Badgerys Creek may or may not be feasible depending on the specific types of air navigation equipment used at the airport and their specific location.

- **Coast Radio Receiving Station:** To the south-east of the proposed airport site, the Overseas Telecommunications Commission (Australia) operates a radio receiving station which is part of the Australian Coast Radio Service. This service provides high quality global maritime radiotelecommunication services to shipping, aircraft, and designated territories. In addition, on behalf of the Department of Transport, the Commission provides communications for ensuring safety of life at sea (SOLAS), and weather and monitoring reports for the Bureau of Meteorology. By the year 1990, it is planned to augment or replace the present SOLAS services by a more technically advanced system, in which the Commission's receiving station will form an integral element. Recognizing that the site is electromagnetically quiet, other agencies from time to time seek access; for instance, the NSW Police Department is currently arranging for installation and operation of its receiving equipment.

- **Bringelly Remote Receiver Station:** Adjoining the Commission's installation to the south is located one of the remote receiver stations which, together with other facilities, form the RAAF and Army communication networks in the NSW (Sydney) Region.

- **CSIRO Field Station:** On the north side of Elizabeth Drive, two divisions of CSIRO, Animal Production and Animal Health, undertake field research. The activities of the Animal Production division are unlikely to be significantly affected by a fully operational airport (see Section 9.7), but according to CSIRO the Animal Health Division would need to be relocated. However, even without the airport it could become necessary to relocate the Animal Health Division in the interests of minimizing risks to public health if the population of the area and traffic on Elizabeth Drive continue to increase.

- **McGarvie Smith Animal Husbandry Farm:** At the McGarvie Smith Animal Husbandry Farm the University of Sydney maintains a commercial dairy, which is also used for a wide range of teaching and applied research programmes. The University of Sydney has indicated that teaching and research activities would be incompatible with airport operations.

Except for Fleurs Radio Observatory and Airstrip, all these facilities lie in Special Uses Zones. The observatory and airstrip are being included in a proposed rezoning, from Rural A1 to Special Uses, incorporated in a Draft Local Environmental Plan currently under consideration by Penrith Council. Other Special Uses Zones and zones with restrictive planning controls which are located in the area but which would not greatly be affected by airport operations are:

- the Department of Defence explosives storage facility in the Kingswood—Orchard Hills area;

- the South Creek Special Uses corridor.

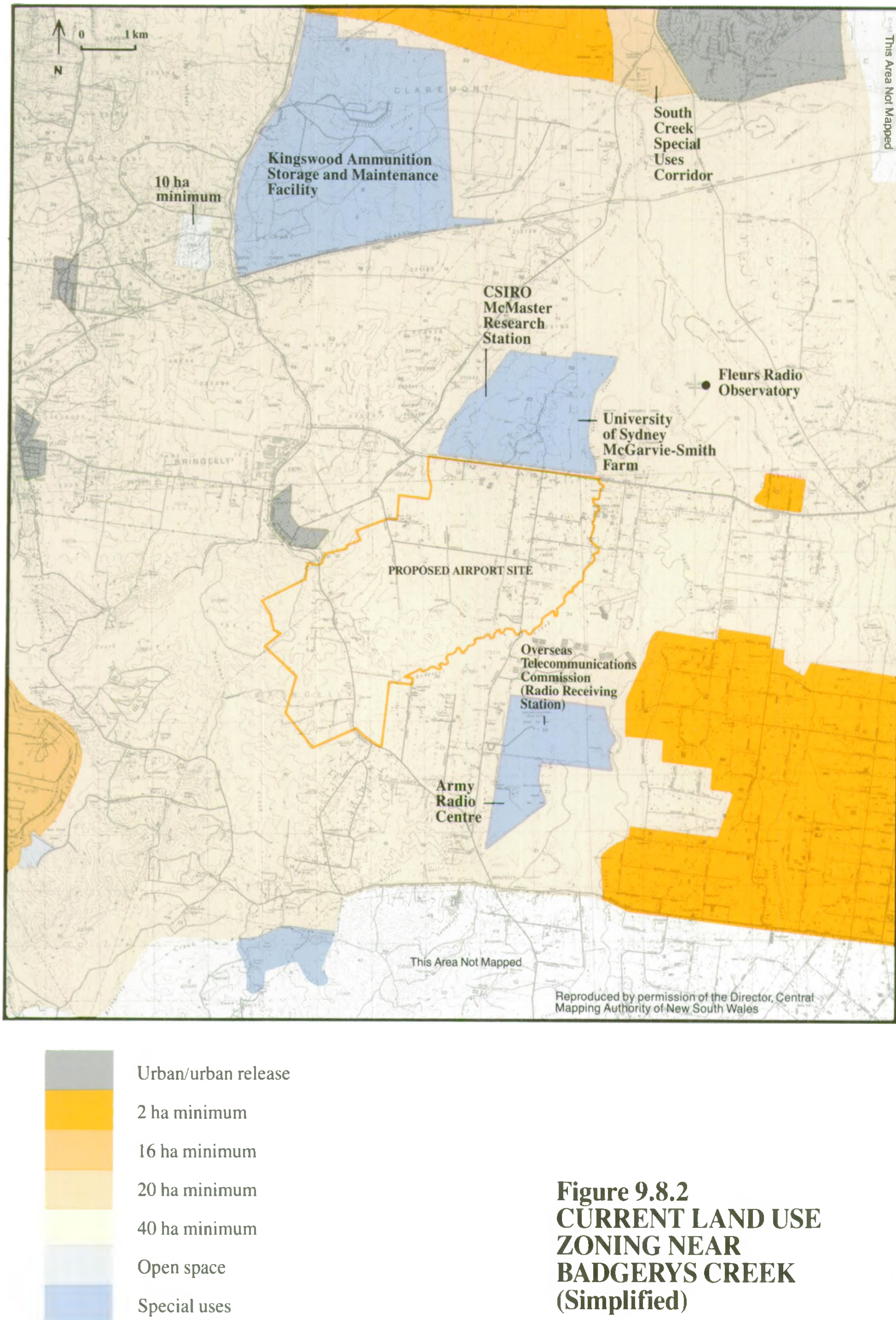


Figure 9.8.2
CURRENT LAND USE ZONING NEAR BADGERYS CREEK (Simplified)

However, the Special Uses zonings are not continuous (Figure 9.8.2), and there are no existing planning controls over the intervening areas, beyond normal subdivision limitations, to ensure that the area remains electromagnetically quiet and free from atmospheric pollution and traffic noise. All the facilities adjoin or are close to main roads or major local roads on which traffic is likely to double by 2011 even without airport development (Section 10.4). Thus, under present planning controls the long-term future of these sensitive facilities in their present locations is very uncertain, in the context of continued metropolitan growth and technological change. The prospect for these sensitive facilities is that they will have to be relocated, irrespective of whether or not an airport is developed at Badgerys Creek.

CHAPTER 10

The Physical Environment and Effects of the Proposal

Introduction

This chapter describes the physical environment of the proposed site, and the likely effects of site acquisition and airport development; and outlines proposals for environmental safeguards and monitoring programmes.

The chapter commences with a description of the geology, soils and physiography of the proposed site in terms of its suitability for airport development (Section 10.1). The effects of airport development and operation on water and air quality are then described (Sections 10.2 and 10.3). In Section 10.4, proposals for road and rail access are described. This section deals with the means by which access could be provided, and with the impact of traffic generated by the airport on the existing road and rail systems. A comparison of the relative accessibility of the Badgerys Creek and Wilton sites is made in Chapter 17. The discussion on access is followed by a description of proposals for relocation of existing infrastructure and for provision of new infrastructure (Section 10.5). The chapter concludes with an assessment of the landscape character and relative scenic quality of the proposed site, and the likely impact of airport development (Section 10.6).

10.1 GEOLOGY, SOILS AND PHYSIOGRAPHY

10.1.1 Geology

This section describes the geology of the proposed Badgerys Creek airport site, including its seismic stability, mineralization, and material that could be used for airport construction or which could become sterilized by the development of an airport at the proposed site. Information for this section has been obtained from the Department of Mineral Resources, which is currently undertaking the compilation of detailed geological information for the Penrith 1:100,000 sheet covering the area of the proposed site (Chesnut 1981a; Clark in press).

Regional geology and stratigraphy

The Penrith 1:100,000 sheet covers an area near the structural centre of the Permo-Triassic Sydney Basin. Consequently, only the youngest Triassic rocks in the basin are exposed. The geology is dominated by the Mid-Triassic Wianamatta Group which occupies most of the Penrith map sheet area, while the underlying Hawkesbury Sandstone, also of Mid-Triassic age, dominates the surrounding lower Blue Mountains, Woronora and Hornsby plateaux. Exposures of the Late Permian—Early Triassic Narrabeen Group rocks can be observed only in the spectacular gorges entrenched into the lower Blue Mountains Plateau. The underlying Permian Illawarra Coal Measures and marine sediments are exposed along the western margin of the Sydney Basin to the west of the Penrith sheet area. There are sporadic, minor, but economically important Jurassic intrusions in the region, while Mesozoic (or Tertiary) dykes are common. Cainozoic alluvium (now preserved as terraces) was deposited in the Cumberland Basin along reaches of the Nepean-Hawkesbury River and Georges River and along tributaries of the South Creek system.

The Sydney Basin evolved as a north-westerly elongated crustal depression on the eastern margin of the Lachlan Fold Belt. During the Early Permian, sediments from the Lachlan Fold Belt were deposited in marine environments within the Sydney Basin. However, during the Late Permian to Mid-Triassic, orogenesis in the New England Fold Belt provided the impetus for vigorous erosion and transport of detritus from that region into a dominantly alluvial and deltaic Sydney Basin.

The structural centre of Triassic rocks in the Sydney Basin is located within the Penrith Basin, a structural sub-basin probably of Tertiary age. (The structure of Pre-Triassic rocks is less well known.) Consequently, much of the area of the Penrith 1:100,000 geological sheet is covered by the youngest rocks in the Sydney Basin. Considerable stream dissection of the lower Blue Mountains Plateau in the western part of the sheet area has resulted in the exposure of rocks down to the middle portion of the Narrabeen Group (Early Triassic).

Sedimentary rocks exposed in the map sheet area comprise the upper half of the Narrabeen Group, the Hawkesbury Sandstone, the Mittagong Formation and the Wianamatta Group. The rocks range in age from Early to Mid-Triassic. No Late Triassic sediments are known to have been deposited in the Sydney Basin. However, it is deduced that Early Jurassic sediments were deposited, but are preserved only where they collapsed into volcanic breccia necks (Crawford et al. 1980). The depositional development of the Sydney Basin has been described by Herbert (1980).

Geology of the proposed site

Both unconsolidated Quaternary sediments and consolidated Triassic rocks occur in the proposed airport site (Figure 10.1.1). Consolidated Triassic rocks occur throughout most of the Cumberland Plain in the immediate vicinity of the proposed site (Bringelly Shale) and westward towards the Blue Mountains escarpment (Minchinbury Sandstone, Ashfield Shale and Hawkesbury Sandstone).

Quaternary alluvium

Quaternary alluvium appears as accumulated surficial deposits along the main creeks in the region. These include Cosgroves Creek to the north of the proposed site and Badgerys Creek, which forms the site's eastern and southern boundary. The alluvium is typically composed of fine-grained sand, reddish brown silt and clay. These deposits of alluvium cover about 5% of the proposed site in an area 100-200 m wide along the eastern and southern boundary.

Bringelly Shale

The Bringelly Shale underlies the soil cover throughout most of the proposed site, where it has a maximum thickness of about 150 m. (Herbert (1979) describes in detail the geology and ceramic potential of the Bringelly Shale.) The Bringelly Shale is interpreted as a coastal alluvial plain sequence which grades up from a lagoonal—coastal marsh sequence at the base to increasingly more terrestrial, alluvial plain sediments towards

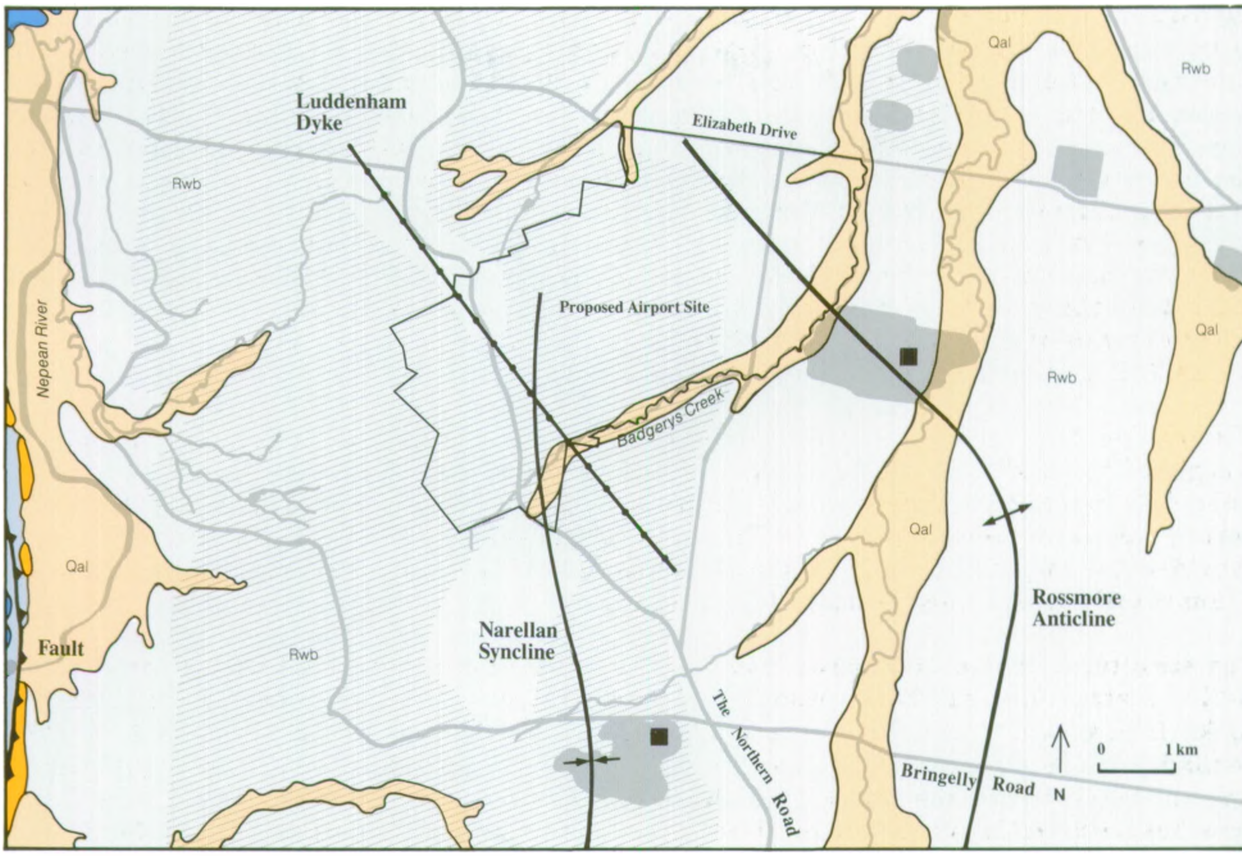


Figure 10.1.1
GEOLOGY

the top of the formation. Lithologies which comprise the Bringelly Shale, in order of decreasing volumetric significance, are:

- claystone and siltstone
- laminite
- sandstone
- coal and highly carbonaceous claystone
- tuff.

Although these lithological types are apparently randomly distributed throughout the stratigraphic section, in any one place there is in fact a degree of order both in the succession of lithologies and in their thickness variation. Claystone and siltstone are dominant in the Bringelly Shale, while thin laminite horizons occur throughout. Sandstone is minor and sporadic, forming prominent 'benches' in outcrop. The lower 30 m of the Bringelly Shale is usually distinctive, being relatively thinly bedded and containing the most carbonaceous sediments within the Wianamatta Group. Above this lower zone, claystone, siltstone and sandstone units are more thickly bedded.

The most persistent lithological sequence in the Bringelly Shale is one which begins with a laminite, and passes upwards into a leached claystone and finally to a carbonaceous claystone. This sequence may be repeated or, more usually, further alterations between light grey leached claystone and carbonaceous dark grey claystone may take place before truncation by another laminite.

These sequences are interpreted as having been deposited in an alluvial overbank environment. Carbonaceous claystone was deposited in permanently waterlogged swamps between levees, and abandoned levees allowed the development of soil profiles which are now represented by light grey leached claystone horizons. Regional subsidence and compaction allowed carbonaceous swamp sediments to inundate the abandoned levees and their overlying mantle of soil. Repetition of these conditions would have allowed further sequences to accumulate. Soil may also have developed on swamps which suffered alternate draining and inundation, thereby producing alternating light grey leached claystone and carbonaceous claystone sequences without an intervening levee laminite.

The high proportion of fine-grained overbank sediments to that of channel sandstone of point bar origin indicates that the major part of the Bringelly Shale was deposited by highly sinuous streams with extensive flood basins. A laminite, up to 10 m thick, occurs at the base of the Bringelly Shale above the Minchinbury Sandstone. This laminite, probably deposited in a coastal lagoon, is rarely absent from the base of the Bringelly Shale, and somewhat resembles the Mulgoa Laminite Member of the upper Ashfield Shale (Herbert 1979).

Basaltic dykes

Basaltic dykes are fairly numerous in the area, although only one has been mapped in Figure 10.1.1. The Luddenham Dyke (north-west trending) and the Orchard Hills Dyke (north-east trending) indicate the preferred orientations of other smaller dykes in the area. The Luddenham Dyke coincides with the elevated ridge that extends south-east from Luddenham through the proposed site.

Coal resources

Coal resources underlie the proposed airport site at Badgerys Creek: these are very roughly estimated to total 40 Mt, and to occur at a depth of 830 m. However, there is no precise information obtainable from present drilling data which can confirm the exact depth and amount of coal involved. Because of the depth of this resource in relation to other coal resources and known reserves, it is unlikely to be mined within the next fifty years.

Extractive resources

Construction materials

The Department of Environment and Planning and the Department of Mineral Resources recently undertook a joint regional environmental study (Department of Environment and Planning 1984) to develop a framework for the planning and management of extractive resources within the Sydney metropolitan region. This study indicated that there are a number of important existing and potential clay/shale extraction sites within the area around Badgerys Creek (Figure 10.1.1) although there are no existing extractive operations within the proposed airport site itself. However, most of the site falls within one of a number of areas of land between Mulgoa and Narellan which were previously identified by the Department of Mineral Resources (Corkery et al. 1980) as having potential for the occurrence of light-firing clay/shale. A total area of 13,200 ha in the Penrith, Liverpool, Camden and Wollondilly local government areas is involved, containing a possible resource of over 4,000 Mt of red and cream-firing clay/shale. Some of this resource could be required by about the year 2015. Although the total area of these potential resources is large, only a relatively small proportion is likely to contain economically significant deposits of light-firing clay/shale and, of this, the areas suitable for extraction would be further limited by environmental considerations, topography and existing land uses (such as small-scale rural residential subdivisions) which would be incompatible with future extraction operations.

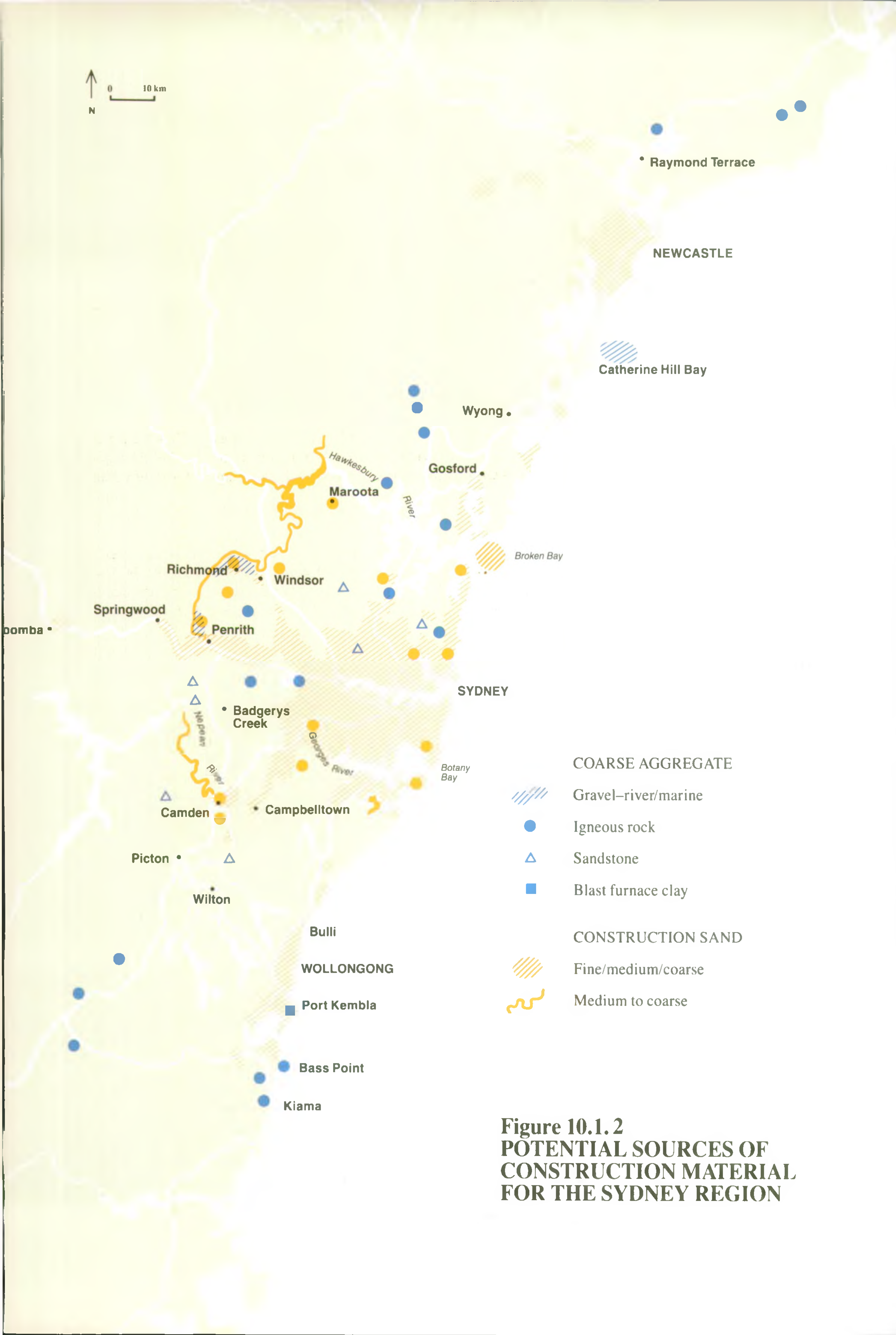


Figure 10.1.2
POTENTIAL SOURCES OF CONSTRUCTION MATERIAL FOR THE SYDNEY REGION

These potential clay/shale resource areas have not yet been tested in any detail and, as a consequence, it is not possible at present to identify those parts which have the highest potential for future extraction. Until this can be determined, the Department of Mineral Resources is opposed to any further sterilization of these potential resource areas, since they represent the only major potential source of light-firing clay/shale capable of meeting the long-term requirements of the Sydney brickmaking industry. The Department of Mineral Resources has recently commenced a diamond drilling and ceramic testing programme over the potential clay/shale resource areas, but it may be twelve months or more before there is sufficient information available to adequately assess the resource potential of the proposed airport site.

Extractive resources required for airport construction
Table 10.1.1 shows the quantities of materials estimated to be required for the purpose of constructing runway and taxiway pavements, roads, car parks and terminal buildings commensurate with the scale of development implied by the preliminary master plan described in Chapter 8.

Table 10.1.1 Estimate of construction materials required for airport construction

Facility	Construction material	Quantity (000 m^3)
Runways, taxiways, roads and car parks	Sub-base 1	1,200
	Sub-base 2	400
	Sub-base 3	600
	Base-course	300
	Concrete	375
	Bituminous concrete	40
Terminal building	Concrete	60

Source: Department of Aviation.

Figure 10.1.2 shows the existing and potential sources from which the required material could be drawn. Most of these materials, which are discussed below, would either be available from existing sources or could be obtained from the site as part of the cut-and-fill required for runway preparation.

- **Sub-base:** Depending on the different qualities of material and the engineering specifications for the sub-base, most requirements should be able to be obtained on site from the shales, sandstones and laminites of the Bringelly Shale. Similar material may also be obtained from nearby shale quarries. High quality sub-base (and base-course) may be obtained from crushed sandstone at Wallacia (currently being mined by Nolan Mining and Quarrying Co.).

- **Base-course:** Some requirements could be met from materials obtained on site (shale, sandstone and laminite from the Bringelly Shale). These may be augmented by high quality base-course from volcanic breccia deposits at Erskine Park (Readymix Farley) and Wallgrove (Pioneer Concrete), and from hard rock (dolerite and picrite) at Prospect (Boral and Readymix Farley).

- **Coarse aggregate (for concrete and bituminous concrete):** Coarse aggregate for concrete and bituminous concrete could be obtained from river gravel deposits along the Nepean—Hawkesbury River and at Penrith Lakes (Readymix Farley, Pioneer Concrete and Boral) and from hard rock (dolerite) at Prospect Quarry (Boral and Readymix Farley).

- **Fine aggregate (for concrete and bituminous concrete):** Medium to coarse-grained construction sand for concrete and bituminous concrete is available from Nepean—Hawkesbury River deposits and at Penrith Lakes (Readymix Farley, Pioneer Concrete and Boral). This sand may need to be blended with more finely grained sand from Kurnell Peninsula (Hooker Industrial Sands and Minerals and Metropolitan Sand Co.) or from Londonderry (Readymix Farley, P.B. White Minerals Pty Ltd and K.H. Dixon Pty Ltd).

Environmental engineering and geological hazards

The following geological features and processes are recognized as affecting land use:

- natural geological hazards, comprising land instability (soil creep and landslip) and seismicity;

- man-induced (pseudo-geological) hazards, comprising settlement of filling or of reclaimed lands.

These are discussed briefly below.

Land instability
Small slides and flow type landslips can occur in areas where highly plastic clayey soils have developed on extremely weathered Bringelly Shale and coincide with a steep land slope. These conditions occur along parts of the ridge line that extends southward from Luddenham. However, the potential for landslip is only likely to occur following periods of heavy rainfall which cause water tables to rise substantially, leading to high pore water pressure which can trigger downslope movement of small amounts of material.

Seismicity
The area covered in the Penrith 1:100,000 sheet has not, in its 200-year recorded history, suffered from earthquakes associated with zones of significant crustal weakness. However, it does suffer occasional tremors, the origin of the strongest of which is inferred to be a zone of weakness in the south-western Sydney Basin, south of the Penrith map area. Records of earthquake data for the region have been collected only since 1909, although some 'felt' intensity records extend back to the early nineteenth century. While seventy years of records cannot be considered a long period in terms of natural geological processes, it is considered sufficient to indicate that the region is probably not in, or near, a strongly active seismic zone.

Figure 10.1.3 shows the values of intensities as measured on the Modified Mercallie scale that would be expected to be exceeded on average once in every 100 years in the region. The Modified Mercallie scale (MM) is used to measure the ground-shaking effects (intensity) of an earthquake. This scale uses twelve levels of intensity (each designated by a roman numeral), for each level of which there are certain criteria that can be readily observed by people experiencing the earthquake. For example, at an intensity level of IV, hanging objects swing, a vibration like that of a passing truck is felt, stationary cars rock, and windows and dishes rattle. Degrees of damage to various classes of masonry structures serve as criteria for identifying higher intensity levels.

With the exception of the Kurrajong earthquake of 1919 (Cotton 1921) and possibly the Lithgow earthquake of 1985, the felt effects from recorded earthquakes in and around the Penrith region are dwarfed by the felt effects generated by seismic events located further to the south. Recorded seismic events indicate that the area can expect to suffer periodic shaking from earthquakes of magnitudes of about 5.5 on the Richter scale, with a probable forty-year recurrence period. The epicentre would more probably be located 50-100 km south (Picton or Robertson), or 20 km north (Kurrajong) of the Penrith city area. The latest example of seismic activity in the area was an earthquake of magnitude 4.0 on the Richter scale with its epicentre near Lithgow, which was recorded on 13 February 1985. Preliminary analysis indicates that it had an intensity of

Figure 10.1.3
MODIFIED MERCALLIE GROUND INTENSITIES EXPECTED TO BE EXCEEDED ON AVERAGE ONCE IN EVERY 100 YEARS

Northwest *5.3* Control point used to estimate the MM V and MM VI contour lines

NOTE: This information has been prepared using earthquake data from the last 100 years of seismicity and using the 'extreme value' method to estimate the Modified Mercallie scale contour lines

Source: After B. Gaull 'Seismic Risk in the Illawarra Region'

III on the Modified Mercallie scale and, while this event will be used to update current earthquake knowledge, it is unlikely to affect the overall assessment of earthquake risk in the region (B. Gaull, Bureau of Mineral Resouces, Geology and Geophysics, pers. com.). The Standards Association of Australia's earthquake hazard classification map shows the Badgerys Creek area to be in Zone A. The Earthquake Code AS2121 for Zone A requires designs for ductile construction (structures, often reinforced, that are capable of absorbing large amounts of deformation) to be in accordance with Standards Association of Australia design codes such as AS1250 and AS1480. Non-ductile construction, such as unreinforced brickwork, should be designed to be able to withstand ground stress lateral loads in addition to those of wind.

Land settlement

Portions of the proposed site have, to a minor degree, been affected by excavation works, including:

- artificial dams
- roadworks
- housing sites
- agricultural facilities.

These features would be removed in the process of constructing an airport on the proposed site, and additional surface workings would be required to level the site and make it suitable for airport facilities. As is normal for this type of construction, special compaction methods would need to be used and attention given to the grain size of fill material and to drainage in order to minimize the potential effects of differential settlement.

Assessment of effects and safeguards

A number of potential geological hazards, such as seismicity, land instability and land settlement, have been identified that would need to be considered during the engineering design and construction phases for an airport at the proposed site, although none is sufficient to preclude its development. Other potential effects of the proposed acquisition and of future airport development include the following:

- **The requirement for extractive materials:** The Department of Mineral Resources (1984) indicates that the materials required for airport construction would be either available from existing sources or could be obtained from the site. The supply of material from existing sources would to some extent depend on the timing and phasing of airport construction. However, it is anticipated that the size of the Sydney market will ensure that there are always suitable existing sources of supply of construction materials and that it would not be necessary to develop special sources of material solely for airport development.

- **The potential to sterilize regionally important light-firing clay/shale resources:** As discussed, a decision to select and acquire an airport site at Badgerys Creek could potentially sterilize regionally important light-firing clay/shale extractive resources. It is anticipated that the Department of Mineral Resources might be able to clarify the position concerning the likelihood of such deposits being located on the proposed site within the next twelve months (Department of Mineral Resources 1984). If suitable deposits were found to occur, it might be possible either to co-ordinate the extraction of some of this material from the site during airport construction (particularly if such construction were staged) or to completely extract the resource prior to airport development. However, for this latter option to be feasible, there would need to be a long lag time between the acquisition of the site and the construction of the airport. It would also require the co-operation of the brick manufacturing industry in terms of receiving material from this source rather than from other sources of supply.

  Parts of the area surrounding the proposed site are already effectively sterilized by small area subdivision although there is still some scope for possible extraction from some of the remaining land. Once the areas with optimum potential for extraction have been identified, rezoning proposals for these areas surrounding the site should be examined closely. Extraction could be a desirable land use in some noise-affected areas unsuitable for residential or other development.

10.1.2 Soils

This section broadly describes the soils of the proposed site and the potential erosion hazard associated with earthworks which would be required for airport development. Information for this section was obtained from survey work currently being undertaken by the NSW Soil Conservation Service. A soil association map of the region which covers the proposed site was prepared by Walker (1960) and most of the literature relating to soils is based on his study. Detailed laboratory analysis of soil samples from the proposed site has not been undertaken.

Soil types and characteristics

The proposed site contains soils derived from the Wianamatta Group (Bringelly Shale) and Quaternary sediments derived from the surrounding Bringelly Shale. There are two main soil types which occur within the site:

- hard setting red-brown duplex soils
- unconsolidated sediments.

Figure 10.1.4 shows the approximate distribution of these two main soil types in relation to the proposed site.

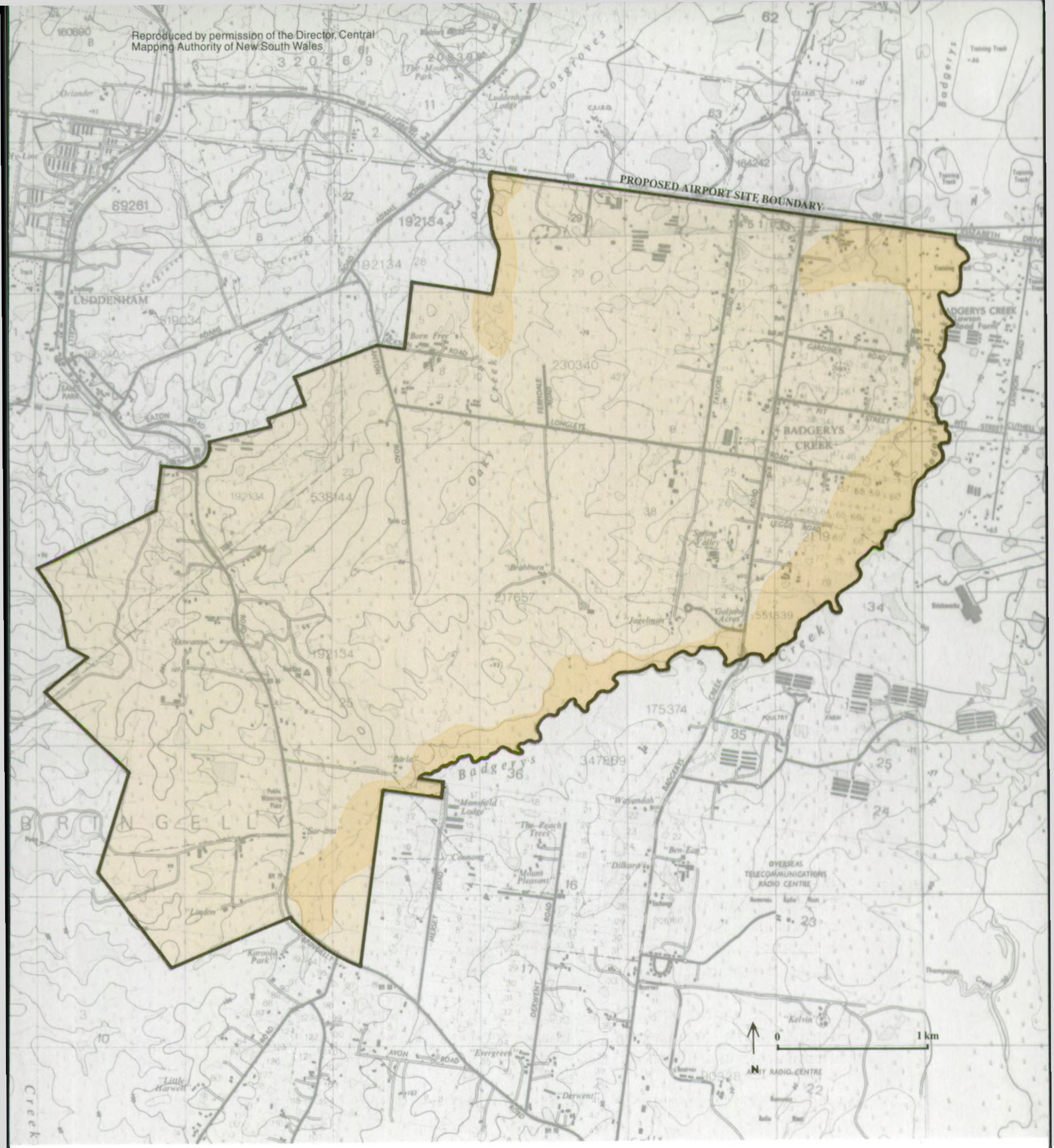
- **Hard setting red-brown duplex soils:** These soils occur over about 95% of the site in association with the underlying Bringelly Shale and comprise the following soil types:
  - lithosols, which are located on the crests of ridges with a topsoil of about 10-20 cm deep overlying either bedrock or reddish brown clay subsoil;
  - brown podzolic soils, which are also found on the crests of ridges but contain numerous rock fragments;
  - red-brown podzolic soils, which are found on the slopes. The depth of these soils can range from about 0.5-2 m, with the deepest profile occurring where the ground slope changes from being convex to concave. These soils are commonly hard setting but can be friable, and generally overlie clay subsoil and highly weathered bedrock;
  - red-yellow podzolic soils, which are found along the drainage depressions or in other areas of poor drainage. The topsoil is usually 10-20 cm deep and overlies a brownish yellow subsoil. These soils are up to 2 m deep and can become waterlogged. They are often saline.
- **Unconsolidated sediments:** These soils cover only a very small proportion of the site. They occur mainly along drainage depressions and narrow floodplains, and are found in association with the Badgerys Creek and to a lesser extent the Cosgroves Creek tributaries. They consist of:
  - yellow podzolic soils, which are likely to occur in the upstream portions of the drainage depressions on footslopes and in association with narrow floodplains. They comprise hard setting loams overlying mottled clays at a depth of about 2 m;
  - solodic soils, which are similar to the podzolic soils but have a distinct columnar structure and deep subsoil cracking. Older alluvial soils may also contain sections of mild gilgai development in which the tuff area has lost all traces of surface soil, leaving concretionary ironstone as a residual on the raised B horizon;
  - gleyed podzolic soils, which are generally found downstream and are more varied, with alluvial clays, loams and sands being present, often stratified. These soils are often saline.

Soil characteristics for these soil types are set out in Table 10.1.2.

The main soil characteristics of concern so far as airport development at the proposed site is concerned would be:

- the erodibility of the soil;
- the potential of sediments to move into the downstream areas during construction activities;
- the special measures needed to establish vegetation on saline soils.

The degree of potential soil erosion depends on the soil profile morphology and the physical properties of the soil unit. Five classes of erodibility have been used in Table 10.1.2 to characterize soil erosion potential and are classified as to the type of



Hard setting red/brown duplex soils

Unconsolidated sediments

Source: Soil Conservation Service
(Preliminary 1:100,000)

Figure 10.1.4
SOIL TYPES

erosive action (Soil Conservation Service 1978). Other characteristics relating to the soils on the site are also presented in that table.

Table 10.1.2 Soil characteristics

Type	Geology	Dominant materials	Occurrence	Intrinsic fertility	Erosion hazard		Drainage	Other characterisitics
					Type	Degree		
Hard setting red-brown duplex soils	Wianamatta Group: Bringelly Shale	Sandy to silty clay loam top-soil; light to medium clay subsoil	Elevated hill crests and ridges	Moderate	Sheet: Gully: Note: subsoil has moderate to high erodibility	moderate moderate	Poor	Moderate shrink/swell; generally acid, and salinity can be a problem in drainage depressions
Unconsolidated sediments	Alluvium	Alluvial clays, loams, sand	Drainage depressions, narrow floodplains	Low	Stream-bank: Gully: Sheet:	high high moderate	Poor	Soils in this unit can have a high salinity

Assessment of effects and safeguards

The construction of an airport at this location would require a major portion of the site to be reshaped. As the site contains soils which are moderately to highly susceptible to erosion, specialized erosion and sediment control measures would be implemented to minimize any problem of sedimentation in the surrounding drainage systems. The specific measures to be adopted would be determined after consultation with the NSW Soil Conservation Service, but are likely to include:

- ensuring that the site is only partially cleared and that, during construction, progressive rehabilitation of disturbed areas is undertaken through revegetation and landscaping;
- special measures for the removal and stockpiling of topsoil, including the progressive use of topsoil for rehabilitation. (Any stockpiles not likely to be used would be stabilized with vegetation);
- land reshaping and contouring to avoid excessive concentration of drainage and, where possible, the locating of slopes away from areas yielding excessive run-off;
- ensuring that contour drains are constructed at as low an angle as possible over the entire lengths of slopes;
- where necessary, creation of diversion banks to disperse run-off and protect rehabilitated work;
- provision of sediment control basins where necessary to trap sediments during construction work, so that downstream areas would not be adversely affected.

The proposed site also contains areas of saline soils which are likely to inhibit revegetation. These soils require special treatment, because they are usually present in areas where erosion is likely to be high and vegetative cover is sparse. Procedures would therefore be taken to remedy salinity by removing saline groundwater through drainage. Also, the rate of movement of water into and through the soil would be increased by techniques such as deep ripping, spreading mulch over the surface, and the installation of subsoil drains. Salt-tolerant plant species would be used for vegetative cover. Advice on rehabilitating saline soils would also be obtained from the NSW Soil Conservation Service, and agreed procedures implemented.

10.1.3 Physiography

This section briefly describes the landform and topography of the proposed site and assesses its suitability for airport development. Landform and topography are important factors in the siting and design of an airport, because relatively flat grades are required for airport runways and aircraft movement areas (taxiways, airport aprons and aircraft maintenance areas) and because extensive obstruction-free approach surfaces with shallow gradients are essential. The selection of a site and preparation of a master plan for airport development at that site therefore have to take into account any significant physiographic features such as terrain, floodplains, and any creek or river valleys which dissect the area.

Information contained in this section is based on the 1:25,000 scale topographic sheets for the area: there was incomplete map coverage of the proposed site at other scales which could provide more detail.

Regional physiographic units

The site is located within the Cumberland Plain physiographic sub-region of the Sydney Basin. The Sydney Basin is a simple asymmetrical structural basin which extends along the coastline from Port Stephens in the north to Batemans Bay in the south and inland to Rylstone and Muswellbrook.

The Cumberland Plain (Figure 10.1.5) is surrounded by the Blue Mountains Plateau to the west, the Woronora Plateau to the south-east and south, and the Hornsby Plateau to the east, north and north-west. There is a distinct transition from the Cumberland Plain to the Hornsby and Blue Mountains plateaux. The transition between the Cumberland Plain and the Blue Mountains Plateau is abrupt, particularly along the Lapstone Monocline where there is a 400 m change in elevation over a very short distance. The transition between the Hornsby Plateau and the Cumberland Plain is less pronounced, consisting of a 100-150 m change in elevation marked by gently rolling hills, with intermediate elevations of between 40 m and 80 m. The Cumberland Plain slopes upwards towards the south, with the transition between the plain and the Woronora Plateau being less distinct as the two units tend to merge.

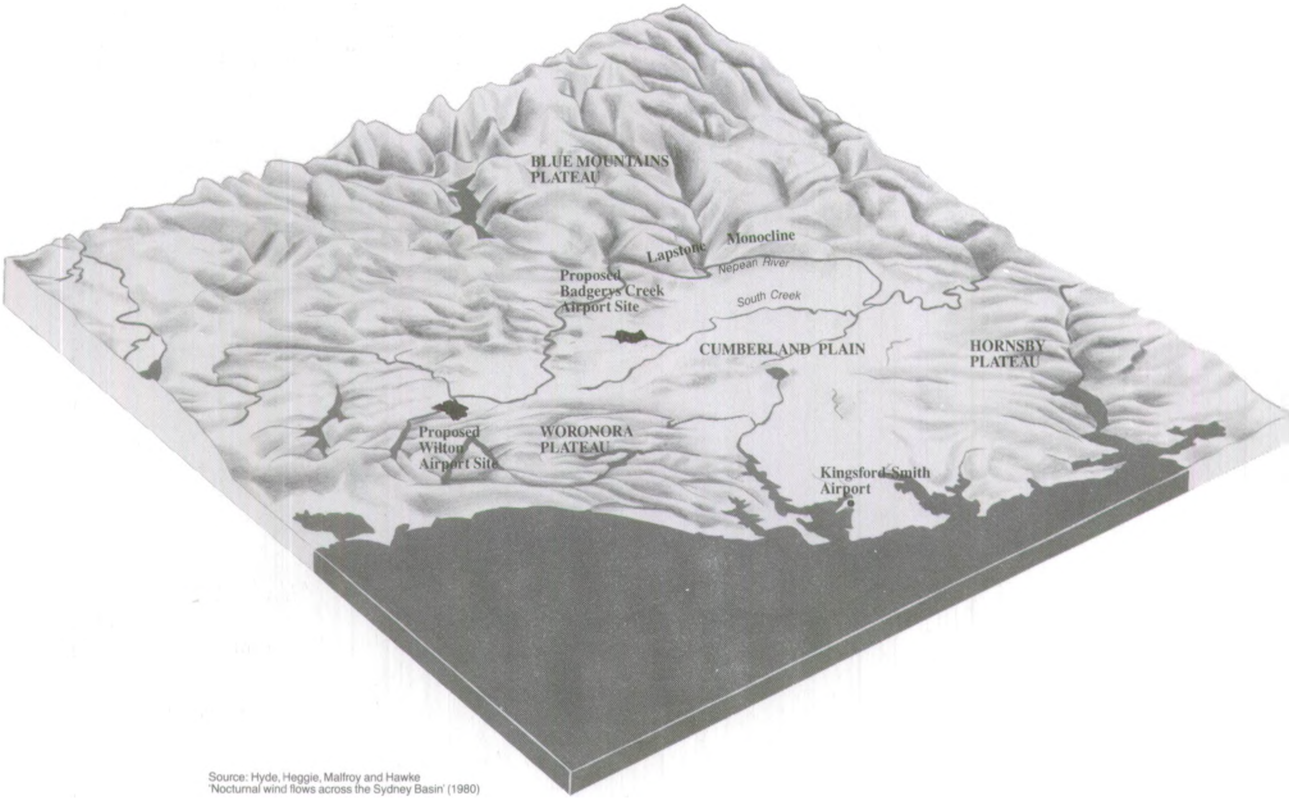
Landform

The proposed airport site is located in the south-western portion of the Cumberland Plain, on the eastern side of an elevated ridge system dividing the catchments of the Nepean River and South Creek. The Cumberland Plain extends from Sackville in the north to near Camden and Campbelltown in the south, and to the Nepean and Hawkesbury rivers in the west. The eastern boundary of the Plain is broadly defined by the southern and south-western suburbs of Sydney.

The Cumberland Plain has an average elevation of about 20 m above sea level in the north, rising to about 150 m in the south around Bringelly, Camden and Campbelltown, a distance of about 50 km. The elevated ridge system on which the site is located begins to rise at Orchard Hills in the north and extends southward to Bringelly and Cobbitty, where it broadens out into an elevated plain.

The site is bounded by the drainage system of Cosgroves Creek in the north, Badgerys Creek in the south and east, and Duncans Creek in the west, and can be categorized in terms of the following landforms:

- ridges
- slopes/undulating land
- terrace
- plain
- stream dissection.



Source: Hyde, Heggie, Malfroy and Hawke
'Nocturnal wind flows across the Sydney Basin' (1980)

Figure 10.1.5
REGIONAL PHYSIOGRAPHY

Figure 10.1.6 and Table 10.1.3 show the distribution and types of these landforms within the site.

Table 10.1.3 Landform units

Type	Distribution	Area	Elevation range (m)*
Ridges	Western portion of site	275 ha (15.5%)	85-118
Slopes	Ranges over entire site	1025 ha (58.0%)	60-95
Terrace	Central portion	195 ha (11.0%)	75-90
Plain	Badgerys Creek and tributary	275 ha (15.5%)	45-80
Stream dissection	Scattered over whole of site	25 km	45-100

* Metres above sea-level.

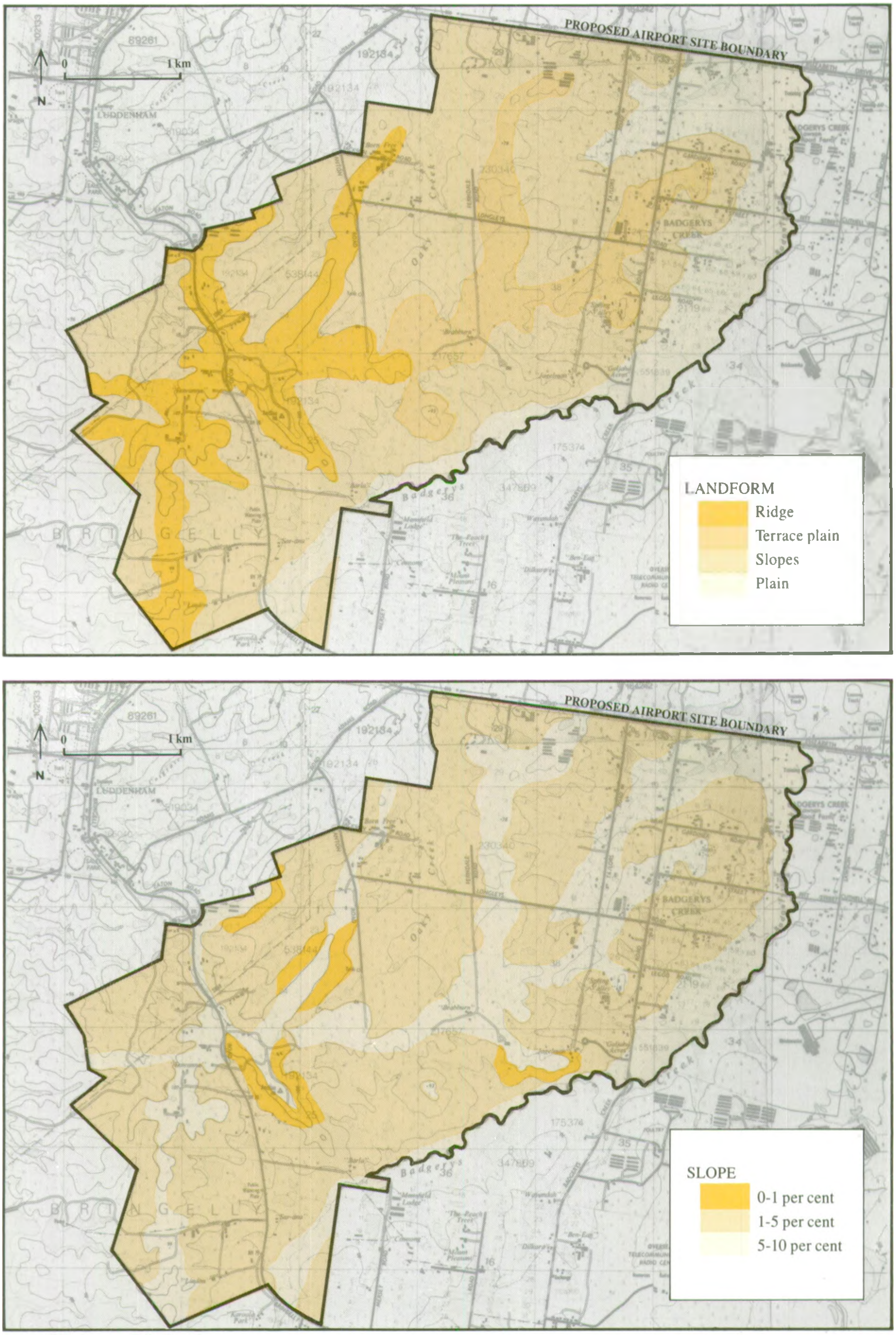


Figure 10.1.6
SITE PHYSIOGRAPHY

Topography

The proposed site has an average elevation of about 80 m above sea-level, ranging from about 45 m at its lowest point where Elizabeth Drive crosses Badgerys Creek to 118 m at the Anchau geodetic station located on the north-west/south-east ridge system about 300 m from The Northern Road. From this point, the site slopes towards the north-east over a distance of about 5 km and towards the south-west over a distance of about 1.5 km.

The site contains a relatively large proportion of flat land. This coincides with the ridge system in the western portion of the site, the elevated terrace section, and the plain associated with Badgerys Creek and its tributary. The maximum slope gradient ranges between 5% and 10% and this occurs in isolated areas adjacent to the ridge system and where the elevated terrace adjoins Badgerys Creek. About 95% of the proposed site has gently sloping terrain ranging between 0% and 5% slope.

Figure 10.1.6 and Table 10.1.4 show the topography of the site categorized into the following three classes of slope gradient:

- flat terrain : 0-1% slope
- gently sloping terrain : 1-5% slope
- undulating terrain : 5-10% slope.

Table 10.1.4 Site topography

Slope (%)	Distribution	Area	Elevation range (m)*
0-1	Central and western portion of site	530 ha (30%)	45-80 70-100 90-118
1-5	Ranges over entire site	1,155 ha (65%)	50-100
5-10	Isolated areas, mainly western portion of site	85 ha (5%)	60-110

* Metres above sea-level.

Topography surrounding the site varies markedly. Immediately to the north, east, and south-east of the site, the topography merges into the South Creek lowlands and the Cumberland Plain. However, further to the north-east, towards Prospect Reservoir the topography rises to form an elevated ridge system which extends from Mount Druitt to Austral. This ridge system divides the South Creek catchment from the Prospect Creek and Cabramatta Creek catchments, which flow into the Georges River. The elevation of this ridge system ranges from about 60 m above sea-level in the north to about 120 m in the south.

South of the proposed site, the topography merges into a relatively flat elevated region which extends to Cobbitty and Campbelltown. The area to the west of the proposed site is highly undulating terrain, featuring relatively steep slopes of between 5% and 20%, and dissected terrain caused by the relatively dense drainage network. The elevation varies markedly, but in the vicinity of the Nepean River generally ranges from 110 m to about 50 m above sea-level. The topography west of the Nepean River becomes very rugged, with elevations ranging from about 200 m at the lower points on the plateau to over 750 m above sea-level at some of the highest areas about 30 km from the site.

Location of airport facilities in relation to terrain

Table 10.1.5 shows the expected position (Section 8.4) of major airport facilities (runways and taxiways, airport terminal area, and aircraft cargo and maintenance areas) in relation to the existing landform and topographic features within the proposed site.

Table 10.1.5 Airport facilities in relation to landform and topographic features

Airport facility	Predominant landform feature	Topographic features					
		Elevation*			Slope category (%)		
		Max. (m)	Min. (m)	Av. (m)	0-1 (%)	1-5 (%)	5-10 (%)
Runway/taxiway:							
- Short	Ridge, slope	110	65	80	10	90	-
- Long	Ridge, slope, terrace	100	65	80	30	70	-
Connecting taxiway	Ridge	115	85	100	45	50	5
Airport terminal area	Ridge, slope	115	75	90	10	85	5
Aircraft cargo area	Terrace, slope	85	60	80	75	25	-
Aircraft maintenance area							
- Commercial	Ridge, slope	105	95	100	65	35	-
- General aviation	Ridge, slope	100	70	85	5	95	-

* Metres above sea-level.

Land shaping

Reshaping of the ground surface by excavating and filling would be required to obtain the necessary grades for future airport development. Where possible, development design would utilize existing topography and natural land features to avoid extreme land modifications. However, because of the nature of the airport development and the requirement to achieve relatively flat grades, much of the airport site would be cleared and levelled for the construction of runways, taxiways and aircraft terminal facilities as well as for a number of other facilities such as maintenance and cargo handling areas (Figure 10.1.7).

The estimated amount of cut-and-fill required for future airport construction is shown in Table 10.1.6. These calculations are based on nearly level runways and taxiways. They would involve up to about 10 m of fill in some locations, mainly to fill in the creek beds, and up to about 20 m of cut where the existing ridge line runs parallel with the connecting taxiway.

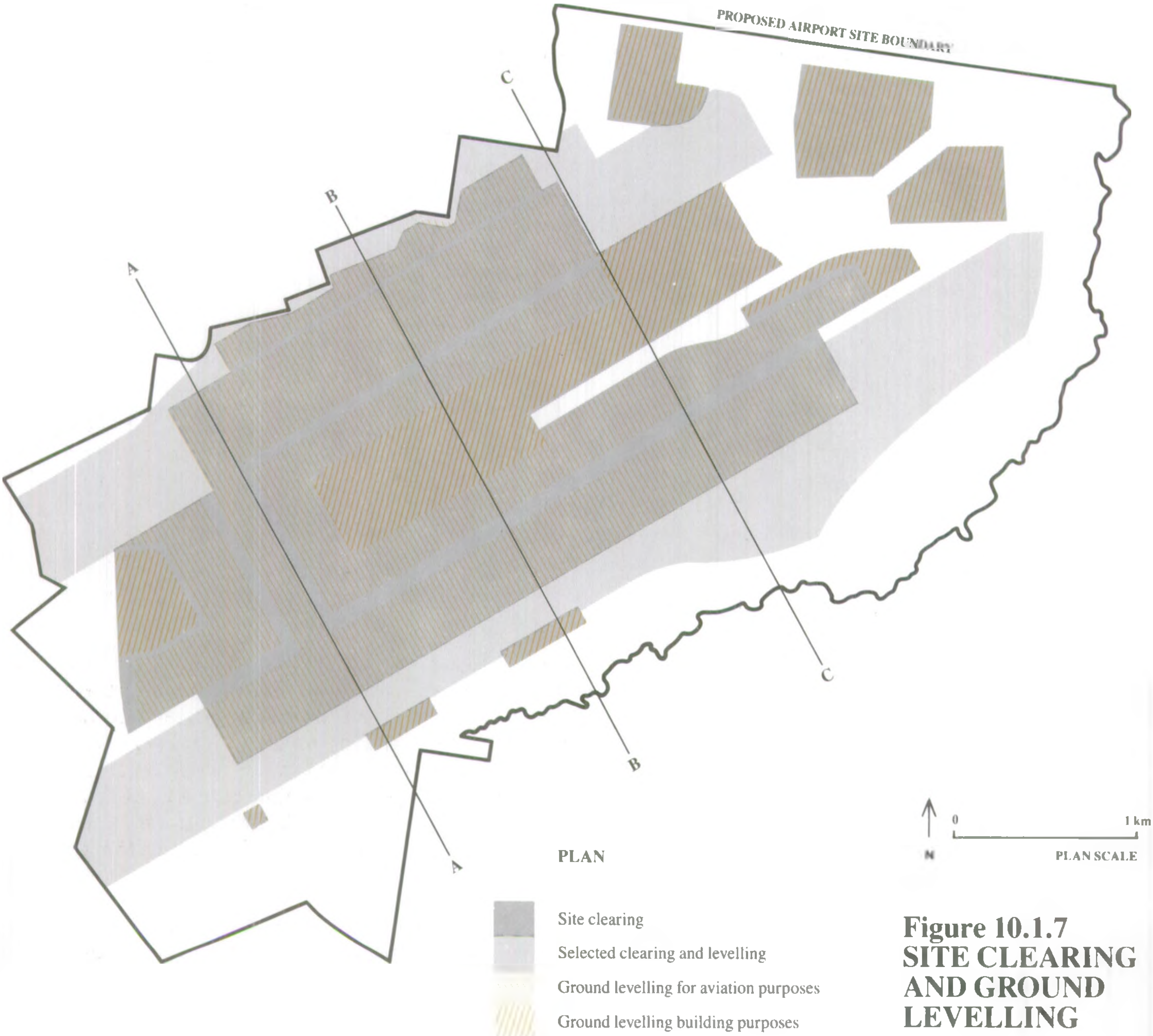


Figure 10.1.7 SITE CLEARING AND GROUND LEVELLING

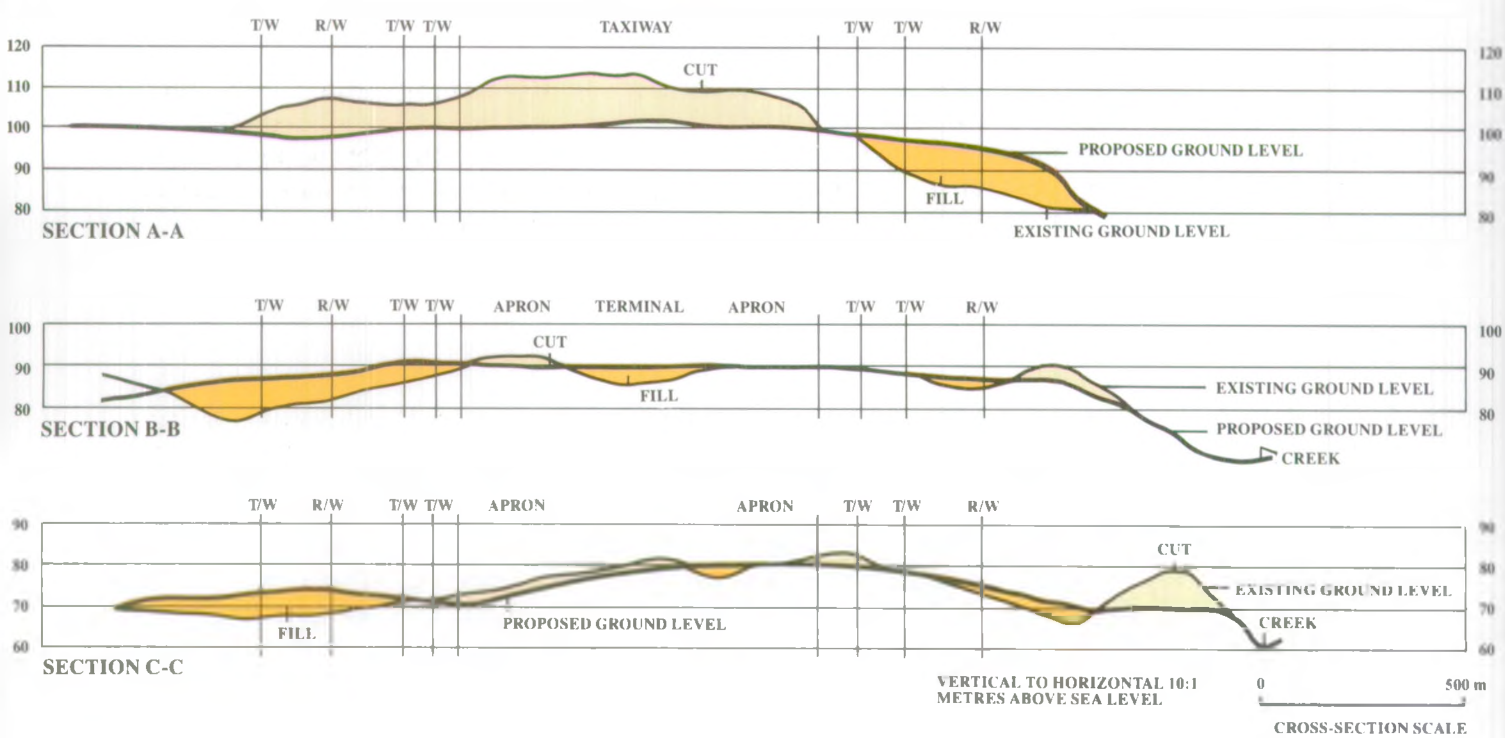


Table 10.1.6 Estimate of earthworks for future airport construction (000 m^3)

Facility	Cut	Fill	Balance*
Long runway and associated taxiways	4,266	3,666	600 (C)
Short runway and associated taxiways	2,076	2,383	307 (F)
Connecting taxiway	220	444	224 (F)
Terminal and cargo areas	9,192	9,330	138 (F)
Total	15,754	15,823	69 (F)

* C = cut, F = fill.

Assessment of effects and safeguards

The nature of the terrain surrounding the proposed site precludes much flexibility in terms of site relocation within the general Badgerys Creek area. The undulating nature of the landform and topographic features to the west of this site mean that there are no suitable sites further to the west of the proposed location, while the broad drainage and floodplain associated with Badgerys Creek and its tributary restrict relocation of the site to the east or to the south. The varied nature of topography immediately to the north of the site also makes it impracticable to locate the site further to the north, as this would necessitate a greater degree of earthworks in order to provide a relatively flat area for runway development.

A range of measures would be adoped during future airport construction to minimize the amount of earthworks and to ensure that appropriate procedures for erosion and sediment controls were established and implemented. Where possible, detailed design and layout of future airport facilities would utilize existing topography and natural features. Land shaping would only be carried out on areas under construction as opposed to shaping the entire site. Soil erosion control measures as discussed in Section 10.1.2 would be implemented.

Up to a 7 degree rotation counter-clockwise would slightly improve the topographic position of the runways and the main connecting taxiways, and may be desirable to minimize the amount of earthworks and to optimize the cut-and-fill. This aspect would be a factor for consideration at the detailed design stage to ensure optimum runway orientation in relation to both topographic and airspace requirements.

10.2 DRAINAGE AND WATER QUALITY

The purpose of this section is to describe, in general terms, the existing surface water and groundwater systems and the potential for flooding of the proposed site; to assess the potential effects of airport development on drainage and water quality within the site and surrounding area; and to describe the drainage and run-off control scheme that would be adopted to manage water flow and preserve water quality, in order to minimize any adverse environmental effects arising from the changed drainage pattern.

Information for this section has been obtained from the Water Resources Commission, the Metropolitan Water Sewerage and Drainage Board and the State Pollution Control Commission, and from topographic maps of the area. Also, preliminary estimates of site run-off before and after development have been made in order to determine the requirements for stormwater run-off control.

10.2.1 Description of existing conditions at the proposed site

Drainage basins

The proposed site contains three main drainage basins (Figure 10.2.1):

- the Duncans Creek drainage basin, about 23 km^2 in area, which drains into the Nepean River about 2 km upstream of Wallacia and 8 km west of the proposed site;

- the Cosgroves Creek drainage basin, about 21 km^2 in area;

- the Badgerys Creek drainage basin, about 28 km^2 in area.

The Cosgroves and Badgerys Creek basins drain into South Creek, which in turn flows into the Hawkesbury River about 2 km north-east of Windsor and 34 km north of the proposed site.

The headwaters of all three basins occur within the site. Table 10.2.1 shows the proportion of each within the site as well as other drainage features.

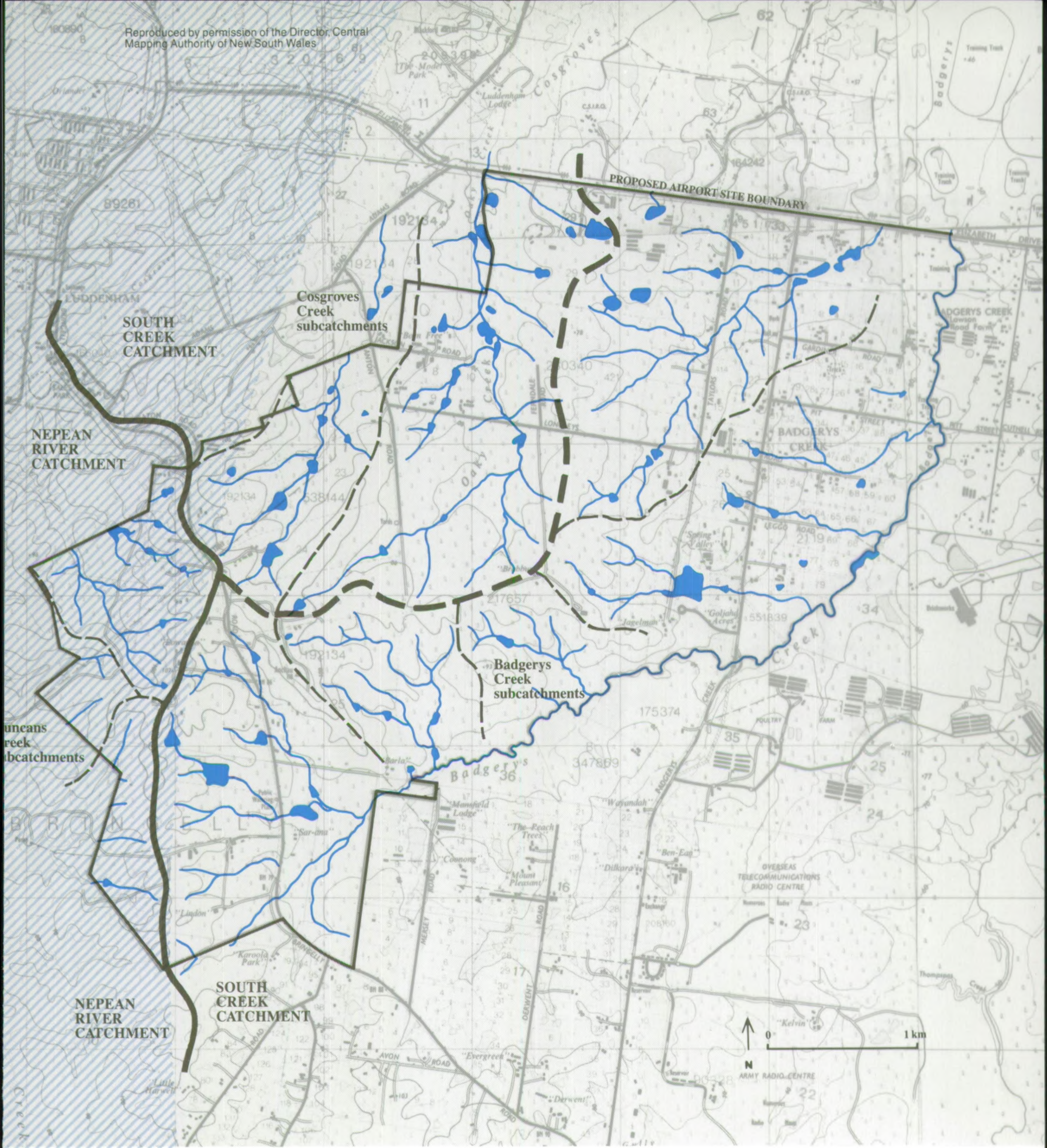
Table 10.2.1 Features of the drainage basins within the proposed site

Drainage basin	Approximate total area of basin (km^2)	Approximate area of basin within the proposed site (ha)	Area of basin within the proposed site (%)	Proportion of total basin area that is within the proposed site (%)
Duncans Creek	23	180	10	8
Cosgroves Creek	21	445	25	21
Badgerys Creek	28	1,145	65	41

Surface water features

The principal surface water features of the proposed site comprise numerous man-made dams and intermittent watercourses (Figure 10.2.1). The only perennial watercourse is Badgerys Creek, which forms the eastern and southern boundary of the site. There are about 25 km of drainage channels flowing through the site and over 70% of the total length of these are minor channels. There are approximately 115 man-made dams.

As a result of agricultural and rural residential development in the Badgerys Creek area, the ground cover of native forest vegetation has for the most part been cleared and replaced by grazing land and market gardens, and by buildings and other impervious surfaces. This has affected natural run-off from the proposed site by increasing the peak flow of the drainage channels. Table 10.2.2 shows the probable run-off co-efficient values for the various types of existing land uses within the site.



Drainage catchment

Major subcatchment

Creek and drainage swale

Dam

Low salinity/low yield groundwater

(After Groundwater in New South Wales Supplementary Maps, map 7, Water Resources Commission, 1984)

Figure 10.2.1
SURFACE WATER FEATURES

Table 10.2.2 Run-off co-efficients for the proposed site before airport development

Condition of site	Area (ha)	Run-off co-efficient for storm intensity of 100 mm/h
Natural and partially cleared forest; clay soil	170	0.6
Agricultural activities	1,405	0.5
Rural residential	175	0.5
Roads	20	0.8

Flooding

Badgerys Creek has a developed floodplain which extends into the north-eastern section of the proposed site south of Elizabeth Drive. The 1:100 year floodplain map compiled by the Water Resources Commission shows the floodplain as about 150 m wide at a point within the site just south of Elizabeth Drive. The floodplain beyond this point on Badgerys Creek has not been mapped. Most of the other creeks draining the site have a sufficiently steep gradient to render flooding unlikely for any duration longer than the particular storm event.

10.2.2 Groundwater

The proposed site is located within the Hawkesbury River Basin (Figure 10.2.1) on the edge of an area that may be expected to give low salinity—low yield groundwater. Apart from sections along the Nepean River between Penrith and Windsor, groundwater resources in the basin have not been developed. The Wianamatta Group, which extends over the site and over much of the Cumberland Plain, has poor groundwater potential and any water that is available is usually brackish or saline. On the sloping areas occurring in parts of the site, the groundwater in the Wianamatta Group might be suitable for watering stock or a similar purpose, but yields are often low (0.1-1 L/s), thereby limiting extensive use of the resource (Water Resources Commission 1984). The unconsolidated sediments along Badgerys Creek might furnish groundwater but it also would probably be saline and of relatively low yield.

10.2.3 Water quality

None of the run-off from the proposed site flows into a river or creek that is classified by the State Pollution Control Commission under Part III of the Clean Waters Act, 1970 (although the Nepean River is classified 'P' (protected) for a section upstream of Wallacia). However, any effluent or run-off discharged from the site would need to conform to the requirements set out in Clause 16 of the Act, which prohibits the pollution of any waters. All the run-off from the site flows eventually into the Hawkesbury—Nepean River, most of it discharging into South Creek before the creek joins the Hawkesbury downstream of Windsor.

Extensive urban and rural areas drain into South Creek, and in addition there are at present five sewage treatment works located within the catchment. The Metropolitan Water, Sewerage and Drainage Board operates plants at St Marys, Quakers Hill, and Riverstone; the Hawkesbury Shire Council operates a plant at Windsor; and there is also a small plant at HMAS Nirimba. South Creek contains high concentrations of nutrients (nitrogen and phosphorous) and has very low assimilation rates, indicating that it functions for part of the time as a drain for effluent, discharging considerable amounts of nutrient into the Hawkesbury River.

10.2.4 Possible contaminants and methods of treatment

Table 10.2.3 lists possible sources of contaminants of site run-off and effluent from operations that might be conducted on the site. The list has been developed from inventories conducted at Kingsford-Smith Airport and other aerodromes in the Sydney Region. All of the sources listed in Table 10.2.3 could be expected to be present at the second airport, should development reach the maximum level indicated by the preliminary master plan.

Table 10.2.3 Potential sources of contaminants during airport construction and operation

Contaminant	Source
Sediments	Natural erosion, site earthworks
Nutrients	Soil sediments, fertilizers, sewage effluent
Contaminated food/water	Kitchen waste from international flights
Sulphuric acid	Wet oil batteries used for standby power supplies, and installed in some airport facilities, e.g. control tower
Emulsified oil, grease, decarbonizing solvent cleaners	Workshops for conventional engine maintenance
Detergents	Aircraft washdown areas, vehicle service and maintenance areas
Paint strippers	Aircraft/vehicle maintenance
Acid, fluorocarbon and hydrocarbon solvents	Fire-fighting equipment
Trade wastes	Kitchens
Aircraft fuel	Fuel storage, aircraft refuelling
Rubber detritus	Aircraft touchdown
Pesticides/herbicides	Ground maintenance

For treatment purposes, these contaminants would be grouped as follows:

- chemical or process effluent arising from operations such as aircraft maintenance;
- domestic sewage from toilets and kitchens;
- 'contaminated' stormwater from heavily used open areas, such as aprons, washdown areas and carparks;
- 'clean' stormwater from cleared and grassed areas and intermittently used pavements.

Because of the uncertainty associated with the nature and scale of operations at the second airport it is only possible to establish proposed waste treatment methods in general terms. However, the Department of Aviation would comply with the requirements of the Clean Waters Act, 1970, in regard to all specific discharges that might issue from the site during the the course of airport construction and operation. The principles for segregating and treating wastewaters are described below.

Chemical or process effluent

Chemical or process effluents would be treated to standards established in consultation with the Metropolitan Water Sewerage and Drainage Board and to the satisfaction of the State Pollution Control Commission. Depending on the nature of the effluents, the process could comprise pre-treatment on-site prior to discharge to a Metropolitan Water Sewerage and Drainage Board sewer, or complete treatment on-site.

Domestic sewage

No sewerage facilities are at present located within or adjacent to the proposed site and no sewage treatment schemes are scheduled for this area in the short to medium-term.

The Department of Aviation could either treat domestic sewage in a dedicated plant located on the airport site, or could discharge to a future Metropolitan Water Sewerage and Drainage Board sewer for treatment in a water pollution control plant located off-site and designed to serve not only the airport, but development in surrounding areas (an estimate of the required capacity of such a combined facility is given in Section 10.5).

In either case, it is assumed that the water pollution control plant would discharge effluent into South Creek and therefore a high degree of the treatment would be needed, including removal of nutrient. It is further assumed that the treatment process used would be of advanced design and would include methods for removal of nitrogen and phosphorus.

If the treatment were to be carried out in a dedicated plant located on the airport site, the Department would investigate the possibility of on-site disposal of treated effluent through irrigation.

Stormwater

Stormwater would be considered in two categories:

- run-off from contaminated areas where there is a possibility that stormwater would contain significant quantities of oil or particulate material;
- run-off from clean areas (for example, taxiways).

The areas designated contaminated would be separated from areas designated clean by suitable grading to direct run-off into the appropriate system.

Contaminated stormwater

Contaminated stormwater would discharge into a holding area where it would be treated prior to disposal by means to be established in conjunction with the Metropolitan Water Sewage and Drainage Board and to the satisfaction of the State Pollution Control Commission. The process could comprise pre-treatment on-site and discharge to a water pollution control plant operated off-site by the Board, or full treatment on site. For run-off from some contaminated areas it might be possible to divert only the first flush to the holding area for treatment, and subsequent run-off to the clean stormwater system.

The Department of Aviation would ensure that the design of fuel storage facilities would comply with the relevant requirements of the Dangerous Goods Act, 1975 and bunding would be designed to ensure that spillage resulting from failure of the facility was fully contained and could not enter the stormwater system.

Clean stormwater

Areas from which stormwater run-off would probably be designated as clean include most areas of the site where there are no operations that could give rise to process or domestic wastewaters, or carry the risk of contamination of run-off through accidental spills of chemicals, fuel, oil or detergents. Such clean areas would probably include, for example, visitor car parks, access roads within the site, roofs of buildings, taxiways and runways, and cleared or landscaped areas. These areas would make up the major part of the total site area.

Stormwater run-off from these areas would be diverted into a number of retention ponds, which together would be adequate to retain the whole of the first flush of stormwater. From here stormwater would be discharged into retarding basins that would control the rate of flow of run-off to the many small tributary creeks around the perimeter of the site (Figure 10.2.2).

The stormwater retention ponds would be designed to contain the first flush for a one-in-ten-year storm of varying duration, depending on the time of concentration of the particular sub-catchment, plus an additional fifteen minutes to allow the drainage area to flush clean. About 250 m^3/ha storage capacity would be required to store the initial flush. This would mean that the total storage capacity for the retention system would be between 200,000 and 300,000 m^3. The capacity of basin sizes would vary 'from about 15,000-20,000 m^3 serving the smaller sub-catchments to 60,000-70,000 m^3 for the larger sub-catchments within the proposed site. At each discharge point, trash screening would be used to remove solids washed off by the first flush of the storm.

Stormwater retarding basins would also be provided for each major creek draining the proposed site, and would be designed with sufficient capacity to contain the peak flow of a 1:100 year storm event, so that discharge of flows from the site would not exceed the present peak flows from such an event. A total of between 400,000 and 500,000 m^3 of storage capacity would be required to control peak flows at about the same level as at present. There are some twelve locations around the perimeter of the proposed site where retarding basins would be required, varying in size from between 35,000 and 40,000 m^3 for the smaller sub-catchments to between 130,000 and 160,000 m^3 for the larger sub-catchments. Release of water from the retarding basins during storm events would be controlled to approximate existing streamflow under storm conditions.

10.2.5 Assessment of effects and safeguards

This assessment of effects is confined to the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further investigation once the locations for these facilities were determined. The authority responsible for constructing new access routes would also be responsible for ensuring that adequate safeguards were adopted during construction to contain run-off and sedimentation, and that adequate provisions were made for drainage and water quality control once construction had been completed.

No adverse effects on drainage or water quality would result from acquisition of the proposed site at Badgerys Creek; until construction commenced the Department of Aviation would endeavour to maintain the existing land uses.

Possible effects during construction and operation of the proposed airport have been considered under the following categories:

- increased potential for flooding in South Creek
- effects on groundwater
- effects on water quality during construction
- effects on water quality during operation.

In addition, the relationship of the proposed stormwater retention system to hazard to aircraft from bird strikes is discussed.

Flooding in South Creek

About 50% of the proposed site (some 880 ha) would become an impervious surface, from which the run-off water would be directed into semi-natural and lined channels, thus increasing the flow rate and volume of water passing a given place at a given time. It is estimated that run-off from the proposed site would be increased by about 26% as a result of paving and of building development. Table 10.2.4 shows the probable new run-off co-efficient values.

Table 10.2.4 Run-off co-efficients for the proposed site after airport development

Condition of site	Area (ha)	Run-off co-efficient for storm intensity of 100 mm/h
Paved areas and buildings	880	0.9
Partially developed and grassed areas	890	0.4

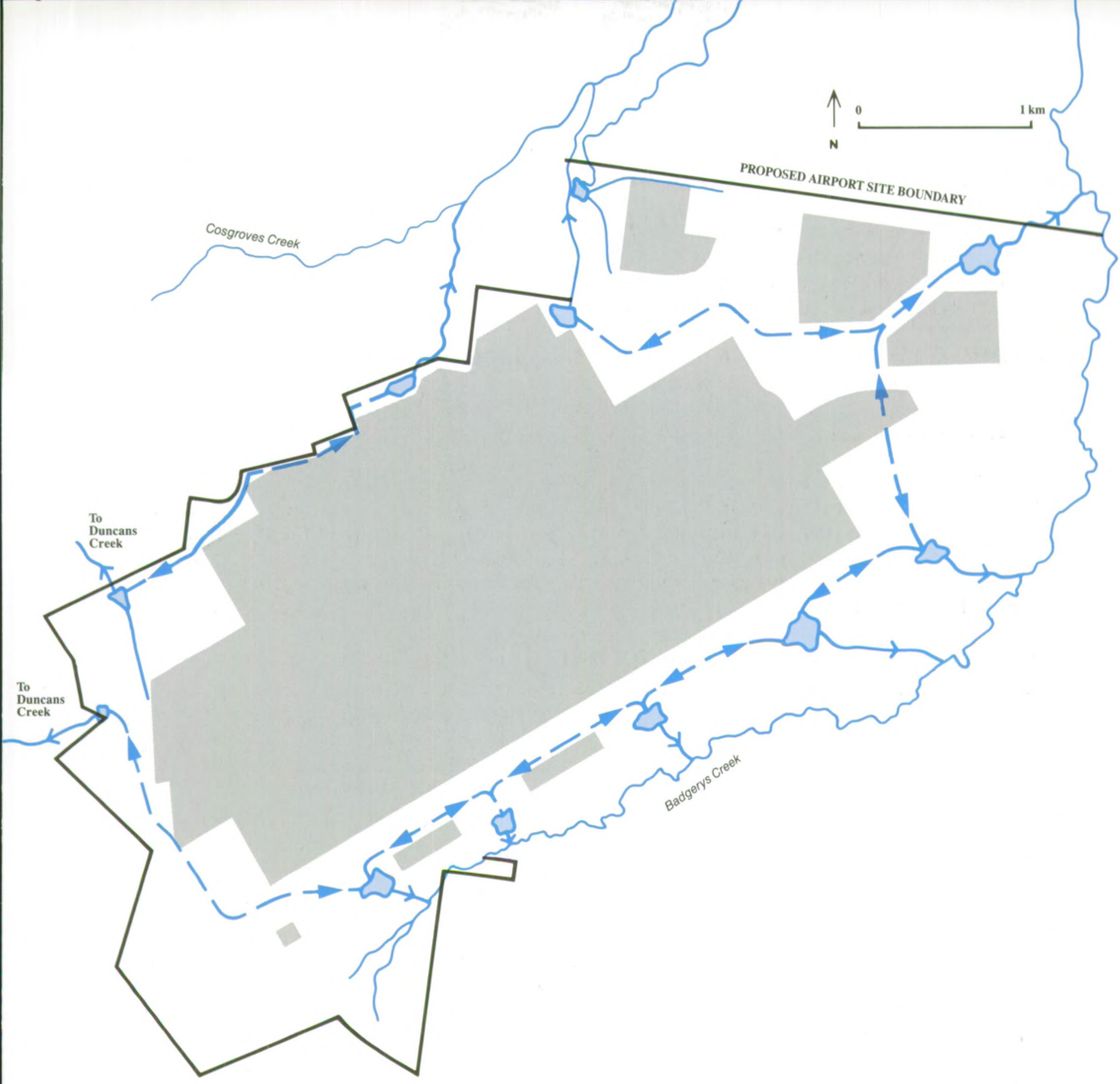
The adverse effects associated with increased run-off and greater potential for flooding, as a result of the development, would be minimized by the retarding basins on each of the main sub-catchments flowing from the proposed site. By ensuring that there would be sufficient storage capacity to contain peak flows from a 1:100 year storm event, flows along the creeks should, in general, be similar to those experienced at present. This would also ensure that any potential effects on riparian vegetation or on agricultural or recreational areas downstream of the site would be minimized.

Groundwater

Effects on groundwater should not be significant as groundwater potential is low in the area of the proposed site.

Water quality during construction

During airport construction there would be some risk of sediments being released from the construction site and finding their way into farm dams, or into Badgerys Creek or one of the other small creeks adjacent to the site. In order to reduce the potential risk of sedimentation occurring during construction, temporary silt traps would be constructed where required, to collect run-off from disturbed areas. To help reduce sedimentation even further, progressive revegetation of disturbed areas would be co-ordinated with the construction work. Also, the proposed drainage system — consisting of retention basins to contain the first flush of stormwater and retarding basins to control the rate of flow of run-off (Figure 10.2.2) — would be progressively installed during the construction phase to suit the development programme and the requirements for run-off control.



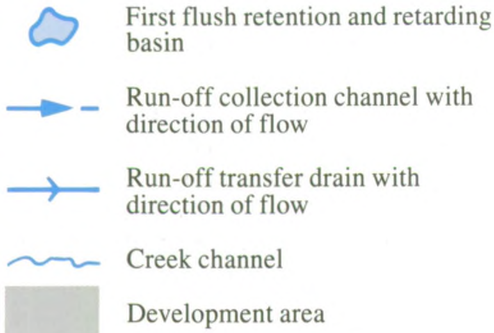


Figure 10.2.2
SCHEMATIC DRAINAGE CONCEPT

During initial construction on the proposed site, water quality in the streams draining the site is likely to be temporarily affected by increased nutrient loads, since total nitrogen and phosphorus entering the system from run-off would be expected to increase. However, once development was finished the contribution of total nitrogen and total phosphorus to the system from run-off would be expected to decrease significantly (Smalls 1983).

Water quality during operation

The Department of Aviation would comply with the requirements of the Metropolitan Water Sewerage and Drainage Board and the State Pollution Control Commission in regard to standards for discharge from the proposed site.

Stormwater run-off from the proposed site, and discharges from the water pollution control plant (which could be located on-site or off-site as a joint use facility) would enter South Creek, and from there the Hawkesbury River at Windsor and thence to the ocean at Broken Bay.

Under low water flow conditions, most of the present flow in South Creek is treated sewage, carrying high nutrient loads. There is little assimilation of these nutrients with the result that South Creek acts as a discharge for effluent into the Hawkesbury River. Considerable population increase is forecast for areas in the catchments of South and Eastern creeks and, as a result, significant increases in nutrient loads are also forecast (Kinhill Stearns 1984). These forecasts are set out in Table 10.2.5.

Table 10.2.5 Forecast nutrient loads in South Creek in the year 2000

Source	Nitrogen (kg/day)	Phosphorous (kg/day
Sewage effluent	1,865	190
Stormwater	320	183
Total	2,185	373

Source: Kinhill Stearns, 1984. South Creek Wetland Study, Table 4.6.

The contribution of nutrients from the second Sydney airport site, when developed to the maximum level shown in the preliminary master plan, has been calculated using the following assumptions:

- domestic sewage for 20,000 population equivalents associated with airport facilities would be treated at a new water pollution control plant located off-site, and also serving other development. The plant would produce daily effluent flows of 0.27 m^3 per population equivalent, with total nitrogen of 5 g/m^3 and total phosphorus of 1 g/m^3;
- nutrients in site run-off would be equivalent to that for a fully developed urban area, and would be estimated at 7 kg/ha per annum for nitrogen and 1 kg/ha per annum for phosphorus.

The resulting estimated total nutrient load in South Creek attributable to airport operations under the worst case is shown in Table 10.2.6.

The worst case level of airport development as represented by the preliminary master plan is most unlikely to arise before the year 2000 — the end of the period for the nutrient forecasts set out in Table 10.2.6. However, if it were assumed that the airport were 50% developed by the year 2000, and that there was no assimilation of airport nutrients in the upper reaches of South Creek, then airport development would contribute about 2.2% of the nitrogen load and 2.0% of the phosphorus load in South Creek in that year.

Table 10.2.6 Estimated nutrient loads in Allens Creek as a result of airport development

Source	Nitrogen (kg/day)	Phosphorus (kg/day)
Water pollution control plant (airport related flows)	27	5.4
Site run-off (total site of 1770 ha)	34	4.8
Totals	61	10.2

Precautions against birds

In addition to the safeguards adopted to minimize water pollution, the Department of Aviation would implement measures to reduce the attractiveness of the drainage system to birds. These would include design provisions such as constructing the basins with vertical walls to discourage plant growth, and operational measures such as ensuring they were empty except during rainfall events.

10.3 AIR QUALITY

This section describes the existing air pollution levels in Sydney, the factors giving rise to them, and the emission sources of airport related air pollutants. On the basis of this data, an assessment is made of airport emissions under worst case assumptions and of the likely contribution to Sydney's future total emissions.

Like motor vehicles, aircraft convert hydrocarbon fuel to propulsive energy and, in the conversion, air pollutants are emitted. For the purposes of assessing effects on air quality the worst case was defined in terms of 275,000 aircraft movements per year, with an assumed division by aircraft type as follows:

- B747: 37,500 movements
- A300: 87,500 movements
- F27: 60,000 movements
- general aviation aircraft: 90,000 movements.

However, a level of aircraft operations of 275,000 movements per year is unlikely to be reached for many years, if ever.

10.3.1 Existing pollution levels

Air quality criteria for urban air pollutants have not been defined in New South Wales. However, the State Pollution Control Commission uses as its objectives the Guidelines of the National Health and Medical Research Council, supplemented by the Long-Term Goals set out by the World Health Organization and the Air Quality Standards of the US Environmental Protection Agency. These criteria for air quality have been determined in the light of international findings on the adverse effects of air pollutants on health; they do not take into account deleterious effects on plants and materials or any reduction to visibility.

Present levels of the major pollutants affecting air quality in the Sydney Region are set out in Table 10.3.1 and discussed below:

- **Ozone:** This is the major constituent of photochemical smog. It is the principal reaction product generated when reactive organic substances (mainly hydrocarbons) and nitrogen oxides are exposed to sunlight in high concentrations. The small number of days per year on which the National Health and Medical Research Council Guidelines are presently exceeded represents a fall from the levels of ten years ago, but it is not known whether this is because of different meteorological conditions or reductions in hydrocarbon emissions.

- **Hydrocarbons:** Hydrocarbons constitute the major portion of the reactive organic substances that eventually cause photochemical smog. They are primarily associated with the processing and use of petroleum products, and are thus present in emissions from aircraft and automobile engines, which consist of products formed during combustion as well as unburnt fuel components. Hydrocarbons in the air also produce the distinctive odour associated with petrol or kerosene products. This odour does not indicate the presence of injurious levels of air pollutants, but it can be objectionable and can lead to complaints from residents near airports.

- **Acid gases:** The major acid gases are sulphur dioxide and oxides of nitrogen. Levels of acid gases in Sydney are not high compared with the levels in large cities overseas because domestic fuels are relatively low in sulphur. Acid gas levels in Sydney peaked in the early 1970s, then decreased, and have now levelled out. They seldom exceed the World Health Organization's Long-Term Goal.

- **Sulphur dioxide:** This is present in the exhaust gases of aircraft engines. However, the concentrations in these emissions are much lower than in emissions from other types of engine owing to the significantly lower levels of sulphur impurities in aircraft fuel.

- **Nitrogen oxides:** Nitric oxide and nitrogen dioxide are formed in a spontaneous chemical reaction during all atmospheric combustion processes. There are several atmospheric reactions which can lead to the oxidation of nitrogen oxide to nitrogen dioxide, which is an essential precursor for the atmospheric reactions that produce photochemical smog. In Sydney, about three-quarters of nitrogen oxide emissions come from motor vehicle exhausts.

- **Suspended matter and total suspended particulates:** Various measures are used in respect of particles suspended in the atmosphere. The 'suspended matter' measure relates to particles mainly below about 5 μm in diameter but up to about 10 μm in size. The 'total suspended particulates' measure includes, in addition to these, larger particles up to about 25-50 μm in diameter. Suspended matter levels in Sydney are usually well below the standards specified in Table 10.3/1, but total suspended particulate levels in both city and suburban sites do exceed them from time to time. Levels of total suspended particulates are not expected to decrease until such time as the State Pollution Control Commission considers them to warrant further attention, identifies the major sources, and implements controls.

- **Lead:** The major source of lead in Sydney's atmosphere comes from the lead additives in petrol. The introduction of unleaded petrol by July 1985 and its use in all new petrol-engined vehicles made on or after 1 January 1986 will fairly rapidly reduce the emission of lead in Sydney, even if petrol usage increases. Lead concentrations in the air should be reduced as a result, and this pollutant is therefore not considered further in this discussion.

- **Carbon monoxide:** Concentrations of carbon monoxide tend to be very localized, and high values are only experienced in areas of high traffic density and poor dispersion, such as the central business district of Sydney. Carbon monoxide trends in Sydney over the last decade have been variable, showing first a decline, then a levelling out and now a further decline. It is considered that these recent reductions are the result of stricter controls on carbon monoxide emissions from motor vehicles.

Table 10.3.1 Maximum pollutant concentrations measured during 1982, compared with accepted standards

Pollutant	Standard, goal or guideline	Sampling period (average)	Reference organization	Network maximum 1982	Number of days/sites at which standard exceeded
Ozone	12 phm	1 hour	NHMRC	18 phm	8 days/3 sites
Hydrocarbons*	0.24 phm	2 hours	USEPA	n.a.	n.a.
Acid gases	60 $\mu g/m^3$	1 year	WHO	51 $\mu g/m^3$	Not exceeded
	200 $\mu g/m^3$	24 hours	WHO	130 $\mu g/m^3$	Not exceeded
Nitrogen dioxide	17 phm	1 hour	NHMRC	21 phm	2 days/1 site
	5 phm	1 year	USEPA	1.6 phm	Not exceeded
Sulphur dioxide	14 phm	24 hours	USEPA	2.6 phm	Not exceeded
	2 phm	1 year	NHMRC	0.4 phm	Not exceeded
Suspended matter	40 $\mu g/m^3$	1 year	WHO	27 $\mu g/m^3$	Not exceeded
	120 $\mu g/m^3$	24 hours	WHO	103 $\mu g/m^3$	Not exceeded
Total suspended particulates	90 $\mu g/m^3$	1 year	NHMRC	122 $\mu g/m^3$	6 sites**
	260 $\mu g/m^3$	24 hours	USEPA	411 $\mu g/m^3$	10 days/5 sites**
Lead	1.5 $\mu g/m^3$	90 days	NHMRC/USEPA	7.0 $\mu g/m^3$	71 (90-day periods)**
Carbon monoxide	35 pm	1 hour	USEPA/WHO	29 pm	Not exceeded
	9 pm	8 hours	USEPA/WHO	n.a.	53 days**

* Non-methane hydrocarbons.
** Includes Newcastle and Wollongong monitoring stations.

Notes:
NHMRC- National Health and Medical Research Council (Guidelines)
USEPA- United States Environmental Protection Agency (Standards)
WHO - World Health Organisation (Long-Term Goals)
n.a. - Not available

Source: State Pollution Control Commission (1984).

10.3.2 Factors affecting air quality

The rate of dispersal of air pollutants is significantly influenced by climate, meteorology (particularly the frequency of inversions) and topography.

Climatic influences

The warmth of Sydney's climate and the prevalence of sunshine are conducive to the production of photochemical smog, and these climatic characteristics are particularly evident at Badgerys Creek. Climatic data for Badgerys Creek is presented in Figure 10.3.1. Compared with Sydney city centre, Badgerys Creek has lower rainfall, more sunshine, higher summer temperatures, and lower winter temperatures.

Wind speeds are greatest during the hottest time of the day when atmospheric instability is highest, and are lowest during the coldest time of the day when the atmosphere is generally most stable. Thus, winds in the area tend to be very light during the night, and to increase in strength during the day (Figure 10.3.2). Compared with the city centre, Badgerys Creek has a much higher frequency of calm conditions.

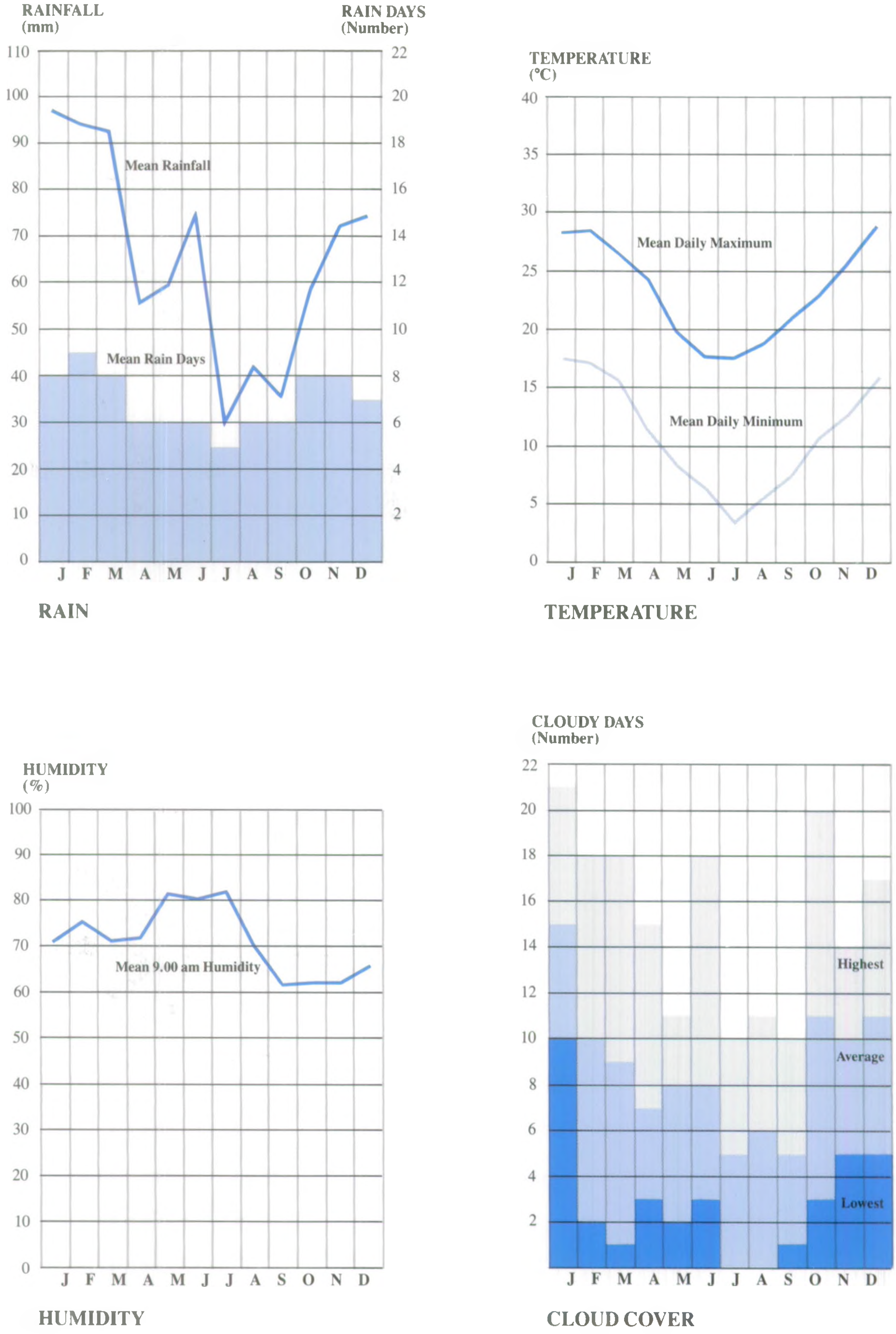


Figure 10.3.1
BADGERYS CREEK METEOROLOGICAL DATA

Source Bureau of Meteorology

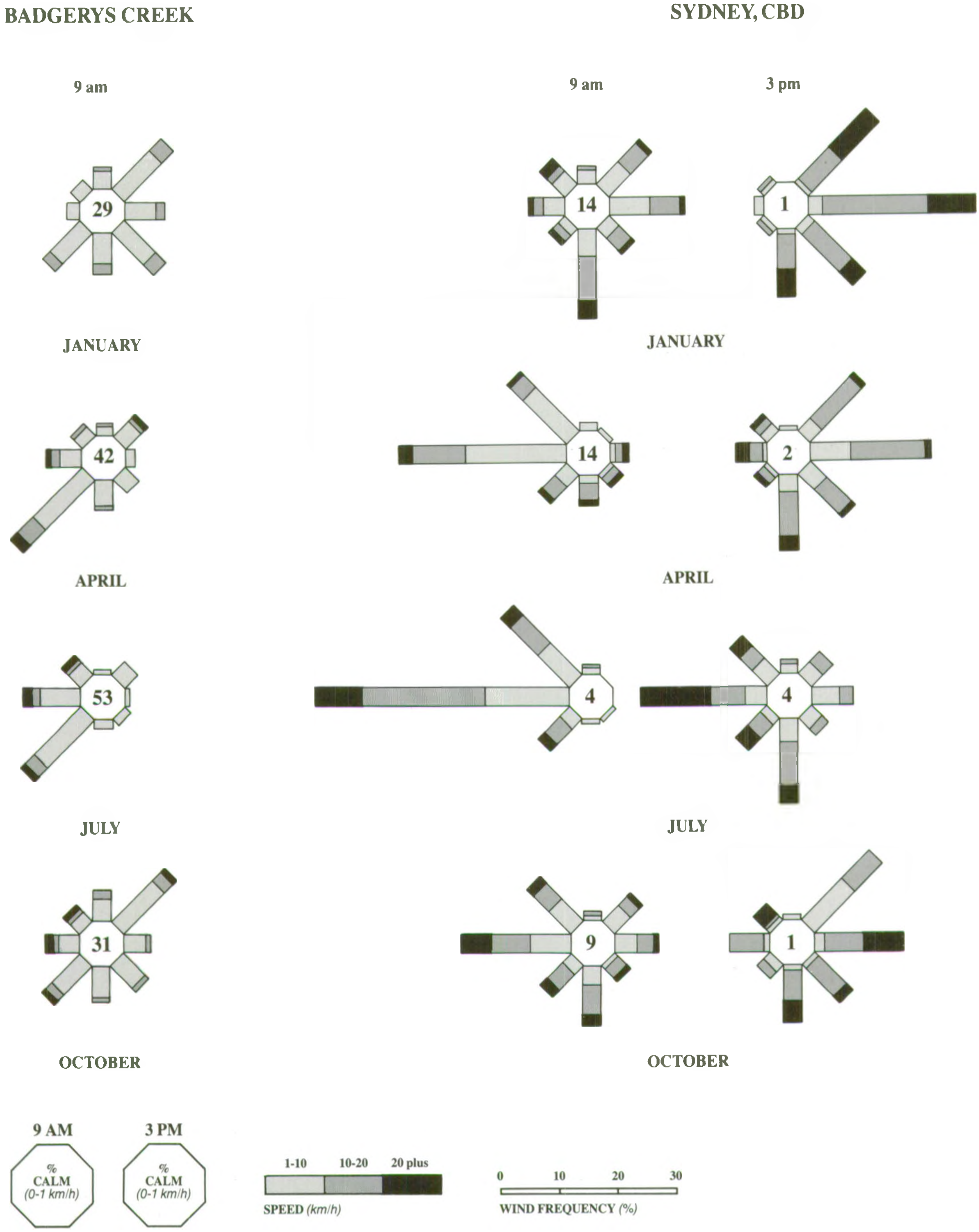


Figure 10.3.2
WIND CHARACTERISTICS

Temperature inversions

There is a band of atmosphere extending from the ground to an uncertain and variable height called the mixing layer, above which vertical mixing is significantly reduced. The height of this mixing layer is related to the local vertical temperature profile. The rate of change of temperature with height determines the stability of the atmosphere. The atmosphere is considered to be unstable when, under dry conditions, the temperature decreases at a more rapid rate than 3°C for each 300 m increase in elevation. Under such circumstances, vertical air movements are facilitated, pollutants are transported up and down, and mixing occurs.

When the temperature either decreases less rapidly with height or increases with height (a temperature inversion), the atmosphere is stable, and transport and dilution of pollutants is inhibited. During an inversion, there is generally little mixing above the base of the inversion. Thus, when a ground level inversion occurs for an extended period, nearly all the pollutants emitted close to ground level remain within about 100 m to 1,000 m from the surface, depending on the inversion height.

The frequency of inversions at Badgerys Creek has not been recorded, but it is expected that they would be more frequent, stronger, and deeper than at Kingsford-Smith Airport. Observations at Kingsford-Smith Airport over nearly two years revealed that, at 6 a.m., inversions were present on 79% of mornings, that 53% of the inversions occurred at heights of under 400 m, and that in 26% of cases the temperature difference between the base and the top of the inversion was more than 4°C (Colquhoun 1983).

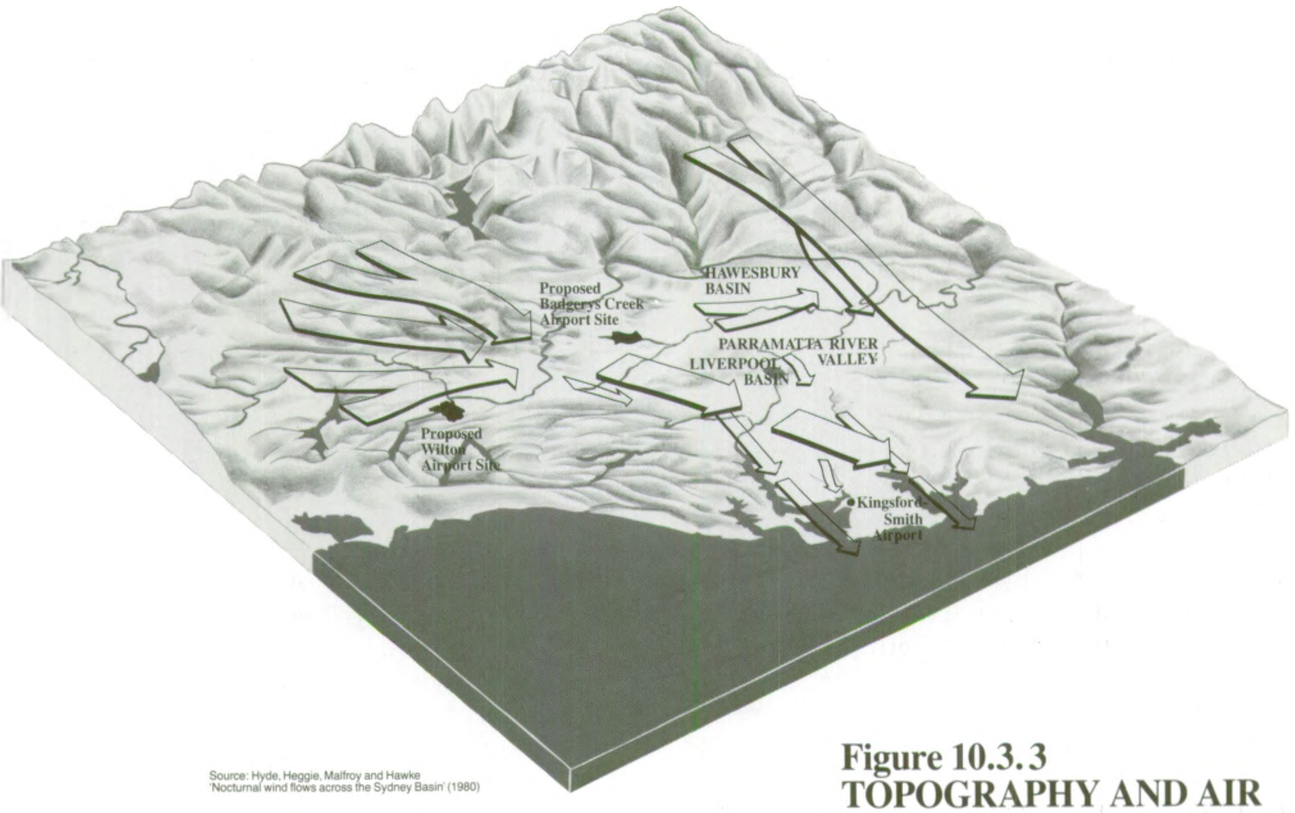
Topographical influences on air movements

Topography can affect the transport and dilution of air pollutants by inducing local flow patterns. Some of the topographic influences that are important for evaluating the effects of aircraft emissions include the channelling of flow through valleys, the persistence and intensification of inversions in valleys, circulations between land and water areas, urban-rural differences in surface roughness and thermal characteristics, and wind intensification on hills and ridges.

The Sydney Region consists of a large basin bounded on the east by the ocean, to the north and south by steep ridges and in the west by the Blue Mountains. For air quality purposes, the Sydney Basin can be conveniently divided into the Hawkesbury Basin (in which Badgerys Creek is located), the Liverpool Basin, and the Parramatta River Valley (Figure 10.3.3).

These basins influence air movement and the build up of pollutant concentrations. Recent studies have shown that trapping of various pollutants within the nocturnal—morning 'drainage' air flows and the late morning—early afternoon sea breezes is the principal cause of high concentrations of air pollution in the Sydney Basin (Hyde, Heggie and Malfroy, 1980). Air drainage occurs as a consequence of differential temperature gradients between air immediately in contact with a cooling ground surface and air some distance above the ground. After sunset, the ground cools rapidly as a result of long-wave radiation from the surface, especially when the sky is clear. The rate of surface cooling is at a maximum for a few hours after sunset but, providing that radiation conditions remain constant, surface cooling will continue until sunrise. If the topography is sloping, differences in temperatures, and hence density, within the near-surface layer will result in cold air drainage. A number of significant internal air drainage flows have been identified in the Sydney Basin (Figure 10.3.3), the following four of which are relevant to the Badgerys Creek site:

- a local southerly flow across the site towards Richmond, which occurred on 73% of nights during a four-month observation period in 1979;
- a westerly regional drainage flow, caused by air flowing down from the Blue Mountains, generally above the local flow;



Source: Hyde, Heggie, Malfroy and Hawke 'Nocturnal wind flows across the Sydney Basin' (1980)

Figure 10.3.3
TOPOGRAPHY AND AIR DRAINAGE FLOWS IN THE SYDNEY REGION

- a south-westerly regional drainage flow with a source region bounded by the Illawarra escarpment to the east, the Mittagong ridge to the south and the Lake Burragorang region of the Blue Mountains to the west;

- a spillover flow caused by the Hawkesbury Basin filling up as a result of cold air drainage and overflowing into the Parramatta River Valley at Blacktown, which occurs at the lowest point along the ridge separating the Hawkesbury Basin from the Liverpool Basin and the Parramatta River Valley.

The local and spillover flows are highly stable and would inhibit the vertical dispersion of low-level emissions.

The Hawkesbury Basin is a receiving area for photochemical smog and winter haze formed both locally and in other parts of the Sydney Basin. An increase in local emissions can lead only to an overall decrease in air quality in the Hawkesbury Basin. At present, the pollutants come more from afternoon sea breezes than from local emission sources. Sea breezes are strongest in the summer months when temperature and sunshine also favour the formation of photochemical smog. During the winter months sea breezes generally occur less frequently, are shallower and weaker, and do not penetrate as far inland.

10.3.3 Future pollution levels in the absence of airport development

No official forecasts of long-term pollution levels in Sydney have yet been issued by the State Pollution Control Commission. However, papers discussing future trends in emissions as distinct from pollution levels have been published by staff of the Commission (Eiser, Koo and Court, 1983; Stewart, Pengilley, Brain, Haley and Mole, 1983) and, for the purposes of this study, provide a basis for estimating possible long-term emissions.

Motor vehicles are the major source of air pollution in Sydney. In 1980 they accounted for about half of all hydrocarbon emissions and about 75% of all nitrogen oxide emissions. Table 10.3.2 shows forecasts of motor vehicle emissions.

Table 10.3.2 Emissions from motor vehicles in Sydney, 1976 to 2000 (t/a)

Pollutant	1976	1980	1986	2000
Hydrocarbons	97,900	87,000	78,800	62,000
Oxides of nitrogen	47,700	51,200	59,600	77,800
Carbon monoxide	670,000	640,000	660,000	540,000
Particulates	5,600	6,200	6,200	6,200

Source: Stewart, Pengilley, Brain, Haley and Mole, 1983.

Although it is arguable whether emissions of hydrocarbons from stationary sources will fall at the same rate as those from vehicles, this has been the recent experience (Eiser, Koo and Court 1983).

Assuming, for the purposes of this study, that the relative contribution of motor vehicles and other sources to the overall level of emissions remained the same as in 1980, and that aircraft movements at Kingsford-Smith Airport did not exceed its present capacity of 203,000 movements a year, total emissions in the year 2000 without a second Sydney airport would be as follows:

- hydrocarbons: 127,000 t/a
- oxides of nitrogen: 102,000 t/a
- carbon monoxide: 710,000 t/a
- particulates: 15,000 t/a.

10.3.4 Airport related emissions

Additional emissions of pollutants would occur both at the construction and operational stages of airport development. Construction of the airport would involve stripping vegetation from extensive areas and redistributing large quantities of earth and stone about the site. During the late summer months, strong westerly winds coincide with hot, dry days, causing significantly higher than average levels of dust deposition throughout the area, and airport construction would inevitably involve work during these periods. However, the increase in pollutant emissions associated with airport operations would be much more significant than those stemming from airport construction, because of the pollutants involved and their long-term nature. Six main sources of pollutants would be associated with the operation of an airport:

- aircraft engine exhausts during aircraft operations
- aircraft fuelling systems
- ground service vehicles and equipment
- aircraft engine emissions during maintenance
- fuel storage systems
- access traffic entering and leaving the airport.

An inventory of total annual airport related emissions, both from within and outside the airport site, has been estimated for the assumed worst case of 275,000 aircraft movements per year at a second Sydney airport at Badgerys Creek. This inventory is shown in Table 10.3.3, and a discussion of each of the main sources follows.

Table 10.3.3 Inventory of airport related emissions under worst case assumptions (t/a)

Source	Carbon monoxide	Hydro-carbons	Nitrogen oxides
On site			
Aircraft emissions	1,411	518	798
Aircraft fuelling systems	-	2	-
Ground service vehicles	550	15	30
Maintenance	2	3	-
Fuel storage losses	-	36	-
Vehicle emissions	1,743	200	251
Total emissions on site	3,706	774	1,079
Off site			
Aircraft emissions	2,370	75	1,331
Vehicle emissions	14,420	1,688	2,077
Total emissions off site	16,790	1,763	3,408
Total airport related emissions	20,496	2,537	4,487

Aircraft engine emissions during aircraft operations

The exhaust gases from aircraft engines consist mainly of substances not regarded as air pollutants (i.e. nitrogen, oxygen and water). Substances present in these exhaust gases that are regarded as air pollutants are particulate matter (smoke), carbon monoxide, unburnt and partially burnt hydrocarbons, and nitrogen oxides. The estimated total concentrations of all these pollutants in the exhaust gases do not exceed 700 ppm, but the amounts of the individual pollutants emitted vary greatly with the particular engine and especially with the part of the operational cycle involved.

The operational cycle of an aircraft normally comprises the following phases: taxiing or idling; taking off and climbing-out; cruising at altitude; approaching and landing. Engine emissions vary greatly between each phase because, at power settings other than the optimum design setting of cruise power, engine performance is less than optimum.

Emissions of carbon monoxide and hydrocarbons are highest when aircraft are idling or taxiing; the take-off and climb-out stages of the cycle, when engine combustion is close to the optimum, are characterized by low carbon monoxide and hydrocarbon emissions. With nitrogen oxides, however, the situation is reversed. Their formation is associated with efficient combustion when temperatures in the combustion chamber are very high, such as during take-off, climbing and cruising. However, except for the short period of take-off and climb-out, only small quantities of pollutants reach the ground, as emissions above an altitude of about 1,000 m are normally prevented from contributing to ground level concentrations by the presence of the mixing layer in the atmosphere.

Particulates are also produced during the take-off and climb-out phase and to a lesser extent during landing. These finely divided particulates were responsible for the smoke trails commonly seen from some earlier types of aircraft, but in recent times there has been considerable success in reducing the level of particulate emissions from aircraft engines and thus the smoke trails.

Aircraft fuelling systems

An essential part of any airport operation is the fuelling of aircraft, which is accomplished either by the use of tanker trucks or of a central underground fuelling system. The possibility of accidental spillage is substantially reduced by an underground fuelling system, which has the added benefit of being more efficient. Underground fuelling systems are installed at the major domestic and international terminals in Australia and would be installed for the level of traffic assumed for the worst case at Badgerys Creek.

Ground service vehicles and equipment

The power-operated ground service equipment for a commercial airport might include: light and heavy duty trucks, tractors, vans, towtugs and trucks, air starters, belt loaders, transports, portable air compressors, 400 Hz power generators, fork-lifts, cranes, welders, fuel trucks, aerial ladders and work platforms. As the ground vehicles at different airports will consume varying amounts of petrol depending upon such factors as airport size, layout and climate, the associated levels of pollutant emissions will also differ.

Aircraft engine emissions during maintenance

Typically, maintenance and ground testing of gas turbine engines involve running the engine almost entirely in idle and cruise modes. The amount of pollutants emitted depends on the emission rates for the particular engines, the time in each mode, and the number of maintenance checks performed daily or annually.

Fuel storage losses

The airport fuel storage tanks represent a source of hydrocarbon emissions. These emissions will vary with the type of tank (fixed or floating roof), tank diameter, type of fuel and whether a vapour recovery system is used.

Vehicle emissions

Motor vehicles coming to or from a second airport would produce emissions throughout the metropolitan area. In Section 10.4 it is estimated that an airport at Badgerys Creek would, under worst case conditions, generate on average approximately 57,000 vehicle trips per day (for passengers, visitors and employees).

10.3.5 Assessment of effects and safeguards

By comparing estimated air emissions related to a second Sydney airport with the estimated total Sydney Region emissions, certain conclusions can be reached with respect to the air quality effects of airport development. Three steps are involved:

- consideration of the net addition to Sydney Region emissions that airport related emissions would represent;
- consideration of the consequent changes to the geographic pattern of emissions over the Sydney Region;
- consideration of the implications for pollution levels, taking account of dispersal patterns to the extent that these are known.

The estimates are set out in Table 10.3.4.

Table 10.3.4 Summary of long-term annual emissions, with and without second airport operations (t/a)

Item	Carbon monoxide	Hydro-carbons	Nitrogen oxides
Total Sydney emissions without airport	710,000	127,000	102,000
Airport related emissions:			
By source:			
Vehicles	16,163	1,888	2,328
Other	4,333	649	2,159
By location:			
On site	3,706	774	1,079
Off site	16,790	1,763	3,408
Estimated net addition as a result of airport	4,333	649	2,159
(% of total emissions without airport)	(0.6%)	(0.5%)	(2.1%)

Net addition to Sydney Region emissions

The airport related emissions, particularly those from vehicles, would not all be additional to the air pollutant levels that would occur in the absence of an operational airport at Badgerys Creek. The estimates for emissions in the event that airport development does not proceed are based on assumptions as to the total number of vehicles and average vehicle kilometres in the year 2000 (both of which would be higher than now); the airport would not necessarily add significantly to either figure, any more than would major new regional shopping centres, recreation centres, and other such major traffic generating projects built between now and 2000. Thus the net addition to total emissions is best represented by the figures given in Table 10.3.4 for other airport related emissions. On this basis the airport would, under worst case assumptions, represent increases over the estimated future level of emissions without the airport of 0.6% in the case of carbon monoxide, 0.5% in the case of hydrocarbons, and 2.1% in the case of nitrogen oxides. This presumes that none of the 275,000 aircraft movements could be accommodated in the Sydney Region unless a second Sydney airport were built. To the extent that some or all of these movements were previously accommodated at Kingsford-Smith airport or at general aviation airports in the region, then the net addition to Sydney Region emissions would be correspondingly less.

Impact of overall geographic pattern of emissions

Although airport related vehicle emissions would not be additional to total motor vehicle emissions in the Sydney Region, they would contribute to changes in the geographic pattern of emissions. Vehicle emissions are a significant component of total on-site airport related emissions, and these would represent a significant increase over the levels likely to be prevailing in the site area by the time the worst case level of operations was reached. At that time local emissions from sources unrelated to the airport would be much higher than at present because of a likely doubling of vehicular traffic (Section 10.4). Nevertheless, even for the worst case, total emissions would still be well below present emission levels (on a per square kilometre basis) in the city centre and inner city areas.

In the case of airport related off-site emissions, the pattern is more complex. The off-site aircraft emissions include those up to a distance of about 20 km from the airport. Vehicle emissions related to the airport would be dispersed throughout the metropolitan area, although about 50% would be within 40 km of the airport. As increases in vehicle emissions along routes taken by airport related traffic would, overall, be offset by numerous decreases in other traffic on many roads, the impact on the geographic pattern of vehicle emissions would only be significant along the major approach routes to the airport (Section 10.4).

Implications for pollution levels

It follows from the discussion of air drainage flows in Section 10.3.2 that there would be two main receptor areas for airport related pollutants. These are:

- the Hawkesbury Basin
- the Parramatta River Valley.

While any increase in local emissions can only degrade air quality in the Hawkesbury Basin, it should be remembered that much of the airport related emissions would not enter the basin, because:

- off-site aircraft emissions would mostly be at altitudes that preclude extensive immediate mixing with the local southerly air drainage flow, which is typically only 80-100 m deep;

- a large proportion of off-site vehicle emissions would be outside the basin.

It is likely that, even under worst case assumptions, the contribution of the airport to a degradation of air quality in the Hawkesbury Basin would be significantly less than that deriving from the increase in motor vehicle emissions consequent upon the State Government's urban release programme in the area (for example, the population of the City of Penrith is forecast to rise by 78% between 1981 and 2001). However, in the North-West Sector Regional Environmental Study (Department of Environment and Planning 1984), which covered part of the Hawkesbury Basin, it was concluded that increases in vehicle emissions in the North-West Sector would not be a significant long-term threat to air quality. While the airport would be unlikely to add significantly to the degradation of air quality in the Basin, its effects would be additive to those of urban development.

In the case of the Parramatta River Valley, airport related emissions could be transported there by the spillover flow or by regional air drainage flows.

The pollutants of most concern are nitrogen oxides since, on the basis of the forecasts discussed in Section 10.3.3, pollution levels are likely to be significantly worse in the future even without airport development. During 1982 the State Pollution Control Commission's Objective for nitrogen dioxide was exceeded on two days at its Earlwood monitoring station. It may be presumed that in the absence of any ameliorative measures the Objective standard will be exceeded more often.

10.3.6 Ameliorative measures

As the operation of aircraft is world-wide, pollution from aircraft cannot be isolated within national boundaries. For these reasons it is essential that emission control standards have a high degree of commonality. The standards for jet aircraft engine emissions formulated by the International Civil Aviation Organization place limits on the maximum permissible emission levels of jet engines manufactured after 1 January 1985, both for existing jet engine types (some of which will have to be modified to achieve the reductions) and for future engine types. Because of the extreme difficulty of imposing tighter emission levels on aircraft in Australia than those applying internationally, and because aircraft in any case represent only a very small percentage of pollutant emissions, it is likely that unacceptable pollution levels would be tackled in other ways. As far as non-aircraft emissions at the airport are concerned (i.e. from ground vehicles, fuel storage and plant), it is anticipated that these would be controlled in accordance with the standards prevailing at the time the airport became operational.

With regard to the construction of the airport, the dust associated with earth moving and site preparation would arise mainly from the operation of mobile equipment over haul roads and cleared areas, and to a lesser extent from wind blowing across exposed areas. However, the emission of dust from these activities would be minimized by watering the working and haulage areas, and by establishing grass or other cover on the exposed areas as early as possible.

10.4 ACCESS

This section examines the potential effects of future airport development at Badgerys Creek on road and rail transport in the Sydney Region. Alternative forms of ground access to the airport are also discussed and their capital costs estimated. As an input to the comparison of sites (Chapter 17) the future travel times by road and rail were estimated.

The assessment of effects is based on a 'worst case' of 13 million passengers per annum using the airport, and on the ground transport needs that this level of passengers would create. To establish baseline data for the evaluation of the effects of ground access arrangements, various assumptions as to the likely characteristics of future road and rail transport in the Sydney Region were made. These assumptions were based on the likely future Sydney metropolitan structure discussed in Section 9.8, which relates to a Sydney Region population of 4.5 million. Under the medium forecast of the Department of Environment and Planning this population would be reached about the year 2011, but it could occur either earlier or later than this forecast date.

10.4.1 The existing and anticipated road system without airport development

The proposed airport site, which is shown on Figure 10.4.1, is centred in the area roughly enclosed by The Northern Road, Elizabeth Drive and Badgerys Creek Road; it is about 48 km by road from Sydney GPO. The site stretches west across The Northern Road south of Luddenham, and east across Badgerys Creek Road.

The existing road network

The area is served by two major road systems. The first runs north—south and comprises The Northern Road, Luddenham Road, Mamre Road, Erskine Park Road and Wallgrove Road. The Northern Road provides connections in the north to the Western Freeway, Penrith and areas to the north-west and west, and in the south to Camden and Campbelltown. It is a two-lane road, generally constructed to a good standard. Erskine Park Road runs from the Western Freeway to Mamre Road and is a two-lane road. Luddenham Road, Mamre Road and Wallgrove Road, also two-lane roads, bring traffic from Mount Druitt, Rooty Hill, St Marys and areas to the north through to Elizabeth Drive.

The second system runs eastwards and comprises Elizabeth Drive and Bringelly Road. Elizabeth Drive connects the area to Liverpool and the Hume Highway. West of Bonnyrigg, Elizabeth Drive is a two-lane road, but on approaching the urban area it widens to four and then to six lanes, with most sections constructed to a high standard.

Bringelly Road, a two-lane road of fair to good standard located south of the site, connects The Northern Road to the Hume Highway. Fifteenth Avenue—Hoxton Park Road runs midway between Elizabeth Drive and Bringelly Road through the residential and industrial areas of Hoxton Park and Liverpool. It is a two-lane road in its western sections, widening to four lanes in the urban area.

The anticipated road network

While there is, as yet, no government commitment to specific long-term changes to the road network, it is necessary for the purpose of this impact study to assume a likely general future road network. With the exception of the South Western and Western freeways, which will probably be extended eastwards, the basic form of the road network is unlikely to change. However, information on urban growth provided by the Department of Environment and Planning (Section 9.8) suggests that the existing road network will need to be upgraded, and the north—south network strengthened by new linking roads. Links would also be required between Cowpasture Road and Mamre Road, running from the Great Western Highway to the Hume Highway, principally to serve the future residential development in the area. It also seems likely that Fifteenth Avenue would be extended westwards towards Badgerys Creek.

Road traffic levels

Data published by the Department of Main Roads (1983) define annual average daily traffic flows for the various roads in the area, and these are set out in Table 10.4.1. The major flows occur on the two freeways and their approaches, and on the Hume Highway. The freeways carry flows of up to 30,000 vehicles per day, while the Hume Highway carries nearly 50,000 vehicles per day east of Cabramatta Road. Several other roads, including The Northern Road, Wallgrove Road, Elizabeth Drive and Cabramatta Road, carry 15,000-30,000 vehicles per day on some sections. Most other roads in rural areas carry fewer than 10,000 vehicles per day.

Table 10.4.1 Existing and forecast annual average daily traffic flows

Road	Location	Annual average daily traffic	
		1981	2011 (without airport development)
Western Freeway	At the Nepean River	15,000	55,000
	East of Erskine Park Road	28,900	70,000
	East of Wallgrove Road	19,300	60,000
The Northern Road	North of Western Freeway	22,100	54,000
	South of Western Freeway	10,200	25,000
	North of Elizabeth Drive	7,300	15,000
	South of Elizabeth Drive	4,000	9,000
	South of Bringelly Road	5,300	11,000
Erskine Park Road	South of Western Freeway	1,400	25,000
	East of Mamre Road	500	9,000
Wallgrove Road	South of Western Freeway	18,900	35,000
	Badgerys Creek Road	500	1,000
Elizabeth Drive	East of The Northern Road	4,800	9,000
	West of Wallgrove Road	11,000	24,000
	East of Wallgrove Road	17,600	35,000
	West of Cabramatta Road	18,000	36,000
	East of Cabramatta Road	18,000	36,000
	West of Hume Highway	27,500	55,000
Cabramatta Road	East of Elizabeth Drive	7,800	18,000
	West of Hume Highway	17,200	39,000
Hume Highway	North of Cabramatta Road	49,600	70,000
Bringelly Road	East of The Northern Road	2,400	25,000
	East of Hume Highway	10,600	20,000
South Western Freeway	North of Campbelltown Road	30,000	50,000
	East of Hume Highway	n.a.	25,000
	East of Henry Lawson Drive	n.a.	30,000

n.a. Not applicable, as the South Western Freeway was not constructed in these locations in 1981.

Source: Existing annual average daily traffic flows were derived from Department of Main Roads publications giving figures for 1979 and 1981. The traffic flows for the year 2011 were derived from data provided by the State Transport Study Group and relate to a Sydney Region population of 4.5 million; this population is forecast to be reached about the year 2011, but could occur earlier or later.

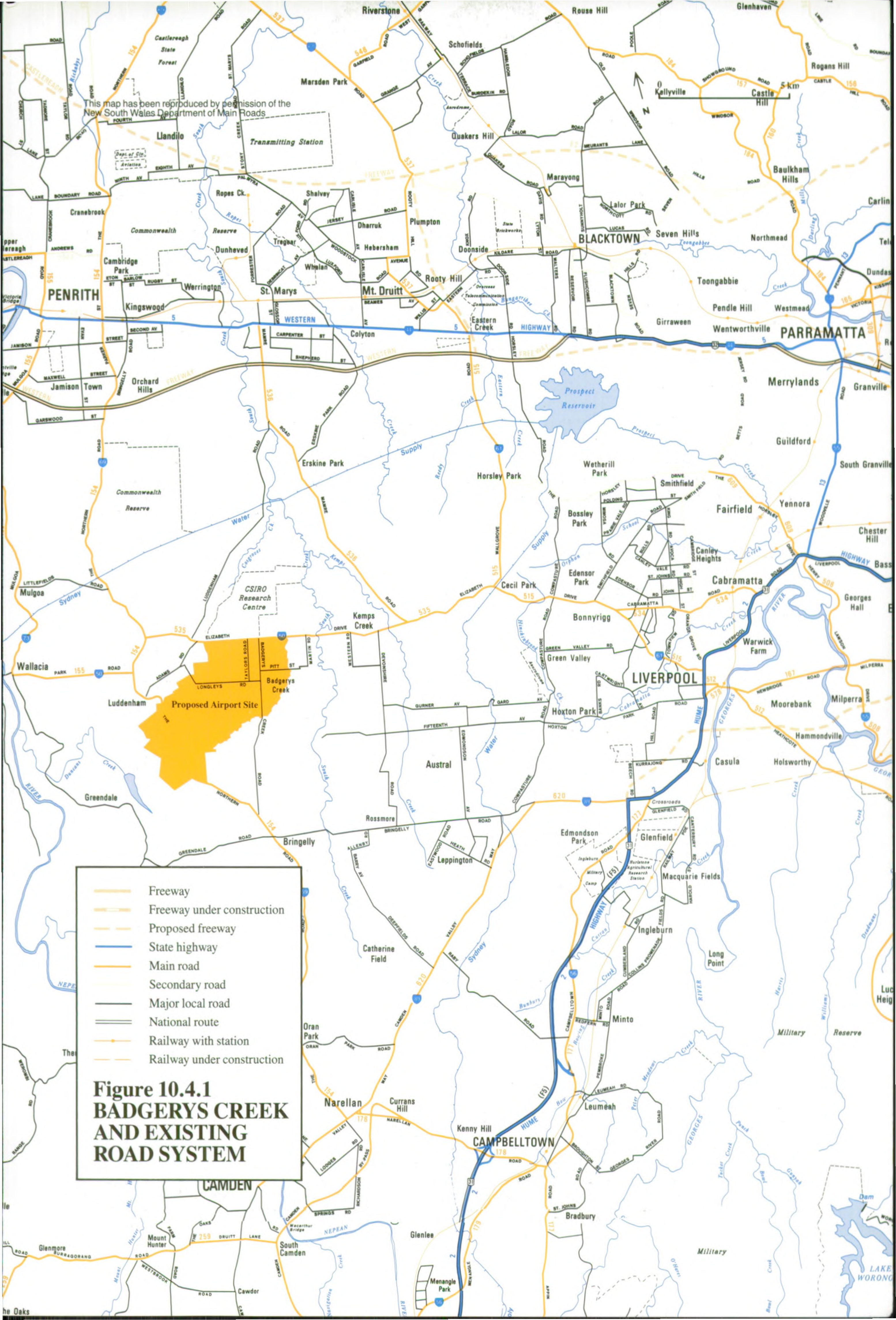


Figure 10.4.1 BADGERYS CREEK AND EXISTING ROAD SYSTEM

Future traffic flows have been estimated using figures provided by the State Transport Study Group. However, these figures have been used only to examine corridors, and the Group's forecast increases have been adjusted for the purposes of this study by a comparison with historical growth rates. These forecast flows, which are set out in Table 10.4.1, must be treated with considerable caution, as they relate to predicted flows on a network thirty years in the future. They are thus dependent upon forecasts of population, employment, and the form of the future road network, as well as on various social and economic factors such as car ownership levels. Nevertheless, it is considered that they provide a reasonable basis for assessing the implications of airport traffic.

Adequacy of road network

Daily traffic flows can be used as a rough measure of the adequacy of a road network's capacity by relating them to the number of lanes available. Table 10.4.2 sets out the maximum desirable average daily flows for different classes of road. It should be noted that these flows are in fact often exceeded, with resulting congestion and delays, and that the capacity of many sections of the network is defined by critical intersections rather than by overall flows.

Table 10.4.2 Maximum desirable average daily traffic flows*

Type of road	Maximum desirable average daily flows (vehicles per day)
Rural roads	
Two-lanes	13,000
Four-lanes, undivided	25,000
Four-lanes, divided	30,000
Six-lanes, divided	45,000
Four-lane freeway	50,000
Six-lane freeway	75,000
Urban roads	
Four-lanes, undivided	13,000
Four-lanes, undivided, with peak hour clearways	25,000 - 30,000
Six-lanes, divided	45,000 - 50,000
Four-lane freeway	50,000
Six-lane freeway	75,000

* In consultation with the Access Working Group (see Appendix A), the Consultant defined maximum desirable flows as being the maximum flows compatible with a reasonable level of service (C to D as defined by the National Association of Australian State Road Authorities), on a road with priority at at-grade intersections.

A comparison between the existing flows set out in Table 10.4.1 and the maximum desirable daily flows shown in Table 10.4.2 indicates that the existing road network in the vicinity of the site is already deficient at a number of locations. Specifically, this occurs on The Northern Road north of the Western Freeway, on Wallgrove Road south of the Western Freeway, and on Elizabeth Drive between Wallgrove Road and Cabramatta Road. There is also limited spare capacity at the northern end of the South Western Freeway where it joins the Hume Highway.

Anticipated upgradings of road capacity

A comparison of the forecast traffic flows shown in Table 10.4.1 and the maximum desirable flows shown in Table 10.4.2 indicates that by the year 2011 the road network will require substantial upgrading even without airport development at Badgerys Creek. In particular, the following improvements are likely to be required:

- widening of the Western Freeway from four to six lanes;
- widening of The Northern Road to six lanes north of the Western Freeway and to four lanes between the freeway and Elizabeth Drive;
- widening of Erskine Park Road to four lanes;
- widening of Wallgrove Road to a six-lane divided road;
- extension of the six-lane section of Elizabeth Drive west to Wallgrove Road and widening to four lanes between Wallgrove Road and Mamre Road;
- widening of the western end of Cabramatta Road to four lanes and the eastern end to six lanes;
- widening of Bringelly Road to four lanes;
- widening of the South Western Freeway to six lanes and extension of the freeway eastwards from Liverpool.

10.4.2 Existing and anticipated public transport systems without airport development

The existing public transport network

The proposed site is roughly enclosed by two arms of the Sydney Metropolitan Railways: the Main Western Line to the north, and the Main Southern Line to the east (Figure 10.4.1). However, it is quite remote from either: 18 km from St Marys on the Main Western Line, and 24 km from Glenfield on the Main Southern Line. Being in a semi-rural environment, the site is not served by any significant local bus service. Even if there were a local bus operation in the vicinity, it would only be operating from one of the major railway stations on the Main Western Line, i.e. Mount Druitt, St Marys or Penrith. Travel by public transport to much of the rest of the Sydney Region must therefore be via the Sydney Metropolitan Railways.

The Sydney Metropolitan Railways are divided into four more or less distinct operational groups (Figure 10.4.2):

- **Sector I:** Eastern Suburbs Railway (Bondi Junction to Central) to the Illawarra Line and branches (Central to Sutherland, Cronulla, Royal National Park, Waterfall and Helensburgh);
- **Sector II:** The City Railway (to/from Circular Quay) to the Bankstown Line (Central to Regents Park via Sydenham), the East Hills Line (currently Tempe to East Hills but to be extended to Glenfield), the Local Line (Central to Ashfield and Homebush), the Suburban Line (Homebush to Granville), the Main Southern Line (Granville to Campbelltown), and the Lidcombe—Cabramatta Line (via Regents Park);
- **Sector III:** The North Shore Line (Wynyard to Hornsby) via the City Railway (Central to Wynyard) to the Suburban Line (Central to Strathfield, Homebush, Lidcombe and Granville), the Main Northern Line (Strathfield to Hornsby and

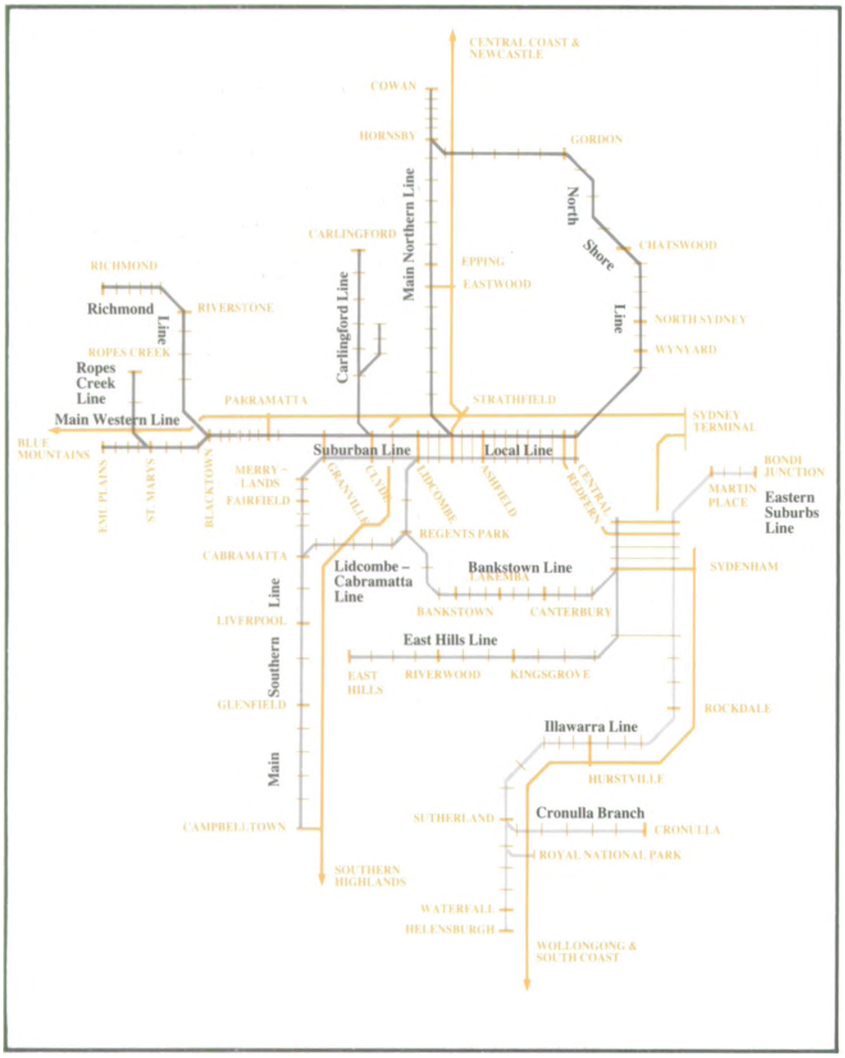


Figure 10.4.2
EXISTING SYDNEY METROPOLITAN RAILWAY SYSTEM

Sector I

Sector II

Sector III

Interurban

Cowan), the Clyde to Carlingford and Sandown Lines, the Main Western Line (Granville to Parramatta, Blacktown, St Marys, Penrith and Emu Plains), the Richmond Line (Blacktown to Richmond), and the Ropes Creek Branch (St Marys to Ropes Creek);

- **Interurban:** Sydney Terminal to the Central Coast and Newcastle, Sydney to the Blue Mountains, Sydney Terminal to the Southern Highlands, and Sydney Terminal to the Illawarra—South Coast (Sydney Terminal is the terminal for interurban trains and is adjacent to Central station).

Almost all the system described above is either electrified or in the course of being electrified.

Rail network loading

Figure 10.4.3 shows existing levels of inward bound passenger flows during the morning peak period for Sectors I, II and III operations, based on extended passenger counts prepared by the State Rail Authority of New South Wales between 1979 and 1980 as part of the data collected for the State Transport Study Group's 1981 Sydney Region Travel Survey.

Figure 10.4.4 shows a stylized representation of train services during the two-hour morning peak period. Essentially, in the inward bound direction, the trains on most lines are well occupied throughout the morning peak period, as shown in Table 10.4.3. As well,

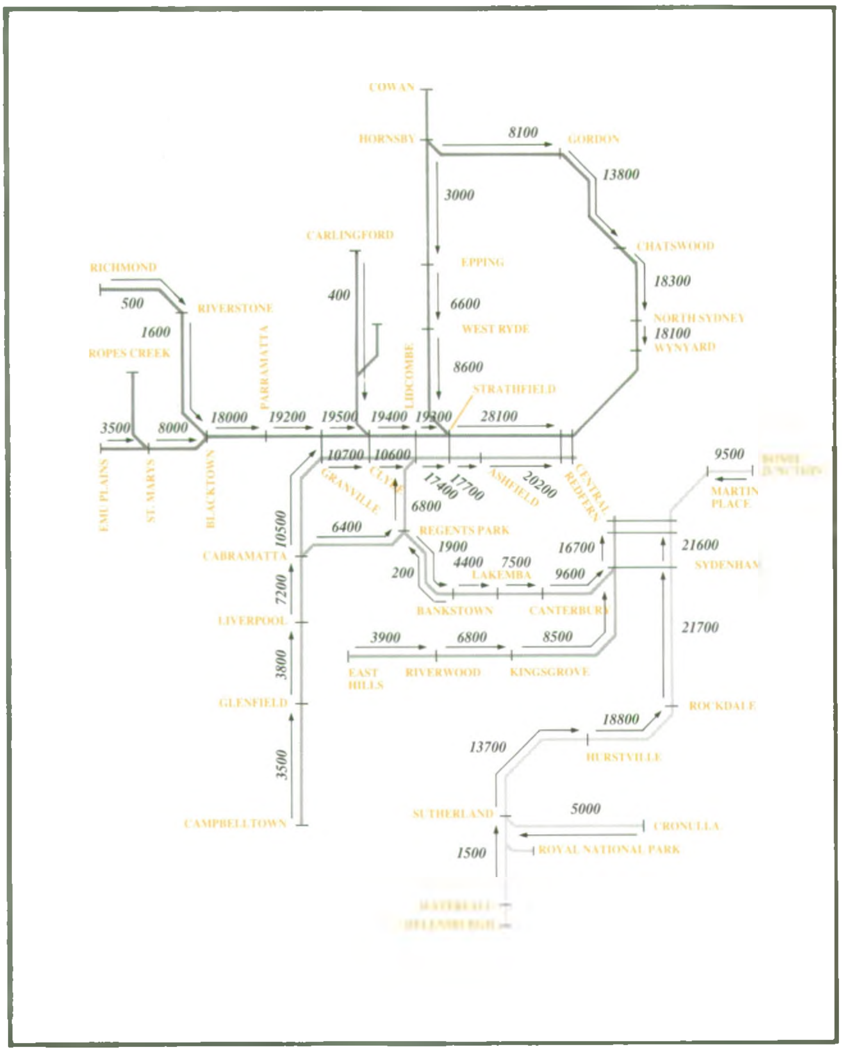


Figure 10.4.3
EXISTING INBOUND MORNING PEAK PERIOD PASSENGER FLOWS ON THE SYDNEY METROPOLITAN RAILWAYS

Sector I

Sector II

Sector III

inward bound track space is generally well occupied on the approaches to central Sydney, on the basis of the following practical track capacities:

- sixteen trains per hour for a mixture of stopping and through trains on the same track;
- twenty-four trains per hour for a homogeneous flow of trains (either all stopping or all through trains).

Nevertheless, potential still remains to accommodate more trains between Sydney and Strathfield by further rationalization of the use of the tracks in that section of railway. Elsewhere, there is spare capacity on lines outside the inner area, especially where there are multiple tracks. However, the exact determination of future line capacity and any need for additional infrastructure would have to be tested by timetabling and future studies.

This discussion of the use being made of the Sydney Metropolitan Railways relates only to passenger services, which account for roughly 2,300 distinct train trips on an average weekday. The network also caters for a significant number of freight trains, perhaps up to 200 trips on an average weekday, which must fit in with passenger train operations at different points around the system. Any discussion of rail system capacity therefore has to take into account the all-purpose nature of the Sydney Metropolitan Railways.

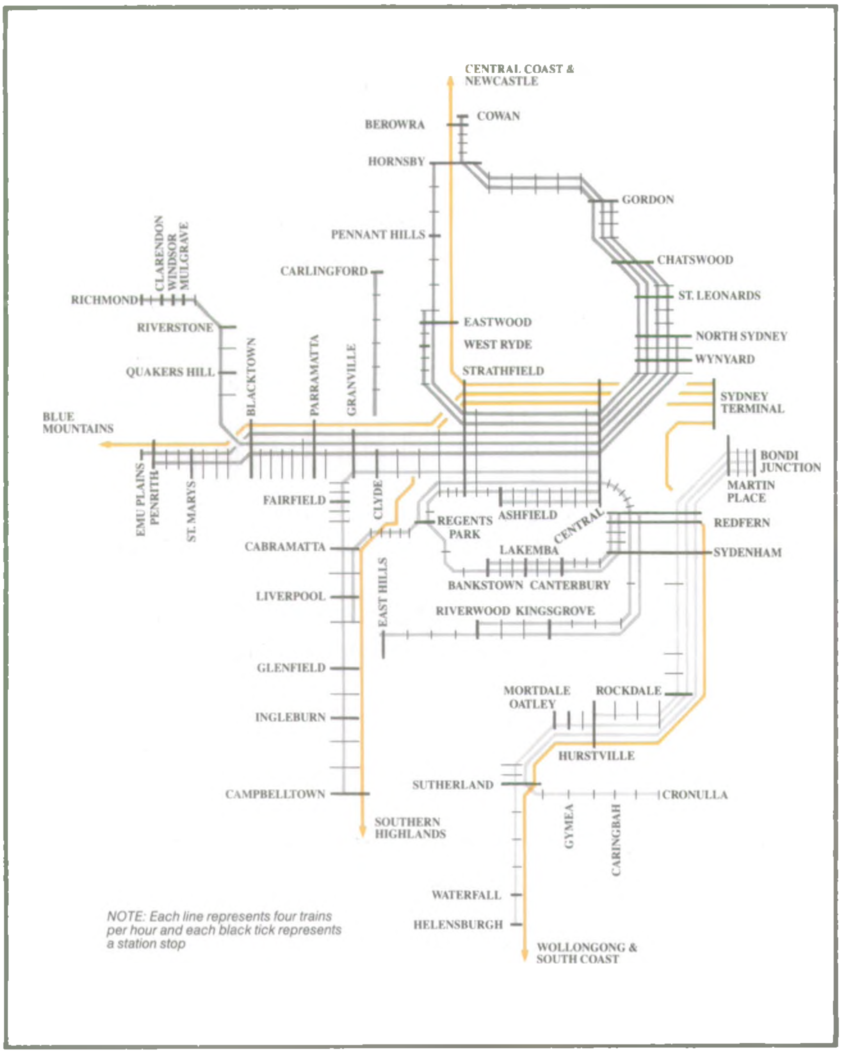


Figure 10.4.4
CURRENT PEAK PERIOD SERVICE ON THE SYDNEY METROPOLITAN RAILWAYS

Sector I
Sector II
Sector III
Interurban

Table 10.4.3 **Inward bound morning two-hour peak passenger and train movements on the Sydney Metropolitan Railways, by line**

Line	Peak morning inward bound passengers*	Station at which measured	Equivalent no. of double-deck cars**	Passengers per car	Proportion of seats occupied+ (%)
North Shore	18,300	North Sydney	164	112	93
Main Northern	8,600	Strathfield	90	96	80
Main Western	19,500	Granville	165	118	98
Local	20,200	Redfern	185	109	91
Bankstown	9,600	Sydenham	86	112	93
East Hills	8,500	Sydenham	74	115	96
Illawarra	21,700	Sydenham	164	132	110
Eastern Suburbs	9,500	Martin Place	156	61	51

* Source: Passenger counts prepared by the State Rail Authority between 1979 and 1980 as part of the data collected for the 1981 Sydney Region Travel Survey (State Transport Study Group, 1982).

** Source: November 1983 Metropolitan Timetable, as representative of the current state of operations. Single-deck cars were equated to 0.67 of a double-deck car for seating purposes.

\+ Average seating of a double-deck car taken to be 120 seats.

Anticipated rail network

While large-scale changes to the network are not anticipated for the period up to about 2011, there are a number of foreseeable changes that could facilitate alternative passenger and freight travel patterns. These include:

- the current extension of the East Hills Line to Glenfield on the Main Southern Line, which would reorient travel between Campbelltown and Sydney;
- the possible direct linking of Merrylands on the Main Southern Line to Harris Park on the Main Western Line, which would permit direct passenger movement between Campbelltown, Liverpool, Parramatta, Blacktown and Penrith, and direct freight movement (primarily of coal) between the Main Western Line and the Main Southern Line;
- the current construction of the Maldon—Dombarton Railway from the Main Southern Line (south of Campbelltown) to the Illawarra Line primarily for coal traffic;
- the possible mainline electrification south of Campbelltown to facilitate freight movement and to accommodate future commuting passenger needs;
- the possible medium to long-term construction of an electrified freight railway from the Main Western Line near Werrington to the Main Southern Line near Glenlee to by-pass much of the metropolitan railway system;
- the completion of electrification to Port Kembla, with the probable expansion of interurban services between Sydney Terminal and Wollongong.

While there are no existing estimates of future rail passenger movements on such an augmented Sydney Metropolitan Railways network, a possible pattern of inward bound train operations during the morning peak period is shown in Figure 10.4.5. For the purpose of presenting a base case against which the access needs of a second Sydney airport site can be assessed, it shows one way in which the Sydney Metropolitan Railway system might be operating in the long term, including the East Hills—Glenfield and Merrylands—Harris Park connections.

If implemented, such a pattern would accommodate an expansion of passenger services on the Main Northern Line, Richmond Line, Main Western Line, Main Southern Line and Illawarra Line. Moreover, since full length double-deck suburban or interurban trains are currently not being operated throughout the whole system, there is even further scope for handling additional passengers within this operating pattern.

Such an augmented network similarly would have scope to handle additional freight movements, such as bulk coal and wheat. Increasingly, there will be major movements of both these commodities between the Main Western and Main Southern lines because of the existing and proposed deepwater coal and wheat terminals at Port Kembla, which will be considerably superior in throughput and shipping capacity to those in Port Jackson.

However, some proportion of any spare capacity could be taken up by non-airport travel demands not already anticipated. The future populations of the various potential areas for urban development (Section 9.8) are not yet known, and their pattern will affect rail travel demands along various routes. There may also be operational changes, such as a systematic increase in train speed, that could affect this assessment of spare capacity.

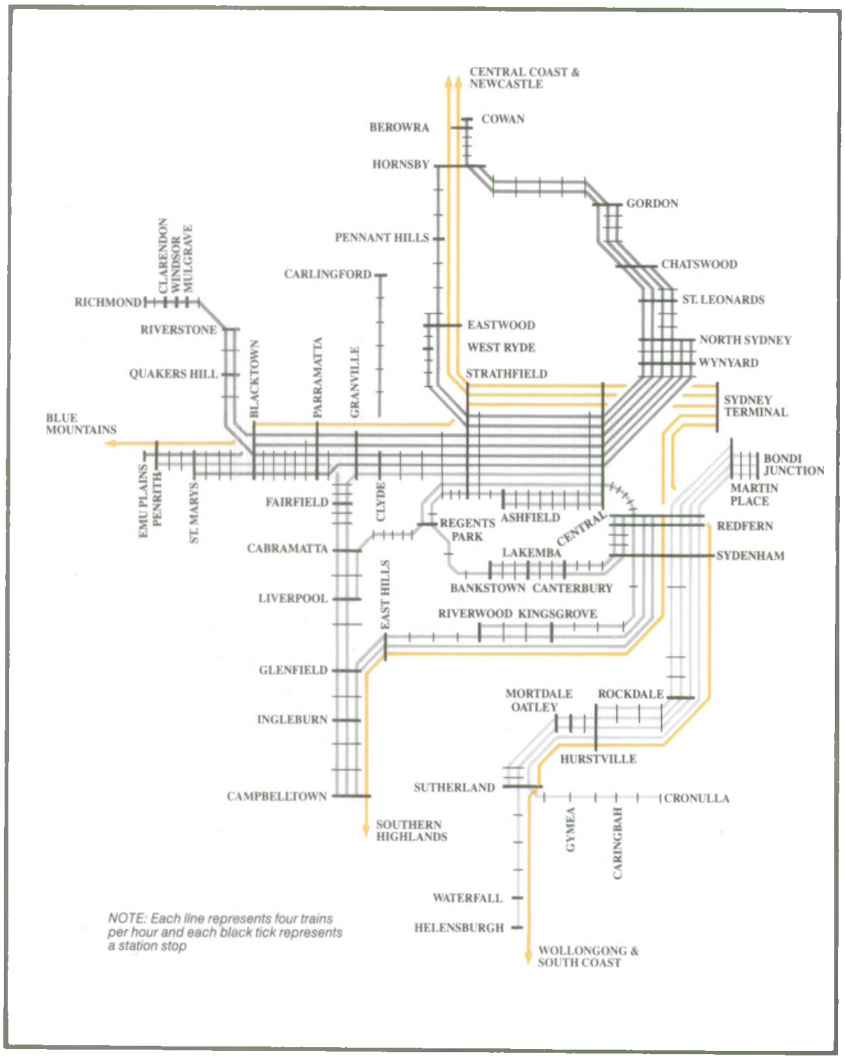


Figure 10.4.5
POSSIBLE FUTURE PEAK PERIOD SERVICE ON THE SYDNEY METROPOLITAN RAILWAYS

10.4.3 Transport implications of airport development

The worst case of 13 million passengers per annum was converted into total travel demands using the following assumptions:

- 20% of air passengers would be in transit and would therefore not require suburban transport to or from the airport;
- a busy day represents 17% of weekly passenger numbers;
- 1% of air passengers (5% of transit passengers) would require transport to or from Kingsford-Smith Airport;
- a maximum of 10,500 people would be directly employed at the airport (Section 9.6);
- a further 2,100 employees would work at or close to the airport in airport related or multiplier jobs (all 900 airport-associated jobs, and half the sub-region multiplier jobs, Section 9.6).

The first two assumptions lead to an estimate of 34,000 air passengers travelling to and from the airport on a busy day. The basis of the 13 million passengers a year worst case is explained in Chapter 4. The assumptions concerning transit passengers are based on present patterns at Kingsford-Smith Airport. There are two reasons why the flow of passengers between the second Sydney airport and Kingsford-Smith Airport would be very small:

- about half of all transit passengers are making on-line transfers, that is, they arrive and depart on flights operated by the same carrier;

- in the worst case, the traffic at the second Sydney airport would be substantially higher than that at Kingsford-Smith Airport today, and therefore there would be services to a wide range of destinations, sufficient to afford most travellers a reasonable level of service to major destinations, without the need to change airports to reach final destinations.

Groundside origins and destinations of air passengers

The number of passengers travelling to the airport from different parts of Sydney and adjacent areas was then estimated, based on the forecast population distribution in the year 2011, and the present numbers of air passenger trips per thousand population in different parts of Sydney. The geographical distribution of air passengers' groundside origins and destinations, as identified by Department of Aviation surveys, is set out in Figure 10.4.6. There are significant differences between the patterns of groundside origins and destinations of Sydney residents, and those of non-residents. At present, Sydney residents account for 41% of passengers (excluding transfer and transit passengers) at Kingsford-Smith Airport, but the future ratio for a second Sydney airport is uncertain. It was therefore considered important to analyse a pattern of groundside origins and destinations that, like the current distribution, represented a mix of resident and non-resident travellers, but in addition, to consider the sensitivity of the results to alternative possible distributions biased towards either residents or non-residents. The implications of these alternative possible distributions were consequently examined, but it was concluded that in the case of road access the results of the analysis were generally insensitive to the distribution owing to the limited number of approach routes serving the site. The only distribution pattern that could affect the conclusions of this analysis was one in which origins/destinations were highly concentrated on the city centre. This was considered unlikely in practice. In the case of rail access, the distribution would affect the overall level of patronage, but the infrastructure requirements would not be significantly different.

Percentage of travellers using rail and road for ground access

Three possible levels of rail use for ground access were considered:

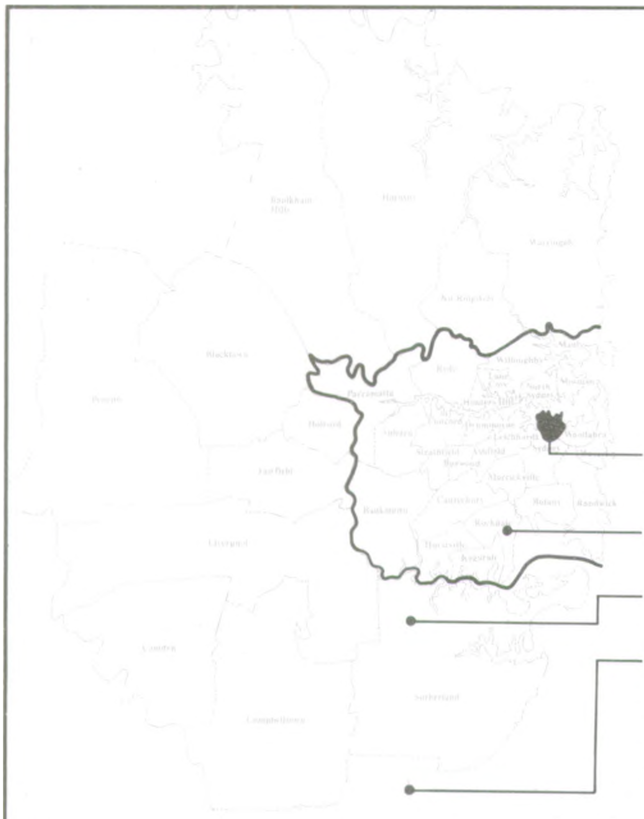
- a 'no-rail' case, with public transport access being mostly provided by a combination of local bus services, and tour and charter coach services;

- a 'low-rail' case, which assumed low usage of a rail service between the city and a second Sydney airport;

- a 'high-rail' case, which assumed high usage of a rail service between the city and a second Sydney airport.

The first two levels were used to examine the worst case for the road network, while the last two were used as a basis for examining the worst case for the public transport network. In all three cases, public transport journeys from the airport were viewed as comprising two phases: new trunk services from the airport, followed by existing local services to ultimate destinations. In the no-rail case, the new trunk services would consist of scheduled bus services to various major centres around the Sydney Region. In the low-rail and high-rail cases, the new trunk rail services would run between the airport and Sydney Terminal, with intermediate connections to suburban rail services.

Source: Department of Aviation surveys at Kingsford-Smith Airport, 1983



	SYDNEY RESIDENTS %	NON RESIDENTS %	ALL PASSENGERS %
CITY	6	43	29
INNER AREAS	59	39	47
OUTER AREAS	32	7	15
OTHER AREAS	1	6	4
NOT STATED	1	5	4
TOTAL	100*	100	100*

*NOTE: *Does not add up to 100 due to rounding*

Figure 10.4.6
GROUNDSIDE ORIGINS AND DESTINATIONS OF AIR PASSENGERS, 1983

Before making any assumptions about the share expressed as a percentage of total ground passenger movements taken up by each mode of travel, overseas experience related to multiple airports was reviewed. However, this information was not wholly conclusive, since it depended upon the efficiency of rail and public transport access to the airport in question.

For example, although Paris-Orly and Roissy-Charles de Gaulle airports both have nominal connections by bus and rail, they contribute comparatively few passengers to the travel market because of the difficulty of access where shuttle bus services to/from railheads must be taken into account. On the other hand, London's Heathrow and Gatwick airports are well connected to the London Underground and to the British Rail Southern Region Brighton Line respectively, and have extensive bus and coach connections.

However, the relative proximity of Heathrow to central London increases the bus, coach and taxi share of travel compared with Gatwick, thereby accounting for much of the difference in the rail mode percentages between the two airports.

The British Airports Authority, in preparing the case for a third major airport for London at Stansted, was considering an airport site relatively as remote from central London (52 km to St Pancras station) as Badgerys Creek is from Sydney (57 km to Sydney Terminal station). In working out the indicative percentage share for each travel mode for the no-rail, low-rail and high-rail cases presented in Table 10.4.4, the British Airports Authority's determinations of travel mode percentages were used, as well as information on currently available methods of transport access to Kingsford-Smith Airport, and the conclusions on use of public transport presented in the Major Airport Needs of Sydney Study.

Table 10.4.4 Indicative percentage share of ground access for each travel mode for each case

Mode of travel	No-rail case (%)	Low-rail case (%)	High-rail case (%)
Private vehicle	65	50	40
Taxi*	5	5	5
Bus **	15	15 (Bus and Coach combined)	15 (Bus and Coach combined)
Coach+	15		
Rail	-	30	40

* The taxi percentage share is a residual, given the long taxi journeys envisaged.
** Regular scheduled bus services to selected points throughout the Sydney Region.
\+ Tour and charter coach services for specific group travel needs.

From the available information on public transport access to airports, there appears to be relatively little variation in the percentage share enjoyed by rail travel in those cases where rail access of a reasonable standard is available. Nevertheless, there could be a wide variation in the total public transport share of airport access to a second Sydney airport. This is because the public transport share would depend partly on the characteristics of air passengers in terms of such factors as purpose of travel and place of residence (i.e. whether the traveller is a Sydney resident or a visitor), and partly on how the public and private transport options compare in terms of speed, cost and reliability. None of these factors can be predicted with any certainty for a 13 million passenger airport, which can only develop in an environment that would be substantially different from that of today. It is therefore necessary to consider a range of different cases for transport access (Table 10.4.4).

Origins and destinations of rail and road users

The indicative percentages for each travel mode were used as the basis for estimating separate distributions of groundside origins/destinations for those air travellers travelling by rail and those travelling by road. In the no-rail case, it was assumed that in-vehicle travel times by bus or coach would be 10% longer than comparable times by private vehicle, and that the origins/destinations of travellers by the various transport modes would have similar distributions over the Sydney Region. In the low-rail and high-rail cases, some areas of Sydney were significantly more accessible by rail than road while the opposite situation applied to other areas. The indicative travel mode percentages were therefore modified upwards or downwards respectively according to the ratio of rail times to road times. This technique was applied to two alternative rail access routes to Badgerys Creek (via St Marys, and via Glenfield), and it was found that the route via Glenfield yielded a higher share for the rail mode of travel (Section 10.4.5). The public transport trips estimated for the no-rail and low-rail cases under the St Marys alternative (i.e. the rail alternative with the lower level of rail patronage) were then subtracted from total trips to give two distinct worst cases for road: one in which all airport related travel was done by road, and one in which the maximum of airport related non-rail travel was done by road.

Estimated total demands for ground travel

To obtain figures for the total travel demands by rail and road for a worst case of 13 million passengers, it was also necessary to consider the travel requirements of those travelling to an airport to greet air passengers as well as the requirements of airport employees and other airport users.

As far as road travel was concerned, applying the indicative road travel percentages (Table 10.4.4) to the figure of 34,000 passengers on a busy day gave figures of 19,000 air passengers travelling by car or taxi in the low-rail case, and 24,000 in the no-rail case. Experience at Kingsford-Smith Airport indicates that after making allowance for those travelling to the airport to greet passengers and for vehicle return trips these figures would rise to 27,000 and 35,000 vehicle trips. After allowing for other vehicle trips to the airport concerned with airport business, freight deliveries and servicing, the figures would rise further to 42,000 in the low-rail case, and 54,000 in the no-rail case. Finally, it was necessary to allow for travel by employees, which added a further 15,000 vehicle trips per day (assuming a maximum of 85% of employees travelling to work by car in both the low-rail and no-rail cases). The overall totals were therefore estimated at 57,000 vehicle trips per day in the low-rail case, and 69,000 in the no-rail case.

As far as rail travel was concerned, it was estimated that some 10,200 air passengers would travel by rail in the low-rail case, and 13,600 in the high-rail case. As with road travel, there would also be other airport users, including people travelling to the airport to greet air passengers. On the basis of information given for Stansted, these additional groups could amount to about 10% of the number of air travellers. Partly because most employees would live within 20 km of the airport, there is not likely to be a high flow of employee travel by rail, although overseas experience suggests that the proportion of employees travelling by rail would not be insignificant. Thus a minimum of 10% and a maximum of 20% of airport and airport-associated employees were assumed to travel by rail. Both these cases were considered because, unlike road travel, the overall rail travel numbers are sensitive to the proportion of employees who travel by rail, especially during peak hours.

10.4.4 Impact of airport development on anticipated road network flows

To estimate the impact of airport related traffic on anticipated road network flows, assumptions were made as to the routes that vehicles would use to travel to and from the airport.

Some roads were considered inappropriate for airport access because of their function in serving residential areas. These included Hoxton Park Road, the possible future links between Cowpasture Road and Mamre Road running from the Great Western Highway to the Hume Highway, and the possible westward extension of Fifteenth Avenue. Major airport access from the Western Freeway and areas to the north would thus be via The Northern Road, Erskine Park Road and Wallgrove Road; from the Hume Highway, South Western Freeway and areas to the east, access would be via Elizabeth Drive and Bringelly Road; while The Northern Road would give access from the south. Of these, the dominant approach route proved to be Bringelly Road and the South Western Freeway. The vehicle trips from each district were then added to those on the appropriate approach route, to give an estimate of future traffic when the airport was operating under worst case conditions. These future flows, estimated both with and without avialable rail access, are shown in Table 10.4.5.

Comparison of the future traffic flows shown in Table 10.4.5 with the maximum desirable daily flows shown in Table 10.4.2 allows a clarification of the changes required in the capacity of the road network. The lane requirements for various sections of the road network are also summarized in Table 10.4.5 for future conditions, with and without the airport development. It is necessary to compare the network requirements based on an assumption of no airport development with those assuming airport development at Badgerys Creek, in order to separate the effects of the airport from the effects of natural growth.

Table 10.4.5 Anticipated road network flows and lane requirements

Road	Location	Average daily traffic			Number of lanes required		
		No airport	With airport		No airport	With airport	
			With rail	No rail		With rail	No rail
Western Freeway	At the Nepean River	55,000	56,000	56,000	6F*	6F	6F
	East of Erskine Park Road	70,000	76,000	77,000	6F	6F	6F
	East of Wallgrove Road	60,000	66,000	67,000	6F	6F	6F
The Northern Road	North of Western Freeway	54,000	56,000	56,000	6F	6F	6F
	South of Western Freeway	25,000	28,000	28,000	4	4	4
	North of Elizabeth Drive	15,000	18,000	18,000	4	4	4
	South of Elizabeth Drive	9,000	10,000	10,000	2	2	2
	South of Bringelly Road	11,000	15,000	15,000	2	4	4
Erskine Park Road	South of Western Freeway	25,000	31,000	32,000	4	4	4
	East of Mamre Road	9,000	15,000	16,000	4	4	4
Wallgrove Road	South of Western Freeway	35,000	38,000	39,000	6D**	6D	6D
Badgerys Creek Road		1,000	500	500	2	2	2
Elizabeth Drive	East of The Northern Road	9,000	12,000	12,000	2	2	2
	West of Wallgrove Road	24,000	40,000	41,000	4	6D	6D
	East of Wallgrove Road	35,000	45,000	45,000	6D	6D	6D
	West of Cabramatta Road	36,000	46,000	46,000	6D	6D	6D
	East of Cabramatta Road	36,000	40,000	40,000	6D	6D	6D
	West of Hume Highway	55,000	56,000	56,000	6D+	6D+	6D+
Cabramatta Road	East of Elizabeth Drive	18,000	24,000	24,000	4	4	4
	West of Hume Highway	39,000	42,000	42,000	6D	6D	6D
Hume Highway	North of Cabramatta Road	70,000	73,000	73,000	6F	6F	6F
Bringelly Road	East of The Northern Road	25,000	52,000	63,000	4	6F	6F
	East of Hume Highway	20,000	46,000	56,000	4	6D	6F
South Western Freeway	North of Campbelltown Road	50,000	50,000	50,000	6F	6F	6F
	East of Hume Highway	25,000	51,000	61,000	4F	6F	6F
	East of Henry Lawson Drive	30,000	53,000	63,000	4F	6F	6F
Badgerys Creek Road replacement	North of Elizabeth Drive	-	15,000	17,000	-	4	4
	South of Elizabeth Drive	-	24,000	27,000	-	4D	4D
	North of Bringelly Road	-	33,000	42,000	-	6D	6D

* F indicates an access-controlled road.
** D indicates a divided at-grade road.
\+ Flows in excess of desirable maximum.

To cater for 13 million passengers a year at the airport under the assumptions made, it would be necessary, even if rail access were available, to undertake the following additional works:

- widening of the South Western Freeway from four to six lanes between Liverpool and King Georges Road;
- widening of Bringelly Road from four to six lanes between the South Western Freeway and The Northern Road;
- widening of Elizabeth Drive from four to six lanes between Wallgrove Road and Badgerys Creek Road;
- widening of The Northern Road to four lanes between Bringelly Road and Narellan;
- replacement of Badgerys Creek Road by a new six-lane road to the east between Bringelly Road and Elizabeth Drive, retaining the southern portion of Badgerys Creek Road for local access;

- construction of a new four-lane connection from the end of this replacement road to Erskine Park Road, to provide access to the Western Freeway.

Examination of Tables 10.4.5 and 10.4.2 also shows that the absence of rail access affects the works required in only one significant respect: Bringelly Road would have to function as a six-lane access-controlled road to cater for the extra load, whereas a six-lane divided road would suffice if rail access were available.

It should be stressed that the works listed above are not recommendations and should not be used for planning purposes, as the intention in compiling this list has merely been to identify the possible scale of worst case effects in the event of future airport development. If the airport were to be developed, detailed studies of alternative access arrangements would be necessary to enable road access to be designed in accordance with traffic forecasts that could at that stage differ significantly from today's worst case assumptions.

Considerations for land uses

In order to minimize the effects of increased traffic flows on surrounding land uses, the major portion of the airport traffic would be directed via Bringelly Road to the South Western Freeway and thence to areas north and east. This would lead to a change of character for Bringelly Road from a four-lane road to a six-lane divided road, possibly with some restriction on access. Other roads, such as The Northern Road, Erskine Park Road, Elizabeth Drive and Cabramatta Road, would experience smaller but significant increases in traffic, with an increase in traffic being particularly noticeable on Elizabeth Drive between Cabramatta Road and Badgerys Creek Road. Such development would not be out of character with the urban arterial function of this road between Cabramatta Road and Wallgrove Road but would change its character between Wallgrove Road and Badgerys Creek Road.

10.4.5 Impact of airport development on anticipated rail network flows

The additional rail passenger movements would, in part, differ in magnitude and direction depending upon the way in which the airport was linked to the rail network. Because the proposed site is closer to the Main Western Line, its regional public transport links would be more likely to be north—south than east—west. While there are busy railway stations on the Main Southern Line (e.g. Fairfield, Cabramatta, Liverpool, Ingleburn), none of the local bus operations now focused on these stations extends far enough westwards to serve as a sufficiently strong link with the airport site. In the future, it is probable that bus services will extend through new residential areas in Fairfield and Liverpool towards the site. However, because of their circuitous nature, the travel time involved, and the conflict with their prime function, such services would be suitable only for access by local employees.

As the site is more or less remote from railway lines, deliberate decisions on trunk routes would be required, whether road or rail-based access systems were being considered. However, a road-based access system would have to connect with the Sydney Metropolitan Railways to assist distribution of airport generated travel throughout much of the region; otherwise it would have to reproduce a similar geographical complexity in order to provide effective access by public transport to the airport. The Sydney Metropolitan Railways already play a significant role in travel by public transport at a regional level, and are capable of absorbing the extra rail travel generated by a second Sydney airport. Two rail options are apparent:

- a trunk route via St Marys, in common with a possible freight railway from Werrington on the Main Western Line to Glenlee on the Main Southern Line, and from there via the Main Western Line to Sydney;

- a trunk route via Glenfield and thence via the East Hills and Illawarra lines to Sydney.

Possible rail flows for each of the two alternatives are summarized in Tables 10.4.6 and 10.4.7. The peak hour flows assume that:

- the peak hour for air travellers coincides with that of other travellers;
- 10% of the daily flow occurs in the peak hour and this divides evenly by direction;
- 70% of travel by employees in one direction occurs during the same peak hour as for air travellers and in the same direction.

Table 10.4.6 Estimated rail passengers for Badgerys Creek via St Marys, by category of traveller and period

Period	Category of travellers	Low-rail case		High-rail case	
Busy day	Air travellers	10,200		13,600	
	Others	1,020		1,360	
	Employees*	2,000	(4,000)	2,000	(4,000)
	Total	13,220	(15,220)	16,960	(18,960)
Peak hour	Air travellers	510		680	
	Others	50		70	
	Employees*	700	(1,400)	700	(1,400)
	Total	1,260	(1,960)	1,450	(2,150)

* Assuming a minimum of 10% (the first figure) and a maximum of 20% (the figure shown in brackets) of all airport and airport-associated employees travel by rail.

Table 10.4.7 Estimated rail passengers for Badgerys Creek via Glenfield, by category of traveller and period

Period	Category of travellers	Low-rail case		High-rail case	
Busy day	Air travellers	10,800		14,400	
	Others	1,080		1,440	
	Employees*	2,000	(4,000)	2,000	(4,000)
	Total	13,880	(15,880)	17,840	(19,840)
Peak hour	Air travellers	540		720	
	Others	50		70	
	Employees*	700	(1,400)	700	(1,400)
	Total	1,290	(1,990)	1,490	(2,190)

* Assuming a minimum of 10% (the first figure) and a maximum of 20% (the figure shown in brackets) of all airport and airport-associated employees travel by rail.

The flows shown in these tables are similar whichever of these two alternative routes is chosen. Irrespective of the route adopted, a range of possible rail operations was considered for a service between the city and the airport. These included:

- an extension of an adjacent suburban service running to Central station and the city railway;

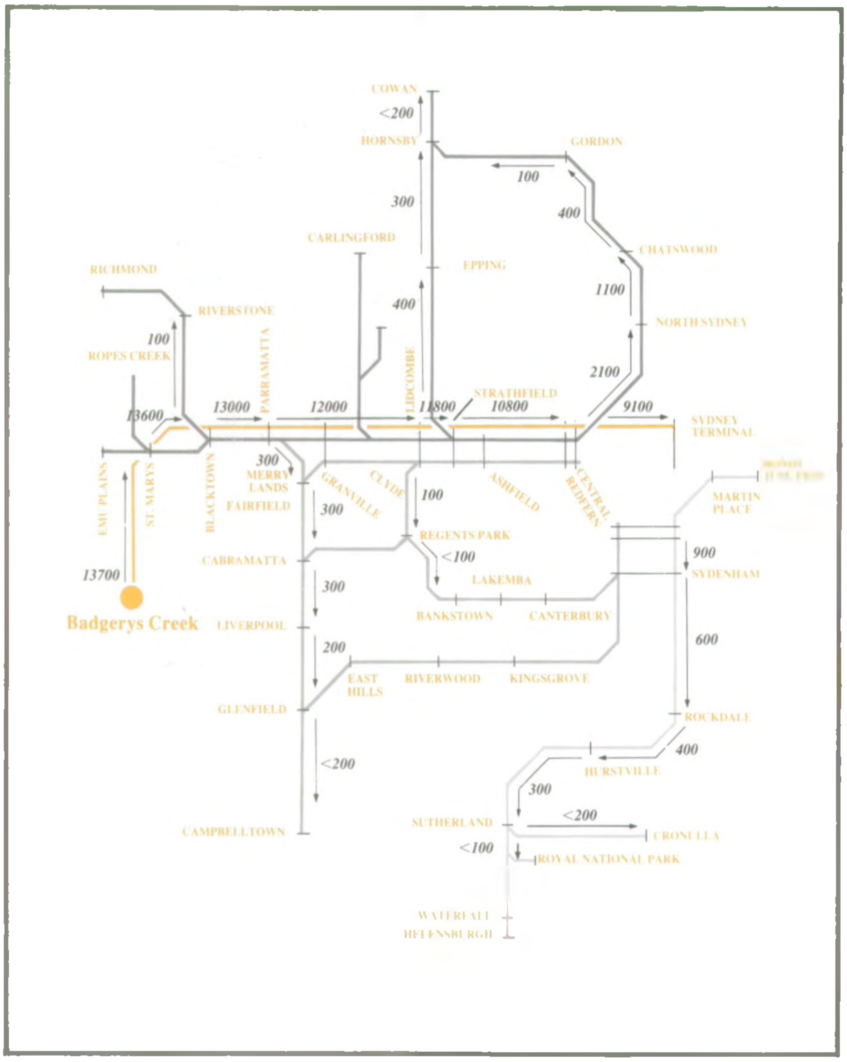


Figure 10.4.7
FLOWS OF AIR PASSENGERS BY RAIL FROM BADGERYS CREEK ST. MARYS OPTION, FUTURE RAIL SYSTEM

Sector I

Sector II

Sector III

Express Service

- an additional interurban service integrated with the existing Central Coast and Mountains interurban services and running to Sydney Terminal;

- a separate (i.e. with dedicated trains) interurban-style service running to Central station and the city railway;

- a separate (i.e. with dedicated trains) interurban-style service running to Sydney Terminal.

This last — a separate interurban-style service running to Sydney Terminal — was considered the most appropriate for an airport express rail service because of the need for an indentifiable and reliable service, able to accommodate the lengthy stops at stations that would be necessary for luggage handling. Interurban-style trains (such as the air-conditioned double-deck trains to the Central Coast and the Blue Mountains) would offer a satisfactory level of comfort to induce air passengers to use an airport express service. They would also offer good point-to-point travel times for the limited-stop services necessary to cut to a minimum the rail access time between the city and the airport. These services would make a small number of intermediate stops (say, three or four), thus allowing efficient distribution of air passengers to areas other than the city by connecting with suburban services. It is expected that with some operational modifications Sydney Terminal station would not only be capable of handling the airport express services, which would require the equivalent of two tracks, but could also be developed to handle transfers to suburban trains, as well as to road transport links such as buses, coaches, taxis, and private vehicles.

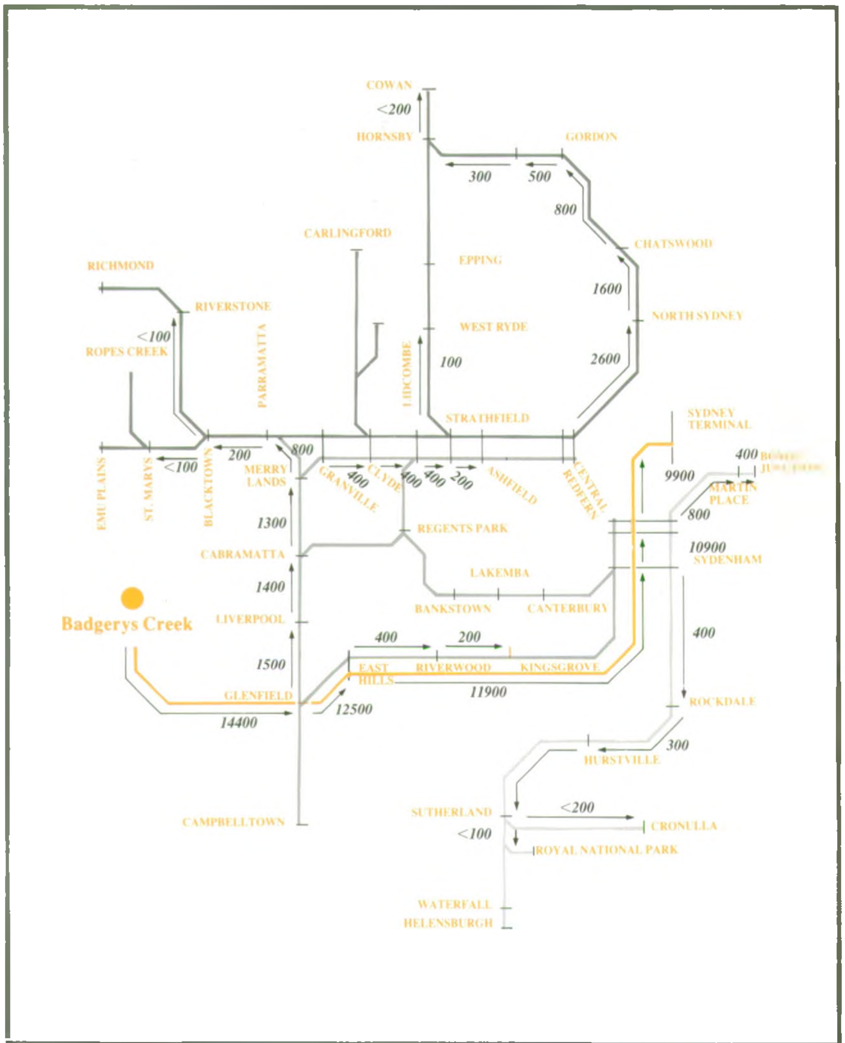


Figure 10.4.8
FLOWS OF AIR PASSENGERS BY RAIL FROM BADGERYS CREEK GLENFIELD OPTION, FUTURE RAIL SYSTEM

Sector I
Sector II
Sector III
Express Service

Because an airport express service would be carrying a combination of air travellers, airport employees and others to eventual destinations throughout the Sydney Region, it would be distributing passengers into the Sydney Metropolitan Railways at selected points along its route. From those points, travellers would take regular suburban and interurban services to complete their journeys. Figure 10.4.7 shows the distribution of air travellers from the airport express route via St Marys and Figure 10.4.8 shows the corresponding distribution of air travellers from the rail route via Glenfield.

10.4.6 Consequent changes to the transport system

This section summarizes the changes to the transport system that might be necessary to cater for the maximum additional travel that could be generated by an operational airport. The cost of these changes is also estimated.

Changes to the road network

At or before the start of airport construction, it would be necessary to replace Badgerys Creek Road with a new road to the east (retaining the southern portion of the road for local access) and also to reroute The Northern Road around the western perimeter of the site. Possible routes are shown on the master plan discussed in Chapter 8. Progressive changes to the surrounding road network would take place in response to demand generated by population growth and growth in air traffic. The network changes that would be necessary to accommodate 13 million air passengers have already been discussed (Section 10.4.5).

It should be noted that these works would also provide a good connection to Kingsford-Smith Airport along Bringelly Road and the South Western Freeway for the small proportion of passengers (1%, or 300-400 per day) that might need to transfer between the two airports. It is assumed that a coach service would be provided to cater for these passengers.

The cost of the changes to the road network have been estimated using unit costs provided by the Department of Main Roads (Table 10.4.8). Costs vary greatly depending upon whether the roads are located in non-urban, outer or inner urban locations, reflecting the varying land values in these areas. The Badgerys Creek site is particularly sensitive to these variations, as the roads serving the site run from non-urban to outer urban areas. Applying the unit costs to the works described above gives an estimate of the capital cost of roadworks of about $159 million if rail access is available, or about $217 million if it is not.

Table 10.4.8 Road construction unit costs*

Cross-section	Total cost/kilometre ($ million)**		
	Inner urban	Outer urban	Non-urban
Six-lane freeway	17.50	12.25	7.10
Four-lane freeway	12.50	8.75	5.10
Six-lane divided road	10.00	7.00	4.05
Four-lane divided road	7.50	5.25	3.05
Four-lane road	6.30	4.40	2.55
Two-lane road	3.80	2.65	1.50

* Costs are for constructing new roads. Upgrading costs are equal to the difference between costs for the existing and future cross-section.

** Costs are derived from unit costs supplied by the Department of Main Roads and are expressed in 1984 dollars.

Changes to the rail system

In addition to the physical connection of the site to the Sydney Metropolitan Railways network, a number of other measures would have to be taken to fit an airport express service into the expected pattern of suburban and interurban services existing at that time. However, transferring passenger flows at various points in the rail network would not warrant any special addition to non-airport services. Basically, this is because air travellers and others would be more or less evenly distributed throughout the day so that the small hourly traffic flows they would generate could be accommodated just as easily on peak or counter-peak suburban or interurban trains. During the peak hour, flows of airport and airport-associated employees would be of a similar magnitude to the flows of air travellers and others (Table 10.4.6 and 10.4.7), but they would most likely disperse fairly quickly once the airport express services reached major stations on either the Main Western Line or the Main Southern Line. In either case, the employee flows would most likely be running counter to peak commuter flows from Sydney and Parramatta, and so would be easily accommodated by relevant suburban or interurban services.

The infrastructural changes required for the route via St Marys would include:

- provision for an airport express terminal complex at Sydney Terminal station;
- either a 13 km duplication of a possible future Werrington—Glenlee single track electrified freight line from St Marys as far as Kemps Creek, or the construction of a new 13 km double track electrified line from St Marys to Kemps Creek;

- construction of a 5 km double track electrified spur to the airport, plus the provision of a two track terminus.

The infrastructural changes required for the route via Glenfield would comprise:

- provision for an airport express terminal complex at Sydney Terminal station;
- provision of two additional electrified tracks on the Illawarra Line between Erskineville and Sydenham over a distance of 3 km;
- provision of two additional electrified tracks on the East Hills Line between Tempe and Kingsgrove (6 km), with a suitable junction with the Illawarra Line between the Meeks Road and Wolli Creek junctions;
- construction of a 24 km double track electrified line between Glenfield and the airport, plus the provision of a two track terminus.

The level of service for airport express trains in either direction was assumed to be as follows:

- four trains per hour for two peak hours in the morning and two in the evening;
- two trains per hour for the balance of fourteen hours of a working railway day (say, 0600-2400 hours).

It is estimated that ten four-car interurban-style trains (including one spare) would be required for the level of traffic predicted under the high-rail case on either route.

The identification of rail infrastructure requirements attributable to the airport has been based partly on the assumed nature of the airport express service and on the assumptions concerning future spare capacity in the network. There may be other, as yet unidentified, calls on critical rail capacity that may affect requirements for additional infrastructure but unless that is the case, the infrastructure requirements are fairly insensitive to the level of forecast air traveller, other traveller and employee flows by rail. If travel were, say, 30% less than the level anticipated, the same sized trains would still be needed, but if it were 30% more, then six-car trains would be required. Notwithstanding the levels of rail travel estimated (which lie in the range of rail passenger flows encountered at major overseas airports served by rail), provision of a rail link would be a more major policy issue than provision of the necessary highway infrastructure.

Costs of rail infrastructure requirements

The costs of the rail infrastructure requirements were estimated, including any changes to the established railway network, using a table of unit costs derived from data on current construction costs supplied by the State Rail Authority for two current railway construction projects (the East Hills—Glenfield Railway and the Maldon—Dombarton Railway). The resulting schedule of infrastructure and rolling-stock costs for both alternatives is shown in Table 10.4.9. On the basis of the assumptions made about rail capacity, total costs of infrastructure and rolling-stock for the St Marys route would be about $101 million or $117 million, depending on whether or not a Werrington—Glenlee freight line were in existence at the time. For the Glenfield route, total costs for infrastructure and rolling-stock would be between about $158 million and $217 million according to the allocation of cost of the additional track shared by the airport service with other passenger services.

Appraisal of rail access options

Capital costs are only one of several factors that might determine the choice between rail access options. The alternative routes for the proposed Badgerys Creek airport site would directly connect with different parts of the Western and Southern Sub-Regions of

Sydney. The route to the city centre via St Marys would pass through Parramatta. On the other hand, the route via Glenfield would offer a shorter, faster journey to the city centre and could attract 5% more air travellers.

Table 10.4.9 Schedule of infrastructure and rolling-stock costs for the alternative routes to Badgerys Creek

Cost item	Costs ($ million) by route			
	Via St Marys		Via Glenfield	
	Joint airport and freight line	Wholly attributable to airport	Excluding shared facilities*	Wholly attributable to airport
Airport terminus	2	2	2	2
Spur to Kemps Creek	16	-	-	-
Additional track, St Marys—Kemps Creek	35	-	-	-
New line, St Marys—airport	-	67	-	-
New line, Glenfield—airport	-	-	108	108
Additional two tracks, Tempe—Kingsgrove	-	-	-	46
Additional two tracks, Erskineville—Sydenham	-	-	-	13
Sydney Terminal station	4	4	4	4
Total infrastructure	57	73	114	173
Rolling-stock (10 trains)	44	44	44	44
Total rail requirements	101	117	158	217

* Facilities shared with other passenger traffic.

Other factors relevant to the choice include operating costs (represented largely by train hours per day, and carriage kilometres per day), travel time, and numbers of air passengers likely to be attracted. Table 10.4.10 is an overall comparison of the two rail options. At present, the Glenfield route would appear preferable on every count except capital cost. However, as the capital costs are sensitive to future capacity being available, and as the differences on some other items are not sufficiently significant to ensure that the relative merits on the two routes might not be reversed in the future, there is an argument for keeping both options open.

Table 10.4.10 Comparison of the rail options for Badgerys Creek

Item	Via St Marys	Via Glenfield
Minimum attributable costs	$m 101	$m 158
Maximum attributable costs	$m 117	$m 217
Train hours per day	83.6	76.3
Carriage kilometres (thousands per day)	23.2	20.1
Air passenger rail trips (thousands per day)	13.7	14.4
Air passenger hours (thousands per day)	16.5	16.3
Average end-to-end duration of trip (hours)	1.2	1.1
Average end-to-end length of trip (km)	69.7	61.5

Necessity of rail access

While the provision of adequate road access arrangements is essential to the operation of an airport, this is not necessarily the case with rail access; many international airports, including all those in Australia, are without direct rail access. A decision to provide rail access would need to take account not only of the airport-related access issues discussed here but also of operational considerations relating to the rail system as a whole. A decision could be many years off.

10.4.7 Comparative travel times to the airport

With or without rail access, the adequacy of the ground access arrangements discussed above depends primarily, though not exclusively, on travel times between the airport and passengers' groundside origins or destinations. Figure 10.4.9 shows isochrone diagrams for peak hour travel to and from the airport by road and rail. These travel times are for end-to-end duration of the trip ('door to door'), and enable an assessment of the comparative accessibility of different parts of the Sydney Region by road and rail from the airport. On the basis of the assumed distribution of air passengers' groundside origins and destinations, overall average travel times in peak hour (end-to-end trip duration) for air passengers would be as follows:

- by road — 69 minutes
- by rail via St Marys — 72 minutes
- by rail via Glenfield — 68 minutes.

Overall, and on the basis of the assumed distribution of air passengers' groundside origins and destinations, a conventional rail link could provide access times comparable to those achievable by road. However, as the comparative rail and road travel times vary from area to area, so would the overall average travel times for all passengers vary according to any differences in the future distribution of groundside origins and destinations from that assumed above.

Concentrated distribution

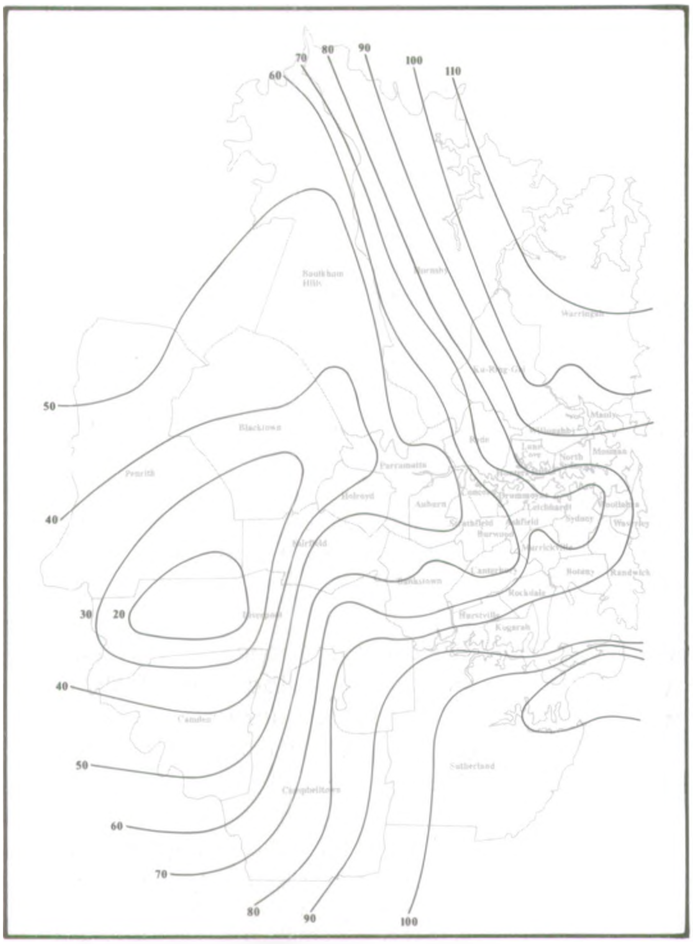
With a more concentrated distribution, with more groundside trips beginning or ending in the city centre, rail would be significantly faster than road for the majority of travellers. This is evident from a consideration of the travel times between city and airport, which would be as follows:

- by road — 74 minutes
- by rail via St Marys — 62 minutes
- by rail via Glenfield — 57 minutes.

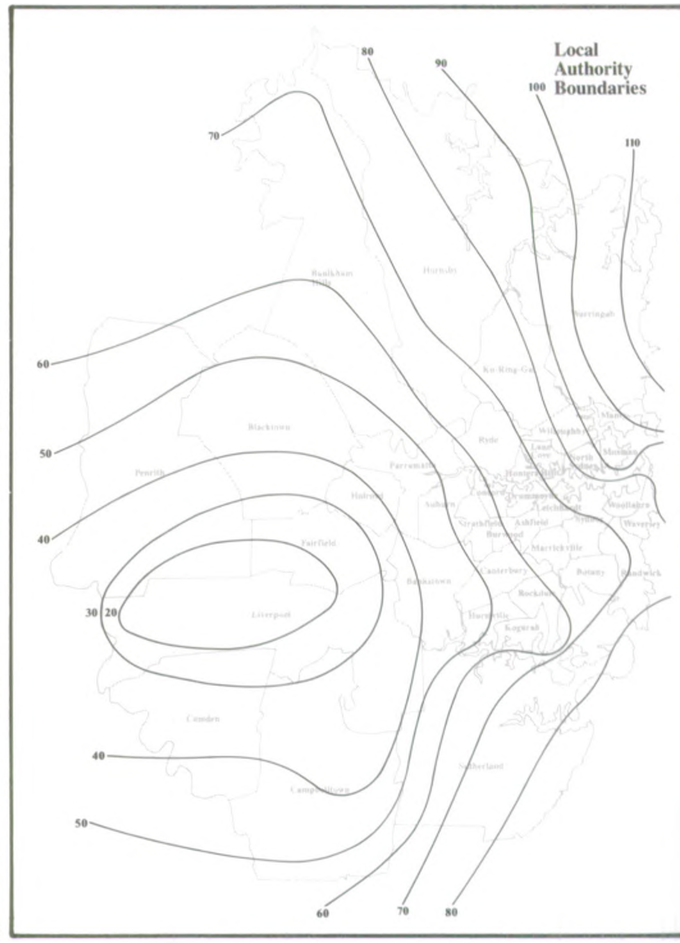
A more concentrated distribution of groundside origins and destinations would most likely arise if a higher proportion of air passengers were visitors than the present 59%. Visitors (other than those visiting friends and relatives) would also be more dependent on public transport, and rail patronage by air passengers would be higher for this reason.

Dispersed distribution

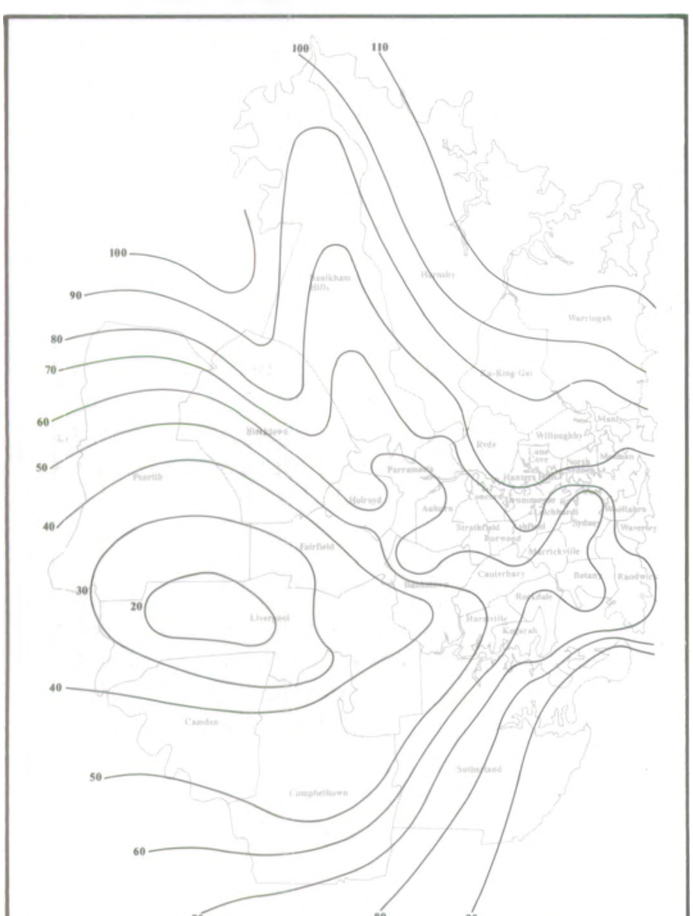
On the other hand, a more dispersed distribution of groundside origins and distributions might well arise if a higher proportion of air travellers using the airport were Sydney residents than at present. In this situation, overall average travel times by road would be less than by rail, and rail patronage by air travellers would overall be less.



BADGERYS CREEK VIA ST. MARYS RAIL TIMES (Minutes)



BADGERYS CREEK ROAD TIMES (Minutes)



BADGERYS CREEK VIA GLENFIELD RAIL TIMES (Minutes)

Figure 10.4.9 ESTIMATED FUTURE TRAVEL TIMES BADGERYS CREEK

High speed ground transport

Several high speed systems have been suggested for access to a second Sydney airport. These include:

- high speed roads
- XPT-type train services
- a Trans-rapid Maglev system
- the high speed railway scheme recently put forward by CSIRO.

While the analysis of airport access in this Draft Environmental Impact Statement has assumed conventional transport systems, the conclusions are not likely to be significantly affected by the possible introduction of high speed road or rail systems. The reasons are as follows:

- even when fully developed, a second Sydney airport would not by itself generate sufficient groundside traffic to justify heavy capital investment in a high speed rail or road route;

- even if a high speed rail or road route could be justified on wider economic grounds, it would only benefit a proportion of air travellers according to the location of their groundside origins or destinations (for example, if a high speed rail service made no stops between the city centre and the airport, only about two-thirds of those air travellers using the service would have significantly faster travel times);

- comparative travel time is only one of a number of factors affecting an air traveller's choice between rail and road access modes, other factors being whether or not the traveller is being met, whether he or she has a vehicle in Sydney, is travelling alone or accompanied, can afford a taxi, has a lot of baggage, and what his or her attitudes are to public transport.

If feasible, high speed road and rail access systems would certainly provide a time saving to many air travellers. However, taking the distribution of groundside origins and destinations into account, the improvement in the overall average ground travel time of air passengers would be perhaps several minutes, and at a substantial cost, which would be borne in part by the air traveller.

10.5 INFRASTRUCTURE AND ENERGY CONSUMPTION

This section gives an account of existing infrastructure that would be affected by selection of the Badgerys Creek site for airport development, and describes in general terms the infrastructure and energy resources that would be needed to support a second airport. The assessment of effects associated with specific infrastructure proposals would require further investigation once the sites or routes for these facilities were determined.

Information for this section has been obtained from the Electricity Commission of New South Wales, the Australian Gas Light Company, the Metropolitan Water Sewerage and Drainage Board, Telecom Australia, and the Metropolitan Waste Disposal Authority. The Department of Aviation, and commercial suppliers of electricity, gas and other services have provided information on energy and fuel consumption at Kingsford-Smith Airport, as a guide to requirements at a second major airport.

Figure 10.5.1 shows the location of various infrastructure services in relation to the proposed site.

10.5.1 Electricity

Existing service

At present several electricity supply lines traverse the proposed site. The major one is the Sydney West—Yass 330 kV transmission line which crosses a 3.2 km section of the site just south of the north-western boundary. As part of its continuing augmentation of the interconnected State grid system, the Electricity Commission intends to make this into a line carrying 500 kV and divert it to the Kemps Creek substation. The Commission has already investigated several possible routes for the diversion.

A number of domestic lines also traverse the site, supplying power to existing residences.

Proposed service

If a second airport were to be located on the site, the Electricity Commission would be obliged to use an alternative more southerly route than that currently proposed along which to divert the 330 kV transmission line to the Kemps Creek substation. This alternative route was one of those previously investigated by the Electricity Commission, but it was assessed as being longer, more expensive and having greater adverse environmental impact than the one at present preferred.

The Commission also uses power lines for transmitting control signals and associated conversation, and this could affect the operation of some navigational aids proposed for the airport. The final positioning of the relocated transmission lines and of the navigational aids would therefore need to be considered jointly, in order to avoid such potential conflict.

The Department of Aviation would inform the Electricity Commission as soon as a decision on a second Sydney airport site had been made so that, if Badgerys Creek were selected, planning and design of the proposed 500 kV transmission line could begin as early as possible, and so avoid unnecessarily disrupting bulk power supplies in south-western New South Wales.

The disconnection and removal of domestic supply lines within the site would be carried out after the present land owners had been relocated and so would not cause any major disruption.

10.5.2 Water supply

Since the site is in an area not served by a reticulated water supply nor scheduled to receive one in the near future, provision of a water supply for a future airport and adjacent development would require the construction of a new system consisting of a water treatment plant, pumping station and water mains.

The second airport's possible maximum water requirements have been assessed on the basis of a level of development similar to that at Kingsford-Smith Airport, except that facilities for major aircraft maintenance and large-scale catering are not likely to be provided there. Requirements for tourist, transport, warehouse and light industrial developments adjoining the airport have been assessed as equivalent to those for a population of 10,000 people.

On this basis, an average of 3.8 ML of water per day would be required for the airport, with a maximum consumption of 9 ML/d and a maximum peak-hour consumption of 0.75 ML; the adjacent development would require an average of 6 ML/d, with a maximum consumption of 11 ML/d and a maximum peak-hour consumption of 0.83 ML. Special storage on the proposed site would be set aside for water that might be needed for fighting fires.

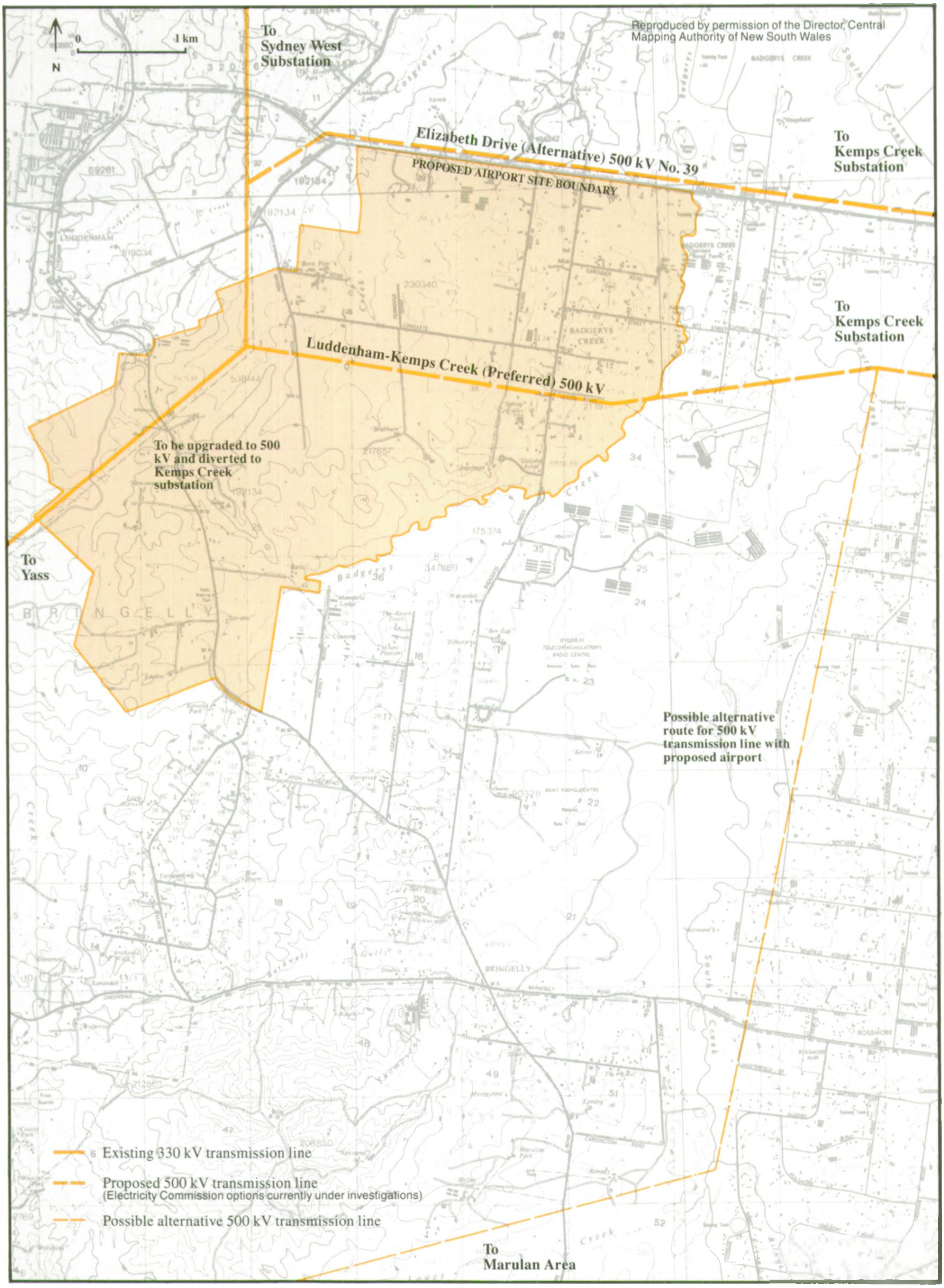


Figure 10.5.1
INFRASTRUCTURE

NOTE: Other possible options for 500 kV power transmission to the south-west of the state are also being investigated by the Electricity Commission and if Badgerys Creek is selected the upgrade of line No. 39 would be abandoned. However it would remain a 330 kV transmission line and would need to be relocated further to the west to avoid the proposed airport site.

Water requirements for the airport and adjacent development would be supplied from the Warragamba Dam via the Warragamba—Prospect pipeline. The facilities needed would include:

- a connection to the Warragamba—Prospect pipeline, and a water treatment plant and pumping station which would be either partly or wholly constructed within the Warragamba—Prospect pipeline easement;
- a reservoir on high land close to the pipeline;
- a rising main from the pumping station to the reservoir, and an outlet main from the reservoir to the airport site, both of which would be laid within the boundaries of existing road reservations.

The Metropolitan Water Sewerage and Drainage Board has indicated that it would need to be provided with the financial or material resources to design and construct these facilities, because its own resources are fully committed in servicing areas to be released under the New South Wales Government's Urban Development Program. As soon as a decision had been made on construction of a second airport, arrangements would therefore need to be agreed on between the Commonwealth and the State, to enable adequate and timely provision of such services.

10.5.3 Sewerage

At present there are no sewage treatment schemes in the vicinity of the site and none is scheduled under short to medium-term urban development proposals. Hence a second airport and the surrounding development would require construction of a new sewerage facility. A site for a new water pollution control plant might have to be selected at some distance from the airport if it were to serve both the airport and the surrounding development. The plant would have to be constructed in stages, and the size of each stage and of the total plant would depend on the rate of airport development and of the surrounding areas that might be served by the same plant. Neither of these factors can yet be assessed, nor is it possible at this time to estimate effluent quantities. However, if it were ultimately sized for the maximum capacity of the airport (the worst case), and for the development in surrounding areas, then the equivalent population capacity of the plant would be 30,000, including 10,000 equivalent population for development in areas surrounding the airport.

While there is no definite proposal at this stage, it is assumed that treated effluent would be discharged into either South Creek or the Nepean River upstream of Wallacia. An alternative or supplementary method of disposing of treated effluent would be to use it as needed for irrigation purposes rather than discharging all of it into the river system. This method would also be considered, particularly if the water pollution control plant were located within the airport site and served only the airport development.

10.5.4 Telecommunications

Existing services

Telecommunication services to existing residences would remain in operation while the residents continued to live there. When the houses were acquired by the Commonwealth Government and the residents moved, the services would be disconnected and removed from the site.

Proposed facilities

If an airport were constructed on the proposed site, more telecommunications facilities would be needed in the area to deal with the increased amount of telecommunications traffic and ensure that it did not disrupt existing services. However, because of the rapid changes being made in telecommunications technology, little is known about the type of facilities that would suit a future airport. There is some speculation that cable easements would not be required, as communication dishes and satellites would be used instead. However, if such easements were required, it is expected that they would be incorporated within existing road corridors.

10.5.5 Waste disposal

The second airport at maximum development would generate about 16,000 m^3 of solid waste weekly, which would be disposed of in regional waste disposal sites operated by the Metropolitan Waste Disposal Authority.

10.5.6 Energy consumption

The energy requirements of a second airport cannot be accurately estimated at this stage, but it is possible to provide some indication, based on past and present consumption of electricity, liquid fuel and gas at Kingsford-Smith Airport (Table 10.5.1).

Table 10.5.1 Energy and fuel consumption at Kingsford-Smith Airport

	Consumption					
Component	Domestic	International	Department of Aviation	Maintenance and cargo facilities	Miscellaneous	Total
Electricity (kW.h) July 1983-July 1984	13,690,393 262,307*	5,725,017	21,133,785	42,950,142	596,043	84,357,687
Gas** (MJ) Dec. 1983-Dec. 1984	14,800,000	n.a.	49,348,000	n.a.	n.a.	64,148,000
Aviation fuel (L) Jan. 1984-Jan. 1985	192,733,802+	560,681,399	n.a.	n.a.	n.a.	753,415,201
Vehicles Diesel fuel (L) Jan. 1984-Jan. 1985	253,217	500,000	105,558	n.a.	n.a.	858,775
Petrol (L) Jan. 1984-Jan. 1985	972,497	752,000	201,358	n.a.	n.a.	1,925,855

* Separate consumption for general aviation.
** Does not include 186,790,000 MJ consumed by Qantas Cookhouse.
+ Includes fuel for general aviation.
n.a. Not applicable.

As the proposed site is close to electricity and gas services, no major extensions to the existing infrastructure would be needed. Diesel and petrol could be transported by road from Sydney and stored in distribution facilities within the site, in compliance with the provisions of the Dangerous Goods Act, 1975.

10.6 LANDSCAPE AND VISUAL QUALITY

This section discusses the results of the assessment made of the landscape character and relative visual quality of the proposed site. The method of assessment was based on that developed by the United States Department of Agriculture's Forest Service (1974) and modified by the Department of Environment and Planning (1981). It involves the identification of topographic units within the proposed site (as the determinants of landscape character), and the evaluation of their relative visual qualities based on generally accepted community visual preferences or responses. However, it is recognized that individual response to the visual quality of a landscape is subjective and in some instances may differ from this generalized assessment.

The landscape character of a site can be described in terms of the landform (terrain/topography), the land cover (vegetation type and land use), and the water form (drainage). In expansive landscapes, particular landscape zones can also be identified, such as a coast zone, mountain region, or plateau. The visual quality of these landscape features when compared with the surrounding region can be categorized as follows:

- distinctive (unusual and superior);
- common (ordinary and widespread);
- minimal (inferior).

10.6.1 Landscape features

The proposed site is located in a transitional landscape zone between the relatively flat Cumberland Plain and the footslopes that rise to the Blue Mountains Plateau. There is about a 75 m range in elevation within the site, which comprises a number of different landform features. About 30% of the site is classed as being flat and about 65% as having gently sloping terrain, while the remaining 5% is moderately steeply sloping. About 90% has been cleared and nearly 90% of this cleared land is currently being used for agricultural enterprises while the remainder is either being used for rural residential purposes or has been left vacant.

Only isolated areas of eucalypt woodland remain, principally in small clumps along roads and drainage lines. There are, however, two relatively large clumps of partially cleared woodland between Anton Road and The Northern Road and there is another smaller clump occurring around the village area of Badgerys Creek.

There is a fairly dense drainage network within the site, consisting of about 25 km of creeks. The flows in about 18 km of the upstream portions of these creeks are intermittent, generally occurring only after heavy rain. There are also about 115 farm dams scattered throughout the site, with a combined water area of between 80 and 100 ha. This gives an average density of about 6.5 dams per 100 ha, although there is a lesser concentration of water bodies in the central area of the site. In addition, there is a section of Badgerys Creek consisting of about 7 km that forms the site's eastern and southern boundary; this generally contains permanent water except for a 1 km length immediately downstream of The Northern Road.

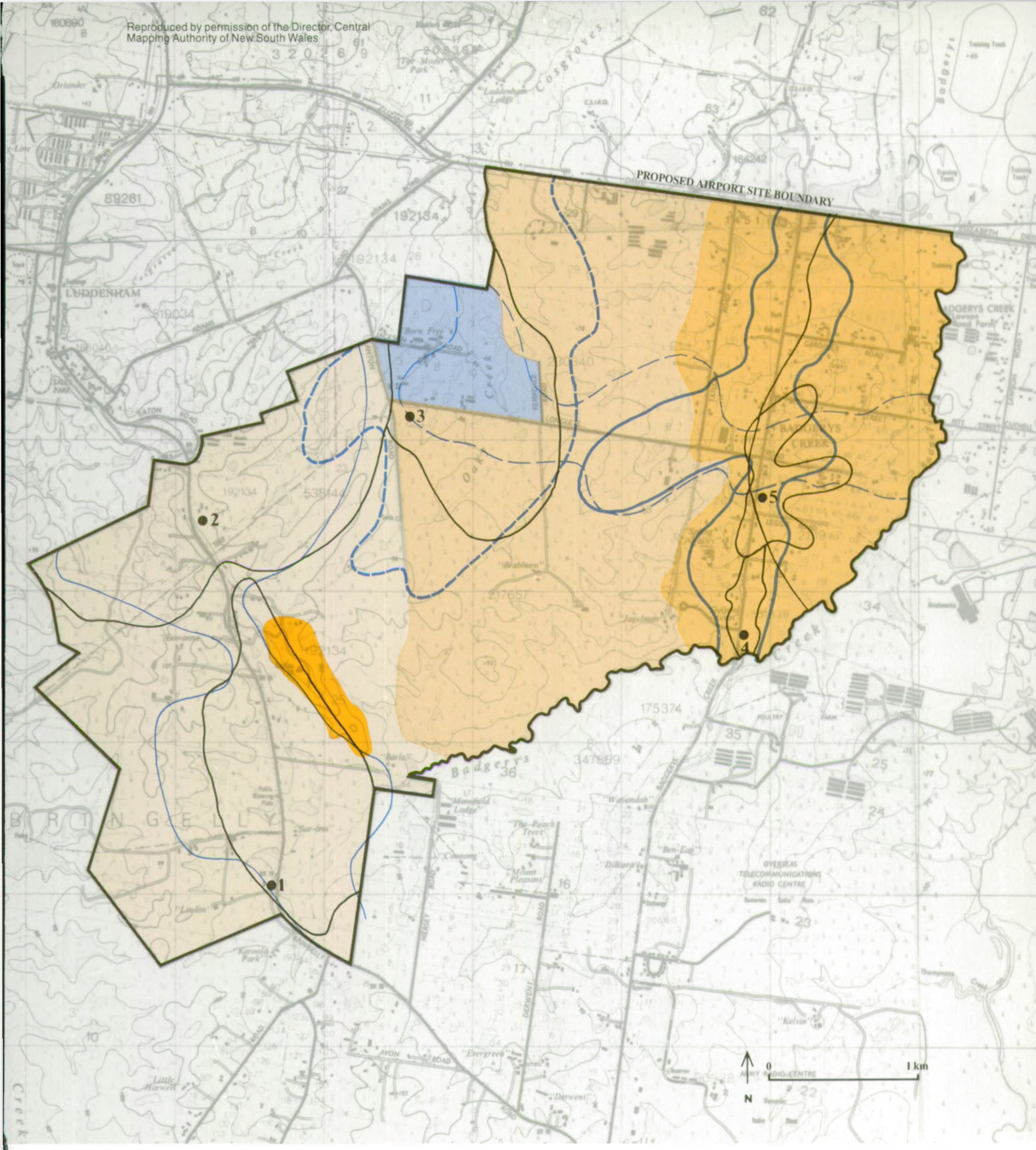
10.6.2 Visual quality

Five viewing points along roads within the proposed site as well as one viewing point on Lawson Road outside the boundary were selected for analysis, in order to identify the important elements contributing to the visual landscape character of the site. These viewing points, which are plotted on Figure 10.6.1, were analysed with respect to the following criteria:

- observer positions
- dominant distance relationships
- form and contrast
- spatial definition
- landscape composition types.

The viewing points were selected because of some distinctive feature, such as high ground or varied landscape components, in order to obtain a representative sample of the site's visual elements. The visual catchments of these viewing points were then mapped, as were the visual catchments of the various roads passing through the site.

Viewpoints 1, 2 and 3 in the western portion of the site give relatively expansive views of the site (beyond 1 km), reflecting the generally higher elevations in this area. The other two viewing points within the site, 4 and 5, have more contained views because of the relative flatness of these locations and the denser pattern of nearby housing development and small clumps of vegetation.



Landscape character			Visual quality
Landform	**Waterform**	**Landcover**	
Ridge	—	Partially vegetated	Distinctive
Undulating and sloping	Creeks and numerous artificial water bodies	Intensively developed rural grazing, sparsely vegetated	Common
Flat, sloping	Numerous drainage swales and scattered artificial water bodies	Rural residential	
and		Intensive agriculture and grazing	Minimal
undulating		Extensive grazing	

VISUAL CATCHMENTS

- Badgerys Creek Road
- Longleys Road
- Anton Road
- The Northern Road
- ●1 Location of viewing point
- Visual catchment from viewing point

Figure 10.6.1 LANDSCAPE CHARACTER AND VISUAL QUALITY

Views of the site from outside its boundaries are difficult to obtain because of the nature of the surrounding terrain and the difficulty of access to high vantage points. Viewpoint 6 is located outside the eastern boundary of the site, about 20 m north of the intersection of Cuthell Road and Lawson Road. While this provides an elevated viewing position, the only area of the site visible from there is the portion approximately between Badgerys Creek Road and Badgerys Creek. Viewpoints beyond the western boundary were also examined in order to determine what portions of the site could be seen from elevated distant viewpoints. However, the views obtainable from the various locations show only a small portion of the western part of the site, as a ridge precludes views to the east beyond its skyline.

Figure 10.6.1 also shows the classification of the landscape features and their visual quality based on an analysis of the views from the six viewing points and an assessment of the proportion of each landscape feature within the proposed site. The only visually distinctive feature within the site is the strong ridge line which extends from Luddenham towards the south-east; this feature represents less than 2% of the site area. About 4% of the proposed site has been classified as having a relatively common visual quality: this area comprises a small valley used for intensive rural activity (horse agistment farms) in gently sloping and undulating terrain, with some scattered trees and a number of dams.

The remainder of the proposed site has been divided into three landscape zones which all have minimal visual quality. The easternmost zone comprises rural residential development on generally flat or gently sloping terrain. The central zone comprises a largely cleared area which is used in part for cattle grazing and other agricultural activities of low intensity, while the westernmost zone comprises a mixture of agricultural uses at a relatively high activity density. Table 10.6.1 summarizes the site's landscape character.

Table 10.6.1 Landscape character of the proposed site

Landscape feature			Visual quality	Proportion of site	
Landform	Water form	Land cover		Hectares	%
Ridge, 30 m elevation range		Partially vegetated	Distinctive	30	2.0
Undulating and gently sloping, 15 m elevation range	Creeks and artificial water bodies	Intensive rural grazing, sparsely vegetated	Common	70	4.0
Flat to gently sloping, 20 m elevation range	Small artificial water bodies	Rural residential and hobby farming	Minimal	410	23.0
Flat to gently sloping, 30 m elevation range	Relatively large artificial water bodies	Cleared grazing land	Minimal	695	39.0
Sloping and undulating terrain, 35 m elevation range	Relatively large artificial water bodies	Intensive agriculture and rural residential	Minimal	565	32.0

From the information in Table 10.6.1 and the analysis of the landscape from the selected viewing points, it is apparent that the proposed site does not contain large areas of significant or prominent features that can be seen from public roads in the area. The only relatively distinctive feature — the ridge feature extending south-east from the village of Luddenham — would not be classed as distinctive when compared with the adjacent mountain landscape features further to the west.

This assessment generally accords with the broader assessment made by the Department of Environment and Planning (1984) in which the Nepean River and the Lapstone Monocline were identified as being regional landscape features of distinctive visual quality while large parts of the Cumberland Plain were considered as having a common or minimal visual quality.

10.6.3 Future built form

The preliminary master plan for the future airport (Figure 8.3) comprises two widely spaced runways, one 2,500 m and the other 4,000 m long, with associated approach lighting and taxiways. The runways are spaced 1,660 m apart, with the area between reserved for passenger terminal development, car parks and airport apron areas. A limited number of sites would be available for commercial development such as hotels and other airport related services. Separate areas for freight handling, aircraft maintenance and general aviation would be provided outside the area between the two runways. The master plan also incorporates areas for additional facilities located around the perimeter of the site, including navigational aids, control tower, fire stations and fuel storage and distribution facilities.

Most structures would have a relatively low profile to avoid creating height obstacles in the operational airspace around the runways. The tallest structure would be the control tower.

10.6.4 Assessment of impacts and safeguards

If the present land use and management practices were continued during the acquisition phase and up to the time of airport construction, the site could be maintained in its current condition. If, however, these were discontinued, then parts of the site might become temporarily downgraded until construction began.

During the construction phase, most of the site would be cleared of vegetation and of existing structures, and earthworks would level much of the high ground. To minimize the visual effects of site clearing and development during the construction phase, the following measures would be adopted:

- wherever possible a screen of vegetation would be provided or maintained around those parts of the site perimeter from which major site clearing and construction would be visible to the public;

- rehabilitation and landscaping of disturbed areas would be undertaken within the framework of the construction schedule.

The site's landscape and visual character would be irreversibly altered by airport construction, as it would be transformed from its present varied form to one which had marked linear and block built forms surrounded by rural landscapes on all sides. These forms would dominate the landscape when viewed from the air, but would be made aesthetically acceptable when viewed from ground level by careful design and extensive landscaping and tree planting around major buildings and car parks.

CHAPTER 11

The Biological Environment and Effects of the Proposal

Introduction

This chapter describes the flora and fauna at the proposed site, assesses the impact of site acquisition and airport development, and outlines environmental safeguards and monitoring proposals.

11.1 FLORA

The proposed airport site at Badgerys Creek consists largely of cleared agricultural land and areas of rural residential development, with only small scattered stands of vegetation in which native species are common. The flora on the site was assessed in order to:

- prepare a vegetation map;
- identify the plant communities present;
- nominate which, if any, of the species or communities could be considered rare or endangered;
- assess the impact on the native flora of the area of the proposed acquisition and of airport development;
- indicate appropriate measures to safeguard the flora or to mitigate the impact;
- determine whether any further studies or monitoring programmes were necessary.

After inspection of aerial photographs, the main areas of native vegetation were identified and mapped. Site visits were conducted, and those areas identified on the aerial photographs as supporting stands of native vegetation were assessed. At each location, the vegetation was classified according to the dominant species present; a list of all plants found was then compiled. Remnant strips of native vegetation along roadsides throughout the area were also examined.

Species were identified on site by reference to Beadle et al. (1982) and, where this proved impossible or uncertain, specimens of plants were collected for identification in the laboratory or by the National Herbarium of New South Wales. Specimens of species regarded as rare or endangered were collected for verification by the Herbarium. The conservation status of species was determined by reference to Leigh et al. (1981) and Benson (1980), and to the staff of the Herbarium.

11.1.1 Description of existing flora on the proposed site

The remnant stands of native vegetation occupy less than 10% of the site area (Figure 11.1.1), and are moderately to heavily disturbed. The largest single stand, of about 50 ha, is located beside Anton Road. A strip of vegetation lines the channel of Badgerys Creek, which skirts the site on its western and southern edges, and this area of about 30 ha contains a number of native plants.

Vegetation types

Two vegetation types were recognized within the proposed site on the basis of aerial photography and inspection. The distribution of the types is shown in Figure 11.1.1 and a comprehensive species list for both types is provided in Appendix D.

- **Type 1 (remnant grey box—red gum woodland):** Some remnants of native vegetation on the site occur in woodland form (i.e. with a canopy of trees), indicating either that the area has never been cleared or, more usually, that it was cleared at some time in the past and there has been some regrowth. These remnant woodland areas are dominated by Eucalyptus moluccana (grey box) and E. tereticornis (forest red gum). Other occasionally occurring tree species include E. amplifolia (cabbage gum), E. eugenioides (thin-leaved stringybark) and Angophora floribunda (roughbarked apple) along Badgerys Creek, and the ironbarks, E. crebra and E. fibrosa, on the higher ground. Bosisto's box (E. bosistoana) also occurs here (D. Benson, National Herbarium of New South Wales, pers. com.).

  These woodland remnants fall within map unit 10C (E. moluccana—E. tereticornis woodland) of Benson (1980). The only substantial occurrences in the survey area have been mapped and are shown in Figure 11.1.1.

  Except along Badgerys Creek, the understorey is usually dominated by Bursaria spinosa (native blackthorn) and Dillwynia juniperina. Badgerys Creek supports a relatively dense understorey dominated by Melaleuca styphelioides (prickly-leaved teatree) and Casuarina glauca (swamp oak).

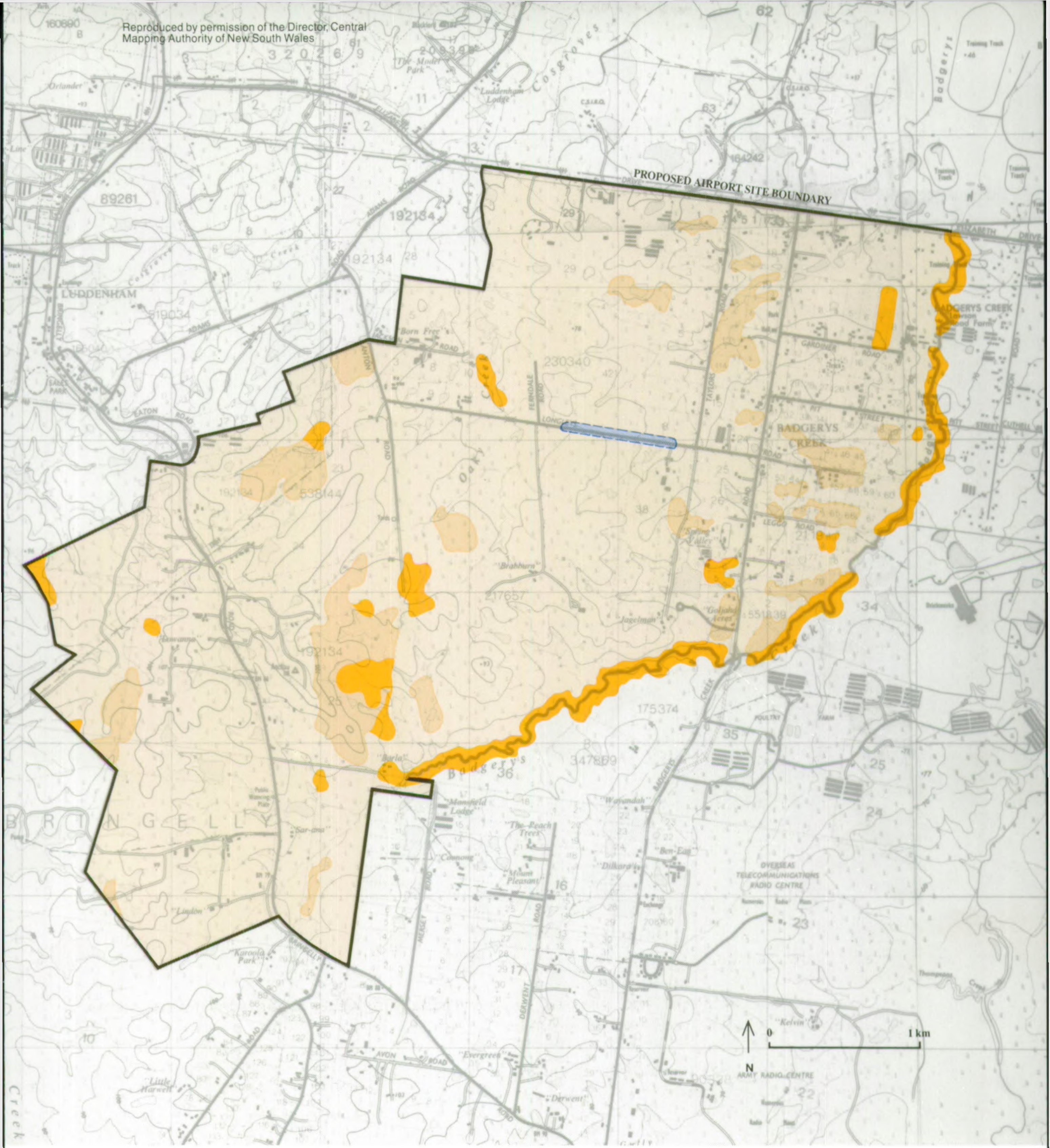
  A groundcover of forbs and grasses occurs throughout the areas supporting some native plants. Introduced plants are abundant.

- **Type 2 (cleared areas: shrubland and grasslands):** On most of the site the tree canopy has been removed, although scattered individuals or clusters of the tree species mentioned in Type 1 remain. For the most part, the cleared areas contain introduced species but occasional small native plants can be found, especially in ungrazed areas such as along the margins of roads. Native species occurring in these cleared areas include Bursaria spinosa (native blackthorn), Dillwynia juniperina, and one population of the rare pea-flowered shrub, Pultenaea parviflora.

Significance of the vegetation types

None of the areas examined on or near the proposed airport site could be described as an authentic remnant of the natural plant cover for this area, and consequently its floristic value is considered to be low. The Eucalyptus moluccana—E. tereticornis woodland is widely distributed in the Cumberland Basin, and samples are conserved in reserves such as the proposed Kemps Creek Nature Reserve.

The vegetation along the channel of Badgerys Creek helps to regulate water quality, by inhibiting the movement of solids and by utilizing nutrients.



Vegetation type 1 – remnant grey box/red gum woodland

Vegetation type 2 (partially cleared)

Cleared (pasture, agriculture, housing)

Pultenaea parviflora

Figure 11.1.1
VEGETATION TYPES

Plant species present

A total of seventy-one native species were recorded, and these are listed in Appendix D.

Significance and conservation status of the plant species

Only one plant species in the area is of significant conservation value. This is Pultenaea parviflora, of the pea family, Fabaceae, an erect shrub growing to 1 m high, with small leaves and flowers. About thirty plants were noted, occurring near the middle of the site in a small strip each side of Longleys Road between Ferndale Road and Taylors Road. No others were found within the site or local environs, and although some may occur on nearby farmland it is unlikely.

Leigh et al. (1981) classify P. parviflora as 3V, 'a rare species in small populations but occurring over a wide area. Often restricted to specific habitats. Vulnerable; not presently endangered but at risk over a long period or if land use patterns are introduced which would be deleterious to the species'.

Perceived trends in the absence of airport development

Current land use in the area is inimical to the long-term survival of native vegetation; existing stands have been greatly modified by fire, clearing, grazing, cultivation and weed infestation, resulting in the loss of many plant species. This process can be expected to continue.

11.1.2 Assessment of effects and safeguards

This assessment of effects is confined to the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further investigation once the locations for these facilities were determined.

No adverse effects on the flora are envisaged specifically as a result of land acquisition, but the small population of Pultenaea parviflora along Longleys Road would remain vulnerable. However, airport construction would result in the clearing of most, if not all, of the existing stands of native plants on the proposed site, and would thus destroy the only community of P. parviflora in the area. Off-site clearance would not be undertaken unless it was necessary for aircraft safety in order to maintain flight clearance levels. With the exception of P. parviflora, the removal of vegetation cover on the site could not be considered a significant loss to the flora of the region. Nevertheless, even small stands of native plants can contribute to the floristic character of an area and may be important components of the habitat of other organisms such as birds and invertebrates (Key 1978).

The creek-fringing plants, which have some value in helping to regulate water quality, would be threatened if earth-moving activities during construction were to cause siltation of Badgerys Creek. Similarly, during airport operation, any rapid discharge of stormwater from unvegetated surfaces (which might be contaminated with solids, hydrocarbons, and so on) could cause risks of erosion and pollution to Badgerys Creek, with consequent damage to the vegetation. However, it is expected that the proposed drainage scheme (Section 10.2) would discharge water along Badgerys Creek at flow rates similar to those at present experienced, and that the safeguards envisaged in the drainage scheme would prevent siltation, erosion or pollution of the creek.

To some extent, the floristic composition of the site could be restored by landscape plantings. Plants used would be chosen from the species list (Appendix D), or from other species known to occur in similar vegetation types in the district.

In the long term, the preservation of P. parviflora would require its inclusion in adequate numbers within reserves. However, preservation of the plants on the site would also be attempted, and would require the following steps:

- Some years prior to airport construction, a regular collection of seeds from the population would be started, in order to serve as possible propagules in case the existing plants die; they would be deposited with the National Herbarium of New South Wales.

- Immediately prior to construction, the existing plants would be removed intact to a place where horticultural care could be provided until they could be replanted on site. Sufficient soil (possibly 1-2 m^3 per plant) would be taken with them to prevent root damage during movement and to sustain their growth indefinitely.

- When the plants were eventually replaced on the site, it would be in a location affording them protection from vehicular traffic and human interference.

Measures would be taken during airport construction and operation to protect the vegetation lining Badgerys Creek. These measures are discussed in Section 10.2.

11.2 FAUNA

This section describes the results of the detailed faunal survey of the proposed airport site and its environs at Badgerys Creek. This investigation was carried out in order to establish the distribution, status and habitat preferences of any terrestrial vertebrates located; to determine whether any rare or endangered species were present; and to estimate the ecological value of each wildlife habitat.

The survey area (Figure 11.2.1) was divided into several habitats and each was sampled for fauna. Methods of location included general observation, identification of tracks, spotlighting transects, and analysis of frog calls. It was difficult to get access to much of the cleared land, and sampling was not as intense there as in areas containing native trees or bodies of water.

During the survey of the site, it became apparent that dams provided an important habitat for avifauna. Consequently, the dams outside the survey area as well as those inside were inspected, the fauna using them was documented, and an assessment was made of the habitat of each one.

The inventory of fauna located was supplemented by published and unpublished observations made within and near the survey area. Records of fauna within the general Badgerys Creek region came from the Australian Museum, and from Zacuba Pty Ltd (1983) and Mulgoa Quarries Pty Ltd (1982 and 1983).

11.2.1 Description of the proposed site

Sixty per cent of the vegetation in the region is cultivated vegetation comprising temperate pasture, vegetables, orchards, etc., while 40% is discontinuous native vegetation (Laut et al. 1981). The proposed airport site has been largely cleared for farming and pasture, and contains only scattered remnants of the original natural vegetation associated with Wianamatta Shale, in the form primarily of woodland of grey box (Eucalyptus moluccana) and forest red gum (E. tereticornis).

Along Badgerys Creek there is still a thin strip of native vegetation, consisting of an open forest of broadleaved ironbark (E. fibrosa) and grey box, with some swamp oak (Casuarina glauca); however, it contains a high proportion of introduced weeds such as blackberry and wandering jew. This remnant vegetation is described in detail in Section 11.1.

Description of wildlife habitats

For the purpose of the faunal survey, the following categories of habitat within the survey area were used:

- **Creek:** The creek habitat consists of the stream bed of Badgerys Creek and the surrounding vegetation, which is a mixture of eucalypt and casuarina with an understorey of saplings, shrubs, grasses and weeds. In many places it has been cleared for stock watering points, and generally the habitat could be classed as moderately disturbed. The water within the creek is eutrophic in many places, and the stream bed is littered with rubbish such as car bodies and industrial waste. There was no water flow apparent at the time of sampling.

- **Woodland:** There are several remnants of the original timber cover: these occur as small clumps of trees or scattered shade trees within paddocks, and as strips of trees along roads and fences. All are disturbed and, because of grazing by stock, there is little middle and lower storey vegetation except for wattles and grass. Both creek and woodland habitats are classed as vegetation type 1 in Section 11.1.

- **Paddock:** The major habitat is cleared agricultural and grazing land, supporting market and flower gardens, orchards and poultry farms, as well as small farms raising cattle, horses, donkeys, goats and sheep. There is also some residential development. The paddock habitat is classed as vegetation type 2 in Section 11.1.

- **Dam:** The survey area contains a relatively large number of farm dams; most are long established and support a dense cover of shoreline vegetation such as reeds and rushes. The dams surveyed outside the proposed site are located mainly on properties north of Elizabeth Drive owned by CSIRO and the University of Sydney, and are similar in appearance to those within the survey area.

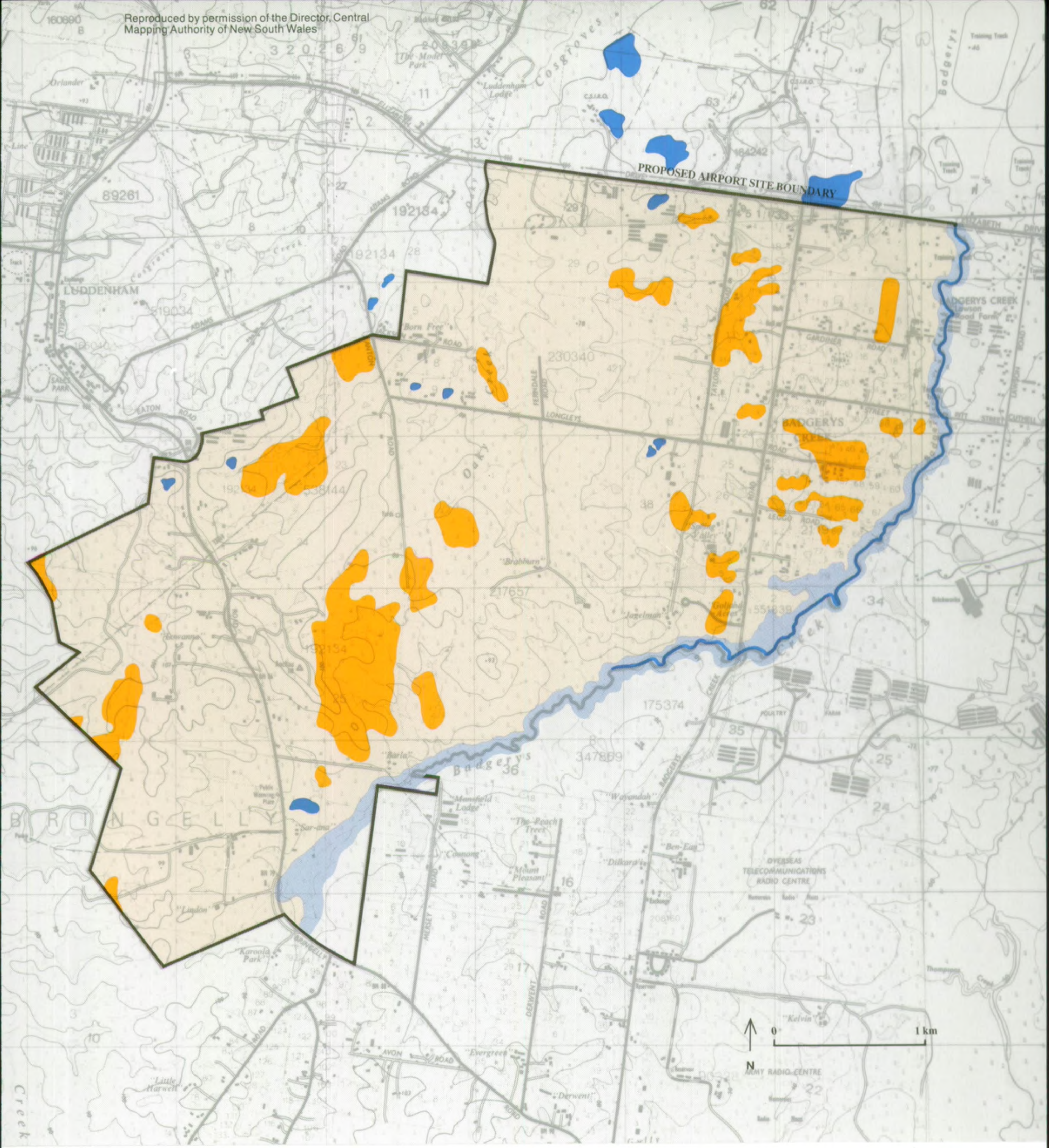
Faunal assemblage

Within the survey area, one native and seven introduced mammal species were located, as well as sixty-one bird, two amphibians and four reptile species (Appendices E, F and G). The native mammal located — the common brushtail possum — is a species well adapted to the urban environment. Two other native mammals are known from the region (common ringtail possum and sugar glider) but were not located. Two introduced rodents (house mouse and black rat) would also be expected.

The low diversity of species within the survey area reflects its disturbed nature. In nearby Mulgoa Valley, seventy-two bird species have been recorded, while at Wilton ninety-six bird species were located (Section 16.2). The presence of only the one native mammal and the seven introduced species also indicates the low natural productivity of the Badgerys Creek site.

The herpetofauna known from the survey area consists mainly of species well adapted to urban surroundings. Cogger (1962) points out that the garden skink (Lampropholis guichenoti) 'has been able to co-exist with man even in densely populated areas'. Although two snake species (eastern brown and carpet python) were recorded from the site, they would be rare there. However, a lace monitor was observed near a farm where there were several large dogs, thus indicating that larger reptiles can exist in the area.

A relatively large population (41%) of the avifauna comprised birds associated with water (Appendix F). This proportion is higher than usual, and indicates the importance of the wet areas within the survey site. Other bird species located consisted of avifauna



HABITAT TYPES

Creekline

Woodland

Paddock

SAMPLE SURVEY SITES

Dam

Spot lighting transect

Figure 11.2.1
WILDLIFE HABITATS AND SAMPLE SURVEY SITES

associated with grassland (Richard's pipit, brown skylark, golden-headed cisticola and little grassbird), timber (jacky winter and rufous whistler), and urban environments (Australian magpie, magpie-lark and common starling). Several small foliage birds (thornbills and wrens) were located within areas containing dense middle and lower storey vegetation. Only one honeyeater, a little wattlebird, was located; the paucity of this bird group was probably a result of the low density of flowering shrubs and the fact that the trees were not in flower at the time of the survey.

Of the faunal species that could be expected in the survey area, many were not located. Nearby Mulgoa Valley has habitat similar to Badgerys Creek (shale vegetation) and it contains at least thirty-eight species of reptile and a higher number of birds and mammals.

Status

The majority of animals located within the survey area are classed as common or abundant. The one native mammal located is regarded as common throughout Australia (Strahan 1983), while all the species of amphibians and reptiles are widely distributed throughout eastern Australia.

All bird species located are classed as either moderately common, common, or abundant in Australia (Appendix F), although one, the introduced mallard, is regarded as uncommon in New South Wales. Within the County of Cumberland, some of the bird species located in the study area are considered to be uncommon or scarce, (Hindwood and McGill 1958). These are the darter, royal spoonbill, rufous night heron, mallard, black-winged stilt, galah and crested pigeon. However, none of these species is threatened and sightings are often reported within the region during the Sydney District Bird Count by the NSW Field Ornithologists Club.

The golden-headed cisticola has been classed as endangered in the Sydney region by Taylor (1984), and it has been suggested that the destruction of swamp vegetation is reducing its numbers in settled areas (Reader's Digest 1976). Despite this, it is regularly sighted throughout the County of Cumberland and is commonly found breeding within small areas of grassland in urban situations. At present, there is little evidence to class this bird as endangered in the Sydney Region, and in any case it is classed as abundant in New South Wales and Australia.

Habitat preferences

Although there were only slight differences in the faunal diversities of the four habitats sampled, the creek habitat contained the highest number of native species: twenty-three bird species were located in the creek habitat, while nineteen were found in the dam habitat, nineteen in the woodland and seventeen in the paddock habitat. The wide variety of niches in the creek habitat would encourage a high diversity of species.

If the numbers of bird species located in the dams both inside and outside the survey area are combined, then this habitat is by far the most important, with thirty-three species. There is a higher bird diversity associated with those dams outside the survey area than with those inside.

Ecological value

Many parameters are used to assess the ecological value of an area. However, those most important in terms of utilization by wildlife are based upon whether an area:

- has a high diversity of faunal species
- is used by rare or endangered species
- has potential habitat for scarce or important fauna.

The survey area at Badgerys Creek does not meet any of these criteria. There is a relatively low faunal diversity, no rare or endangered species are present, and there is little habitat with potential for supporting scarce or important species. It can be concluded that the proposed airport site at Badgerys Creek is of low ecological value.

11.2.2 Assessment of effects and safeguards

This assessment has been confined to assessing the impact of acquisition and airport development on faunal habitats within the site. Assessment of associated effects arising from clearance requirements for infrastructure corridors (for example for new road and rail access routes and power transmission lines) could not be undertaken until such time as the locations of these facilities were determined.

While acquisition of the proposed site would have no foreseeable effect on the fauna there would be some impacts from airport development, as construction would involve clearing a large area of the site. Most of the vegetation is introduced grassland, but there is a small amount of native vegetation, particularly along the creek itself, and if all this were cleared the habitat loss could affect many wildlife species.

Many animals displaced during development would probably not be successful in colonizing unfamiliar territories. This would apply particularly to animals dependent upon a specific habitat or area (Ewer 1968; Tyndale-Biscoe and Calaby 1975). However, within the Badgerys Creek site many of the wildlife species (including carrion feeders such as the magpie, Australian raven and some of the waterbirds) are not dependent upon specific habitats and can be classed as 'cosmopolitan', i.e. species capable of utilizing many habitats and/or areas. Such species are nomadic and utilize favourable habitats opportunistically. Thus their displacement should not cause as much impact as the displacement of species of more restricted habitat.

As no animal or bird species located on the site can be regarded as uncommon or scarce, airport construction would have little impact upon the overall status of the wildlife of the region. Moreover, since most of the Badgerys Creek area consists of cleared land which does not support a high diversity of species, the vegetation loss would not have any great impact. Similarly, the loss of the dams from the site would not noticeably affect the fauna; there was in fact a higher diversity of species found on dams outside the site than on dams inside.

The vegetation and wildlife habitats along Badgerys Creek could be affected by potential changes to its hydrology through airport development and there would be an increased risk of water pollution. It should be pointed out, however, that this creek is already polluted. Any major changes in water flow and quality might have some off-site effects upon South Creek, which, like Badgerys Creek, is fringed by a strip of moderately disturbed native vegetation. However, it too, contains polluted waters.

During airport operation, some species would recolonize the area. These would include birds adapted to urban conditions such as the introduced common starling, common mynah and spotted turtle-dove, and native birds such as the masked plover, Richard's pipit, black-faced cuckoo-shrike and brown thornbill. Van Tets (1969) listed seventy-one bird species located at Kingsford-Smith Airport, and it could be assumed that a proportion of these would be found at a future airport at Badgerys Creek. There is the possibility that collisions between aircraft and avifauna could occur in the vicinity of the airport, and might involve species such as raptors that have conservation value.

Ameliorative measures

Little could be done during the construction phase to reduce the impact of habitat loss. However, disturbance to fauna would be minimized by limiting the amount of clearing to that required for each stage of construction. Off-site clearance would not be undertaken unless it was necessary for aircraft safety in order to maintain flight clearance levels.

The area of native vegetation that fringes Badgerys Creek contains a relatively high diversity of animals and also acts as a corridor for wildlife moving between areas of preferred habitat: the Department would ensure, as far as possible, that this fringing vegetation along the creek would be preserved.

Landscaping would be designed to minimize the attraction to those birds that might be a hazard to aircraft. However, small birds such as honeyeaters might be expected to recolonize some of the native shrubs that would be planted on the site. The presence of such bird species is unlikely to seriously affect air traffic. The Department of Aviation would undertake a detailed and continuing assessment of the likelihood of bird/aircraft collision once the airport became operational and would implement whatever measures might be needed to minimize the hazards of bird strikes. The risk of accidents arising if herbivores strayed onto runways or taxiways should be slight, as the site would be fenced at the commencement of construction with a 2 m chain mesh fence.

Disruption of water flows and the risk of water pollution would be kept as low as possible through a water management policy described in Section 10.2. Baseline water-flow rates along Badgerys Creek would be measured prior to airport construction and these rates used as a basis for water release during airport operation. Retention of watercourse vegetation and some degree of water ponding would continue in the long term. Siltation of watercourses should not occur over the long term given the implementation of the soil conservation measures described in Section 10.1.

PART C

THE PROPOSAL AT WILTON

CHAPTER 12

Introduction to the Assessment of the Proposed Airport Site at Wilton

12.1 ASSESSMENT PROCESS

Following completion of the short-listing phase of the programme described in Part A of this Draft Environmental Impact Statement, Wilton was confirmed as one of the two short-listed sites to be selected for more detailed evaluation. This work involved the following steps:

- the assumptions for the worst case used in the short-listing phase (Chapter 4) were reviewed;
- additional runway orientations were investigated within the broad area in which the notional Wilton site was situated, and a specific site boundary was defined;
- a preliminary airport master plan was prepared, taking into account the requirements for airport facilities and airspace;
- a detailed environmental assessment was then undertaken in accordance with the Draft Environmental Impact Statement guidelines (Appendix A).

12.2 LOCATION OF THE PROPOSED WILTON SITE AND ITS ENVIRONS

The proposed airport site (Figure 12.1) is located in the Wollondilly local government area which is situated on the Woronora Plateau south of Campbelltown, about 81 km south-west of Sydney. The Shire of Wollondilly comprises about 2454 km^2 of relatively rugged forested land of which about 75% is designated Metropolitan Water Sewerage and Drainage Board protected catchment areas. It includes the villages and towns of Silverdale, Yanderra, The Oaks, Picton, Thirlmere, Tahmoor, Douglas Park and Appin, and scattered rural holdings around them. The adjacent local government areas include Camden, Liverpool, Wingecarribee, Campbelltown and Wollongong.

The proposed site is located south of the village of Wilton on the Woronora plateau at an average elevation of about 310 m above sea level. The plateau is incised by the drainage systems of numerous rivers including the Cordeaux River and Wallandoola Creek, which are situated to the west and east respectively of the proposed site. About 6 km to the south of the proposed site the elevation of the plateau is about 400 m, sloping downwards towards Wilton and dropping in elevation to about 200 m around the township. The plateau is relatively flat in the east—west direction although it does rises to about 450 m to the east near Darkes Forest. West of the proposed site the plateau does not rise substantially until beyond Bargo.

About 86% of the proposed site is situated within the Metropolitan Water Catchment and is controlled by the Metropolitan Water Sewerage and Drainage Board. The other 14% drains directly into Allens Creek, which eventually flows into the Nepean River just upstream of Douglas Park (Figure 12.1). The 1981 Census estimated a resident population for the Shire of Wollondilly of 19,830, giving an overall population density of 8.1 persons per square kilometre. However, most of this population is concentrated in small village areas and townships or is scattered among dispersed rural areas.

The major portion of the proposed site has been designated as Metropolitan Catchment since about 1880. A number of land grants were issued around the perimeter of the proposed site but were subsequently acquired by the Metropolitan Water Sewerage and Drainage Board. Some of the grants were used for agricultural activities but have since been abandoned and are currently managed as part of the Metropolitan Catchment.

The proposed site contains an abandoned airstrip, about 1500 m long, in approximately the same position and orientation as the long runway which forms part of the proposed airport master plan. This strip was built about 1940 as part of a series of fighter airstrips built during that time. The airstrip has recently been used by the Department of Main Roads as a testing area to assess the performance of different vehicle braking/slow down surfaces.

Part of the Sydney South to Dapto 330 kV steel tower transmission line crosses the eastern section of the proposed site in a north/south direction. About 2 km of line is within the proposed site area. In addition, about 2.5 km of wooden pole line is within the proposed site.

The most direct road access to the proposed site from the city is via the South-Western Freeway (F5) from Liverpool, exiting at the Picton—Wollongong interchange.

There is no direct rail access to the proposed site at present although the Maldon—Dombarton—Port Kembla railway line, which passes along the western boundary of the site, is under construction and could be duplicated in order to provide direct access to the proposed site.

Mount Keira Road, the main road to Wollongong, passes through the central portion of the proposed site for a distance of about 4 km. There are no other public roads within the site, although there are about 10 km of access tracks used by the Metropolitan Water Sewerage and Drainage Board personnel for patrolling and managing the Metropolitan Catchment Area. Some of those tracks are also used to provide access to the transmission lines which traverse the site.

The proposed airport site is surrounded on all sides, except for a small section of the northern boundary, by the designated Metropolitan Catchment area. The area immediately to the north is used for rural purposes and the village of Wilton is located about 5 km north of the proposed site.

12.3 RECENT BUSHFIRE

Between 2 and 6 March 1985, about 180 km^2 of bushland and rural farming land around the proposed airport site were burnt. The bushfire started in the vicinity of Pheasants Nest, and the initial fire-run spread eastward from the fire source; back-burning was carried out from southern and eastern areas of the burnt out bushland. The fire spread eastward as far as the Cataract Dam and southward as far as the Avon and Cordeaux Dams (Figure 12.2).

Figure 12.1 REGIONAL LOCATION

The intensity of the fire across the proposed airport site varied; the canopy did not ignite but in some areas leaves in the canopies of trees 20-30 m tall were desiccated and killed. On the other hand, in some places foliage less than 5 m from the ground survived, while patches of the site, particularly in the south, did not burn at all.

This fire is not expected to produce any significant impact on the flora in the long term. The plant communities would have been subjected to similar fires regularly for many thousands of years and their component species have evolved features that promote the survival of the species after fire. Some plants regenerate from underground storage organs or, in the case of some trees and large shrubs, from dormant buds protected beneath thick bark. Some other plants protect their seeds in fire-resistant woody capsules or produce hard-coated seeds that can survive in the ground for many years until stimulated by fire to germinate. Certain other species survive by colonizing sheltered habitats amongst rocks or in gorges.

The effects of the fire on fauna are likely to be more significant, at least in the short term. However, the Metropolitan Water Sewerage and Drainage Board has had a policy of low intensity burning in the catchment for many years and fauna appear to have adjusted well to this practice. It is expected that many of the fauna displaced by this most recent fire will recolonize the area after post-fire regeneration of flora.

12.4 STRUCTURE OF THE REPORT ON THE ENVIRONMENTAL ASSESSMENT OF THE WILTON SITE

The assessment of the Wilton site is contained in Part C of this document, comprising Chapters 12-16. These chapters describe the acquisition proposal as it relates to the Wilton site, and the environmental effects likely to arise from possible future development of a second Sydney airport at that site. Part C is structured as follows:

- **Chapter 12:** This introductory chapter provides the context for the subsequent discussion of the site assessment, and briefly describes the regional location of the proposed site at Wilton.

- **Chapter 13:** In this chapter, the proposed site area is described, the assumptions relating to the worst case are reviewed, and the preliminary master plan for possible future airport development based on this worst case is summarized.

- **Chapter 14:** This chapter, which is concerned with the socio-economic environment and the likely effects of the proposal, contains the following principal sections:

  - **Section 14.1** — a discussion of site acquisition procedures;

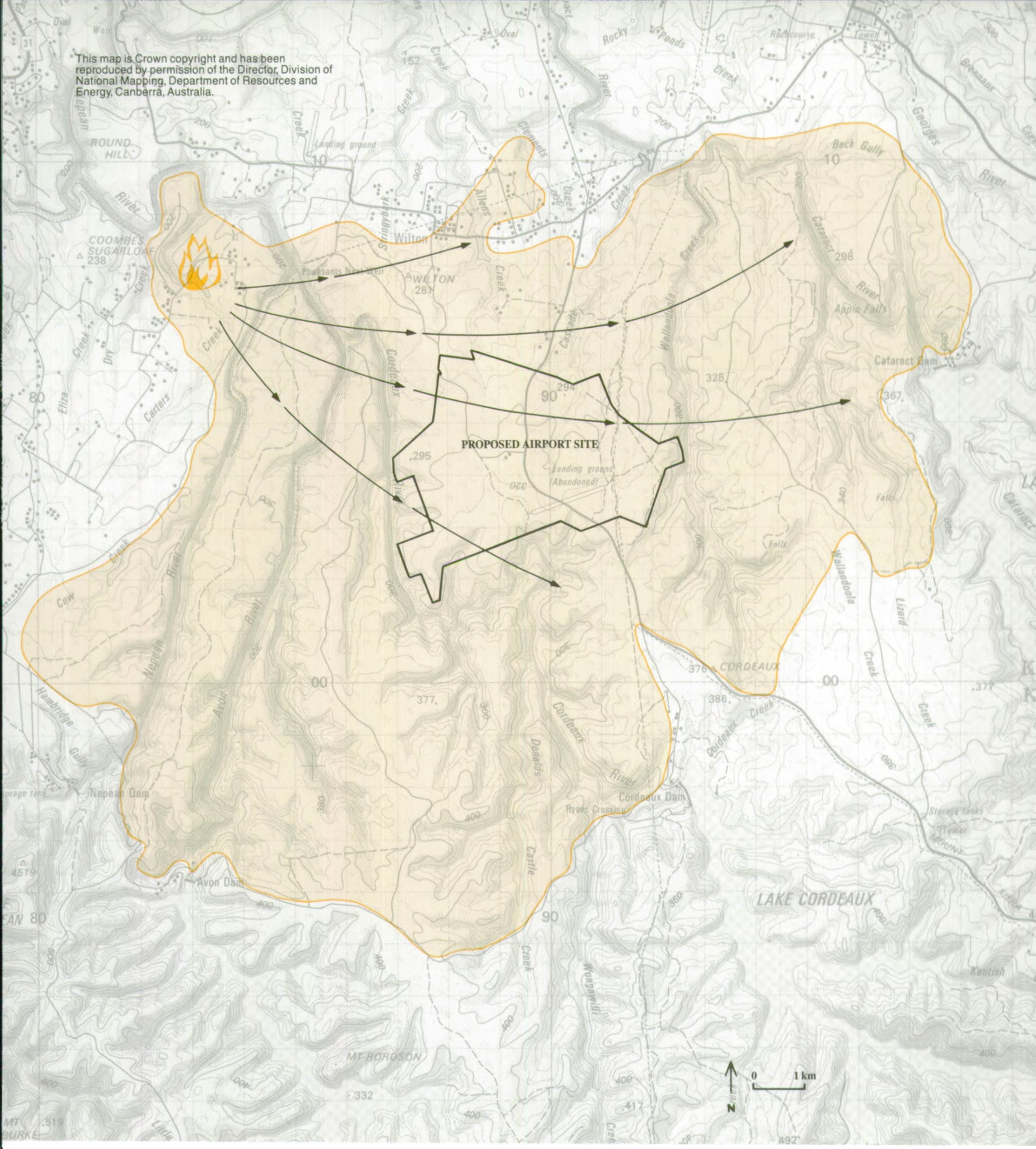
  - **Section 14.2** — a description of the extent of noise effects likely to be associated with future airport development at the proposed site;

  - **Section 14.3** — the conclusions of the archaeological assessment of the proposed site;

  - **Section 14.4** — an account of the views and concerns of Aboriginal people who may be affected by the acquisition of the site and future airport development there;

  - **Section 14.5** — an assessment of the European heritage of the proposed site;

  - **Section 14.6** — a description of the economic effects of acquisition, construction and operation of a second Sydney airport at the site;



Approximate extent of bushfire
2 March to 6 March 1985

Fire source

Initial fire front

Figure 12.2
EXTENT OF RECENT BUSHFIRE

- **Section 14.7** — an examination of the nature and extent of agricultural activities likely to be affected by site acquisition and future airport development.

- **Section 14.8** — an assessment of the implications for regional planning, particularly of those portions of the Macarthur and Sydney Western Sub-Regions that would be affected by the acquisition and future development of an airport at Wilton.

. **Chapter 15:** This chapter describes the physical environment of the Wilton site and the likely effects of the proposal on it. Like Chapter 14, it also contains a number of principal sections:

- **Section 15.1** — a description of the geology, soils and physiography of the site in terms of the site's suitability for future airport development;

- **Section 15.2** — an assessment of the effects of future airport development on drainage and water quality;

- **Section 15.3** — a discussion of the emission sources of airport related pollutants, and an assessment of the likely contribution of airport related emissions to Sydney's future total emissions;

- **Section 15.4** — an examination of the potential requirements for road and rail access in relation to the future development of an airport at the site;

- **Section 15.5** — an evaluation of infrastructural requirements associated with airport development (the relocation of existing infrastructure and the need for its extension and upgrading), and of the relative consumption of electricity and fuel;

- **Section 15.6** — an assessment of the landscape character and relative scenic quality of the proposed site both in its current state and after future airport development.

. **Chapter 16:** This chapter, which describes the biological environment and effects of the proposal, is divided into the following two sections:

- **Section 16.1** — a description of the flora within the site and the effects that future airport development would have on important species;

- **Section 16.2** — the results of the faunal survey of the proposed site and an assessment of the effects of airport development on important species and on the ecological value of wildlife habitats.

The sub-sections within Chapters 14, 15 and 16 have a common structure: the existing environment is described; the effects of acquisition of the proposed airport site, and of construction and operation of an airport are assessed; and environmental safeguards and monitoring programmes are proposed.

Following the assessment of the proposed Wilton site presented in Part C, and the similar assessment of the proposed Badgerys Creek site in Part B, a comparison of the characteristics and anticipated effects of airport development at these two sites is presented in Part D. This comparison follows the structure of Parts B and C, and includes a table which summarizes the information contained in each section of Parts B and C. No attempt is made to nominate a preferred site.

CHAPTER 13
Description of the Proposal at Wilton

13.1 PURPOSE OF THE PRELIMINARY MASTER PLAN

A preliminary airport master plan was prepared for the proposed airport site at Wilton in order to:

- define a site boundary for acquisition of property;
- provide a project definition (in terms of operational levels and physical characteristics) for a maximum level of future development at a second Sydney airport in sufficient detail to permit an assessment of the potential impacts at Wilton;
- predict noise contours based on this maximum level of development so that, if this site were finally selected, appropriate land use planning controls could be implemented to protect potentially noise-affected areas from further incompatible development;
- identify required airspace for a new airport so that, if this site were finally selected, this airspace could be reserved and necessary modifications planned in the existing airspace in order to avoid disruptions to the aviation system in the future;
- establish requirements for access to an airport at the site so that long-range planning could be undertaken.

This chapter describes this preliminary master plan. The plan is based on a set of two widely spaced parallel runways, one 4,000 m in length and the other 2,500 m, with a separation of 1,660 m between runways. This configuration was arrived at after considering four possible runway configurations developed during the short-listing phase, and airport operating parameters which the Department of Aviation believes will satisfy aviation requirements well into the future. The airspace requirements for operating a second Sydney airport are also described.

13.2 THE PROPOSED AIRPORT SITE

The proposed airport site (Figure 13.1) is 1,440 ha in area. There are eighteen separate land titles within the site boundary, most of which are held by the Crown or the

Metropolitan Water Sewerage and Drainage Board. There are no residences on the site. The proposed site boundary, except for a small portion which falls outside the Metropolitan Catchment, is defined largely by physical and topographical features and broadly follows the perimeters of the plateau surface and the valleys of the incised rivers and creeks. The small portion of the boundary that is outside the Metropolitan Catchment area extends westward from a point about 1,200 m south of Lisa Road to intersect with Allens Creek. The boundary then extends to the south along the creek for about 200 m, and thence westward again until it reaches the Metropolitan Catchment boundary.

About 1,245 ha (86%) of the proposed site is within the Metropolitan Catchment. Of the remaining 195 ha, approximately 75% is privately owned, with the balance held by the Metropolitan Water Sewerage and Drainage Board.

Where possible, potential property severance has been kept to a minimum. However, some severance of holdings would be necessary along part of the boundary owing to the Commonwealth's obligation to acquire only the land that is needed for Commonwealth purposes.

The method of acquiring the finally selected site, together with the related compensation procedures, are described in Section 14.1. Once the selected site has been announced, the processes for acquiring the site under Commonwealth acquisition procedures would commence. Properties within the site would be acquired either by agreement or by compulsory process.

13.3 PRELIMINARY MASTER PLAN ASSUMPTIONS

The assumptions used during the short-listing process (Chapter 4) were reviewed for the more detailed analysis required of the two short-listed sites. As a result of this review, the following assumptions were adopted:

- a second Sydney airport would be planned to serve all types of aircraft from small piston-engined general aviation aircraft to large, wide bodied jet operations (including a future generation of larger aircraft which could have wing-spans of up to 95 m);

- the operational mix of aircraft activity would be similar to that currently experienced at major airports but with a higher proportion of general aviation;

- the future airport would operate without a night curfew, thus requiring careful consideration of potential aircraft noise levels and existing and future land uses.

For planning and evaluation purposes, it was determined that the maximum level of development that could be accommodated within the proposed site would be for an airport with a capacity of 275,000 annual aircraft movements and 13 million annual passenger movements on a widely spaced parallel runway layout without a cross-wind runway.

13.3.1 Operational capacity

Tables 13.1, 13.2 and 13.3 set out the number of aircraft movements, operational mix, and capacity assumed for the purposes of the preliminary master plan.

Figure 13.1
PROPOSED
WILTON
SITE

Table 13.1 Annual aircraft movements

Aircraft type	Number of movements	Percentage
B747, DC10	37,500	14
A300, B767, B727	87,500	32
F27, Metroliner	60,000	21
General aviation*	90,000	33
Total	275,000	100

* Business jet, twin and single piston-engined aircraft.

Utilizing the above mix of operations, a calculation of passenger activity was made as follows:

Table 13.2 Passenger activity

Aircraft type	Number of annual aircraft movements	Average passenger load per aircraft movement	Total annual passenger movements
B747, DC10	37,500	150	5,625,000
A300, B767, B727	87,500	75	6,562,500
F27, Metroliner	60,000	15	900,000
Total			13,087,500*

* Does not include passengers carried on general aviation (estimated at less than 5% of the total).

Table 13.3 Capacity and area comparison between CSPR and WSPR layouts

Layout type	Approximate annual aircraft movements (000s)	Minimum land area requirements* (ha)
CSPR	190	1,070
WSPR	275	1,340
Percentage difference	45%	25%

* The difference between these figures and those in Table 4.2 results from exclusion of the area for a cross-wind runway.

13.3.2 Runway layout

During the short-listing process, various airfield layouts were examined for each of the ten sites under consideration. These layouts were:

- SR — a single runway
- CSPR — a set of closely spaced parallel runways
- WSPR — a set of widely spaced parallel runways
- DWSPR — a double set of widely spaced parallel runways.

Airfield capacities were calculated for each layout and found to vary from 117,000 annual aircraft movements for the SR layout to over 300,000 annual aircraft movements for the DWSPR layout (without a cross-wind runway). Given the operational mix and passenger movement assumptions described above and the range of likely forecasts for aviation activity, each of the four preliminary layout types was considered for its suitability.

The SR layout was rejected because of its limited potential capacity (117,000-138,000 annual aircraft movements) and the difficulty of providing a wide range of operational mixes on a single runway. A mix of heavy and light aircraft using a single runway considerably restricts the number of aircraft movements: this is because it is necessary to provide greater longitudinal separation between aircraft, to ensure that smaller aircraft are not affected by wing tip vortices generated by large aircraft.

The DWSPR layout, which gives a total of four primary runways, was rejected because the theoretical additional gain in capacity over that of a WSPR layout did not justify either the additional land needed or the cost of that land.

The final choice of layouts was thus between the CSPR and the WSPR layouts. Table 13.3 provides a theoretical comparison between these two layouts based on a hypothetical airfield using minimum dimensional criteria (no allowance for local topography, sub-division of land and severance) and assuming no cross-wind runway.

The WSPR layout was selected as it allowed greater operational flexibility for an aircraft mix containing a high proportion of smaller aircraft, and it was more efficient in terms of total runway capacity related to land area requirements.

13.3.3 Cross-wind runway

The number of runway directions required at an airport site is influenced by the direction and strength of prevalent winds at that site. A cross-wind is defined as the component of wind normal (perpendicular) to the direction of travel of the aircraft which, in the case of landings and take-offs, coincides with the orientation of the runway in use. Generally, the lighter the aircraft and the slower its design speed, the more difficulty it will have in compensating for cross-winds during landing and take-off. Transport category aircraft can manoeuvre in cross-winds as high as 30 knots but other categories of aircraft with lower flying speeds have less cross-wind capability. Nonetheless, 20 knot cross-winds can be tolerated by most general aviation aircraft when landing on dry runways.

International airport design criteria, however, are quite conservative with respect to operations with cross-winds in order to allow for such factors as variations in pilot proficiency, wet pavements, and a range of runway surface conditions. The International Civil Aviation Organization recommends that 'the number and orientation of runways at an aerodrome should be such that the usability factor of the aerodrome is not less than 95% for the aeroplanes that the aerodrome is intended to serve' (International Civil Aviation Organization 1983). The usability factor is the percentage of instances when at least one runway at an airport is available for use by the aircraft using that airport without exceeding their specified cross-wind tolerances.

The requirement for inclusion of a cross-wind runway at a second Sydney airport was reviewed following completion of the short-listing phase of the study. It was concluded that the Department of Aviation's current requirements for wind coverage (99.8% at capital city airports) would be unnecessary when applied to a second Sydney airport, given the presence of Kingsford-Smith Airport and several general aviation airports within reasonable flying distance of either of the short-listed second airport sites. It was therefore recommended that the Department of Aviation's requirement be relaxed to 95% wind coverage for the second airport. When this criterion was applied to the two short-listed sites at Badgerys Creek and Wilton, it was found that there was no need to provide a cross-wind runway.

It is estimated that aircraft certified to operate in cross-winds up to 10 knots would be able to use an airport at Wilton for 95.8% of the time, while aircraft certified to operate in 20 knot cross-winds would be able to use it for more than 99.9% of the time.

13.4 PRELIMINARY MASTER PLAN CRITERIA

13.4.1 Dimensional criteria

The preliminary master plan is based on dimensional criteria generally accepted for airport planning. Comparisons were made with airport planning criteria published by the Department of Aviation and other agencies throughout the world (principally the International Civil Aviation Organization and the US Federal Aviation Administration). In order to ensure that a second Sydney airport would meet future, as well as present, aviation needs, current aviation planning criteria were augmented with available information about long-range trends in aircraft design as applicable to airport layouts.

The results of this study concluded that planning for a second Sydney airport should allow for a future generation of large aircraft (as yet not designed) with wing-spans of up to 95 m. Wing-span is the principal basis for establishing airfield geometric spacing for safety purposes. However, it was recognized that, with the diversity of aircraft types expected to use the airport, not all components needed to be designed to handle such large aircraft, and lesser geometric criteria could therefore be used in certain areas.

Table 13.4 sets out the dimensional criteria that were established for the purposes of the preliminary master plan.

Table 13.4 Dimensional criteria used for preliminary master plan

Component	Criteria (m)		
	Future aircraft (95 m wing-span)	ICAO* (60 m wing-span)	ICAO (36 m wing-span)
Runway width	60	60	45
Taxiway width	30	30	23
Runway/taxiway separation	200	190	168
Taxiway/taxiway separation	122	101	46.5
Taxiway/apron edge separation	107	86	35

* International Civil Aviation Organization.

13.4.2 Runway length

Determination of runway length was based on a review of the runway requirements of existing aircraft as well as likely maximum haul lengths. Examination of performance characteristics of the various aircraft showed that the Boeing 747, operating at maximum gross loads over maximum haul lengths, would require a runway of 4,000 m. Research of available data on future aircraft trends revealed that this length should also be adequate for any new aircraft likely to be designed in the foreseeable future.

A length of 4,000 m was therefore used for the primary runway in the preliminary master plan.

The second runway does not need to be the same length as the primary runway, and it was established that a sufficient length would be 2,500 m — the length required for most short and some long haul lengths.

13.4.3 Runway separation

The International Civil Aviation Organization standard for the minimum separation required between parallel widely spaced runways to allow independent aircraft movements is 1,500 m, while the US Federal Aviation Administration standard minimum separation is 1,300 m. However, although these widths may be sufficient for operational purposes, it was considered that they could be restrictive given the need to develop and operate a terminal between the two runway systems.

Therefore, in order to establish a separation width between runways that would be suitable for a second Sydney airport, separation distances between parallel runways at other existing or planned airports around the world were reviewed for a variety of terminal layout concepts. Although these separations ranged from 1,311 m to over 2,500 m, it was found that many of the busy airports with activity levels similar to the maximum assumed for a second Sydney airport (275,000 annual aircraft movements) had separations of 1,500-1,600 m. This separation dimension was reviewed for a variety of terminal concept configurations and for the spatial requirements of large aircraft with 95 m wing-spans. It was concluded that a distance of 1,660 m would be a minimum but adequate separation which balanced all airfield operational requirements, and ensured that a second Sydney airport did not occupy more land than was needed.

13.5 PRELIMINARY MASTER PLAN

13.5.1 Alternative airport layouts

For the short-listing phase of the present study, a layout with a north/south primary runway orientation was used. Subsequent to the short-listing of Wilton, two additional alignments were examined. These were a north-west/south-east alignment (published in the 18 September press release announcing the short-listing of the Wilton and Badgerys Creek sites) and an east/west alignment. These two alignments plus the one used in the earlier short-listing phase are shown in Figure 13.2. The principal bases for selecting the east/west alignment for the preliminary master plan were that it avoided the need to acquire land within the village of Wilton, and that it did not affect large areas suitable for potential urban development. Section 14.2 describes the relative noise impacts of the two alignments examined for this Draft Environmental Impact Statement.

13.5.2 Future airport development based on the configuration adopted

Figure 13.3 shows the basic layout used in the preliminary airport master plan for the proposed site. This layout incorporates all building and facility requirements as described in Sections 13.5.3 to 13.5.7 for a fully operational airport and depicts the likely access to the proposed site.

The proposed runway layout is based on a set of widely spaced parallel runways designated 06R-24L and 06L-24R, with the terminal area located between them. Runway 06R-24L is 4,000 m in length and runway 06L-24R is 2,500 m. The distance

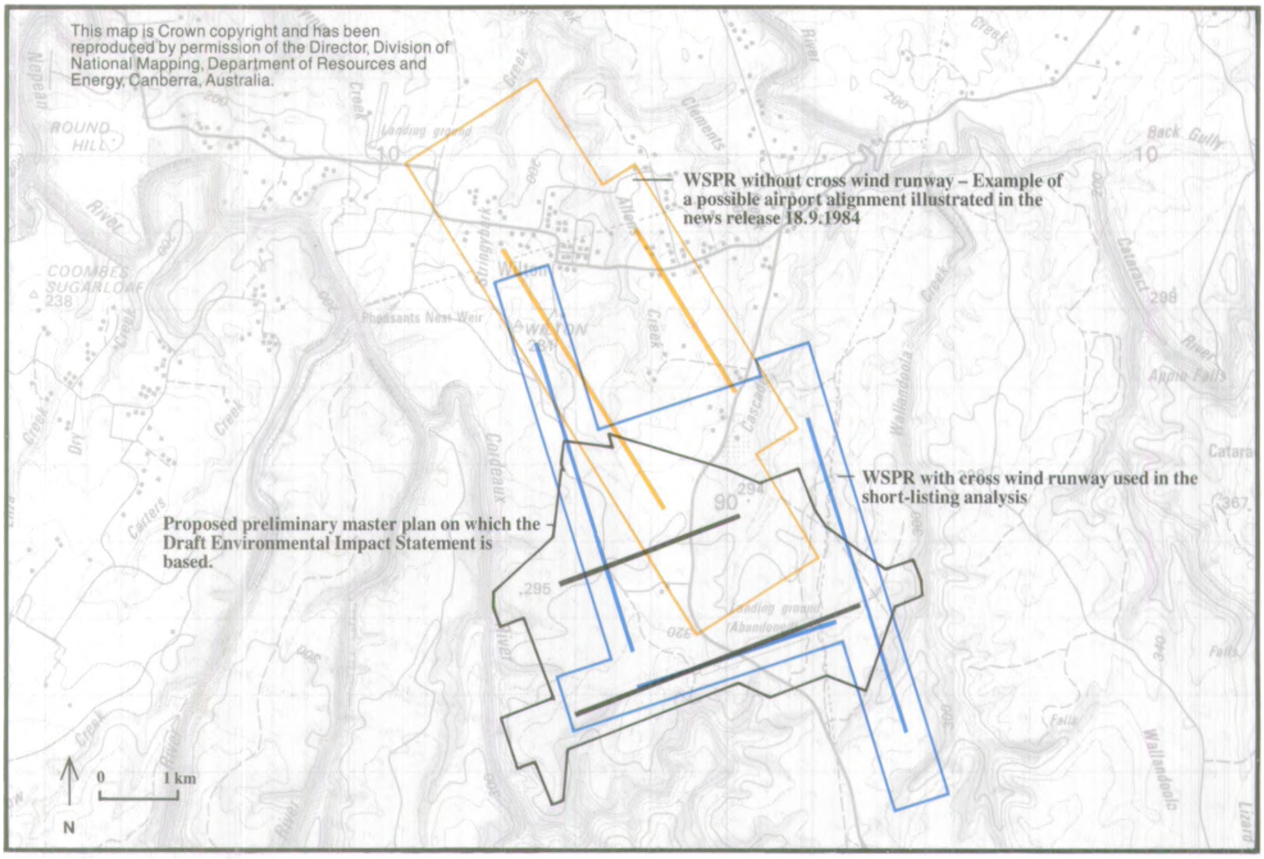


Figure 13.2
ALTERNATIVE RUNWAY ALIGNMENTS

between the runways is 1,660 m. The approach and departure surfaces have a 1.6% gradient, and thus meet the Department of Aviation's criteria.

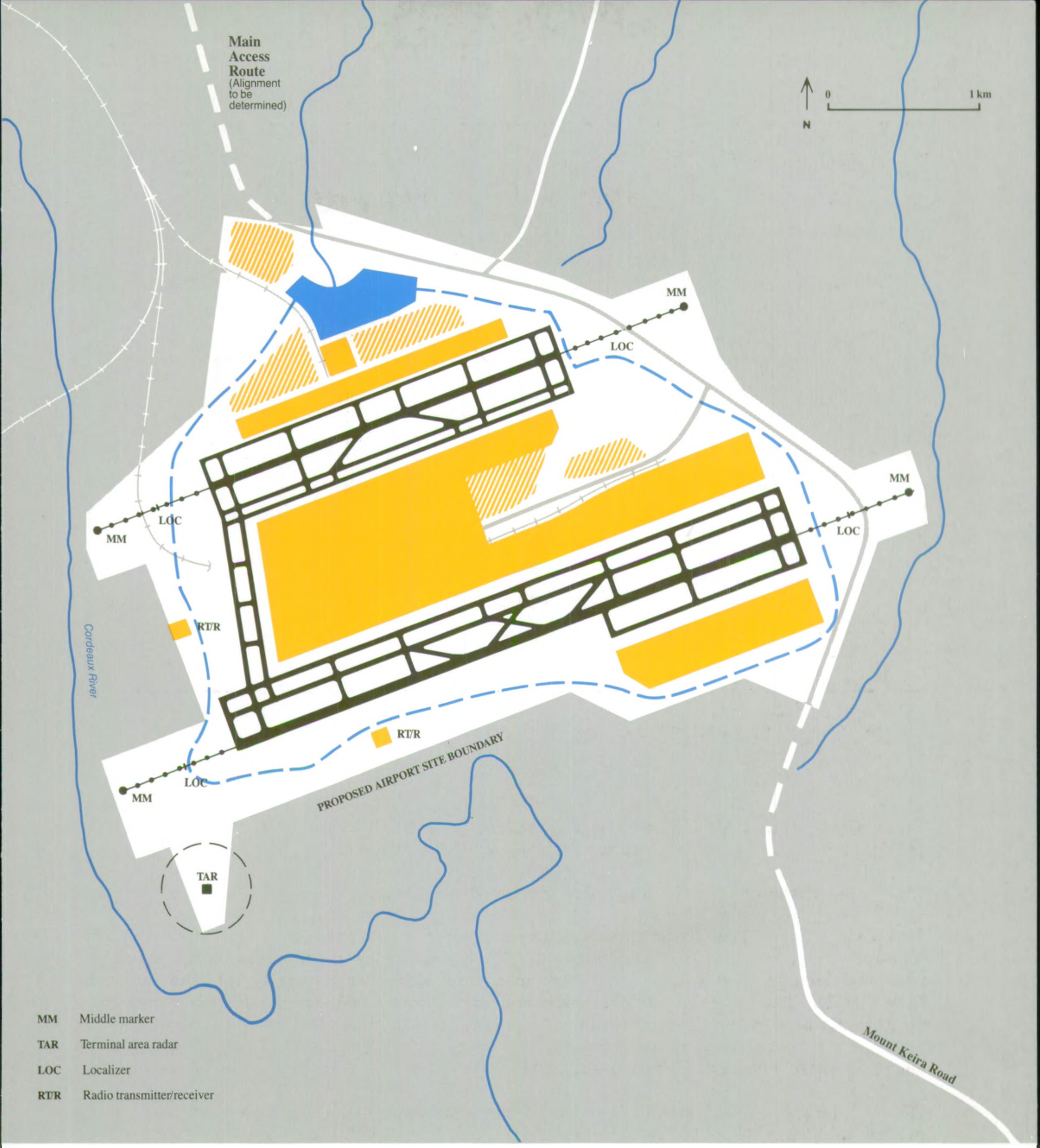
13.5.3 Considerations relating to the general apron area

For planning purposes, estimates of the number of aircraft gates and apron areas required for each of the different categories of aircraft were made based on the assumed mix of aircraft (Table 13.1) and the maximum forecast capacity of the airport (Table 13.2). Estimates of possible gate and apron area requirements for air cargo and aircraft maintenance were also made.

Wide and narrow bodied aircraft apron areas

The apron area for B747, DC10 or larger sized aircraft was planned to accommodate twenty-four aircraft, with twelve gates sized for aircraft of 60 m wing-span and twelve for aircraft of 95 m wing-span. The total of twenty-four aircraft was arrived at by starting with the number of wide bodied aircraft expected to use the airport on an annual basis and converting this to peak-period requirements. A total of 113 aircraft movements per day was assumed as the worst case. This is 10% more than the assumed average daily aircraft movements and was used as the worst case for planning purposes. Aircraft movements during the peak period of a day were assumed to be 33% of the assumed daily aircraft movements (or 38 aircraft movements).

Using similar reasoning for the gate requirements for A300, B767 and B727 type aircraft, a total of twenty-five positions was calculated as being required. This number was arrived at by starting with 87,500 annual aircraft movements and then assuming 264 daily aircraft movements. Again, this number is 10% more than the assumed average daily aircraft movements and was used as the worst case for planning purposes.



- Runway and taxiways
- Runway approach lighting
- Terminal and apron area
- Leased site for airport related activity
- Perimeter drainage system
- Possible road access route
- Possible rail access route

Figure 13.3
PRELIMINARY MASTER PLAN WILTON

Although a mix of aircraft gate sizes would be appropriate for final planning purposes, for this initial planning effort all gates were sized to accommodate aircraft of 60 m wing-span.

Commuter apron area

This area was designed to accommodate a total of ten positions based on 60,000 annual aircraft movements.

General aviation area

It was estimated that 25% of the 90,000 annual aircraft movements assigned to general aviation would consist of itinerant operations requiring tie-down spaces (parking space with anchoring facilities). On average, it was assumed that about 40% would stay for two days, so that approximately eighty-five itinerant tie-down spaces would be required. Additional space for fixed base operators, hangars and other general aviation facilities has been provided.

After examining various aircraft positioning arrangements for tie-downs, it was determined that, for small single and twin-engined aircraft, an allocation of twenty-five aircraft per hectare was reasonable. For large multi-engined general aviation aircraft, an allocation of five aircraft per hectare was used.

The same allocation of twenty-five aircraft per hectare was used when estimating hangar space requirements for small and twin-engined aircraft utilizing the airport but not based there, with five hangars per hectare being allocated for this purpose. Commercial operations based at the airport were allocated a minimum of 1 ha per operator.

Altogether, a total of 25 ha was allocated for the general aviation facilities area.

Air cargo area

An allocation of eighteen to twenty parking positions was made to accommodate air cargo operations. To ensure that adequate space was available, all gates were based upon accommodating aircraft of 95 m wing-span. Although this space is significantly more than that typically found at large airports, it anticipates the possibility that aircraft of such a size will be designed in the future thus enabling air cargo to be transported in bulk at competitive rates.

In order to accommodate such volumes of cargo, adequate storage and sorting facilities must be available, together with truck manoeuvring areas, cold storage accommodation, bonded warehousing and office facilities. It was estimated that these requirements, plus customer and employee parking lots and access roads, necessitated approximately 2.5 ha per aircraft position. The total allocation was thus 50 ha.

Aircraft maintenance area

This area was planned to accommodate up to fourteen large aircraft on outside aprons, with associated maintenance hangars, workshops, equipment, storage facilities and employee car parking. A total of 40 ha was allocated for this purpose.

13.5.4 Passenger terminal facilities

Several factors influence the design and size of terminal facilities at an airport. These factors include the function of the airport, the type of operations and traffic, the number of user airlines, the airfield configuration, the number of passengers to be accommodated, and the types of ground access available.

The assumptions for a second Sydney airport which therefore had to be taken into account in planning the terminal facility layout were:

- the potential need to accommodate a wide range of aircraft types
- an airfield with two widely spaced runways
- the potential to accommodate a maximum of 13 million passenger movements
- direct servicing of the terminal area by rail and road
- a likely requirement to construct in stages.

While it is not necessary at this stage to select a specific terminal concept, the planning must ensure that adequate space has been allocated to accommodate the potential passenger load and associated aircraft gate requirements. The layout incorporating widely spaced parallel runways that was selected for a second Sydney airport dictated that the terminal area be located between the two runways. It was therefore necessary to ensure that the separation distance between these runways was sufficient to allow for the taxiways, apron, terminal building, access roads, automobile parking and associated facilities. A variety of terminal configurations is possible within this separation distance. Figure 13.4 illustrates a typical section between runway systems showing the airfield and terminal area requirements that would be appropriate to the maximum level of activity assumed for a second Sydney airport.

13.5.5 Taxiway considerations

Two important elements in an airfield layout are the circulation taxiways for aircraft manoeuvring and the entrance/exit taxiways that connect the runways to the circulation taxiways. To ensure maximum flexibility for aircraft to circulate from the runway complex to various apron areas, provision has been made for two uni-directional taxiways paralleling each of the runways. The separations between runway and taxiway, taxiway and taxiway, and taxiway and apron edge conform to the criteria stipulated in Table 13.4. An apron edge taxiway has also been included in the passenger terminal area.

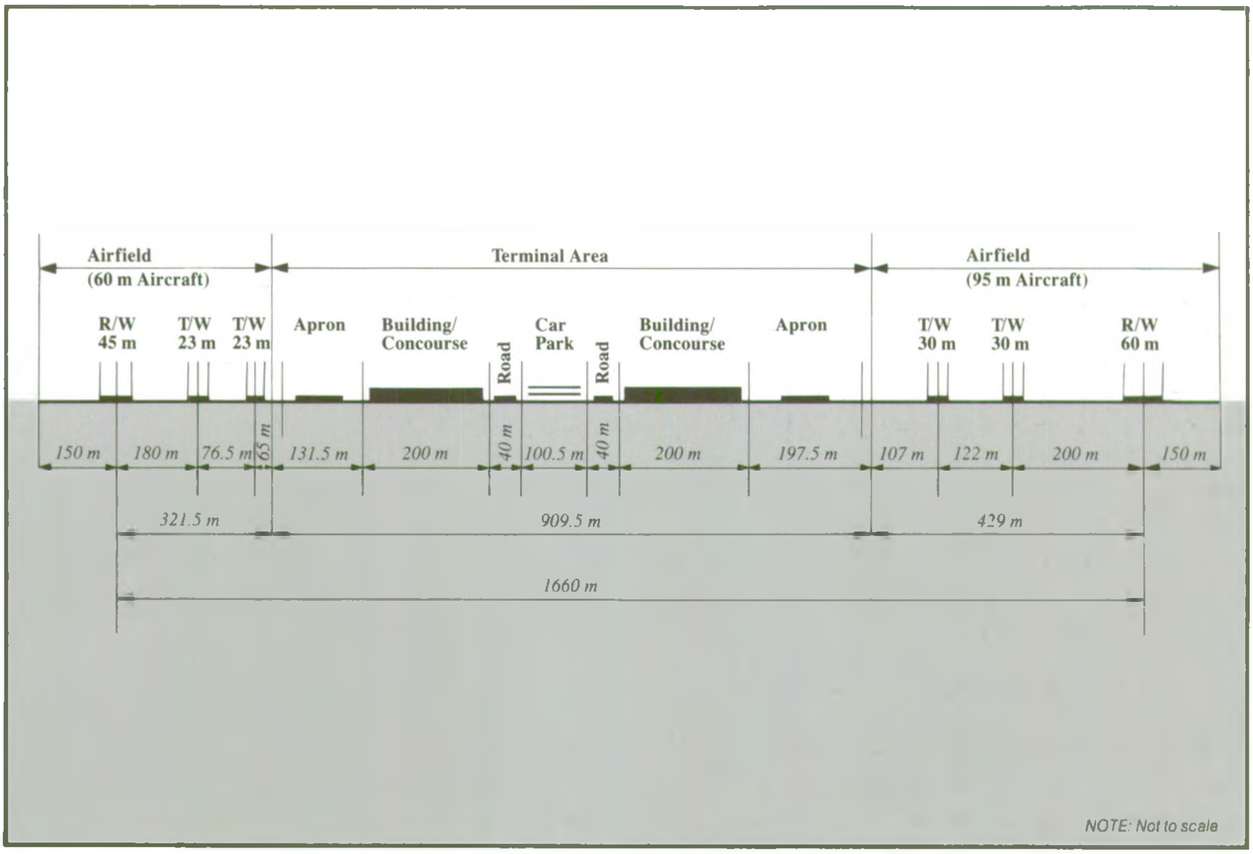


Figure 13.4
TYPICAL AIRFIELD CROSS SECTION FOR 1660M RUNWAY SEPARATION

13.5.6 Air navigation aids and air traffic control facilities

A second Sydney airport at its maximum level of development would incorporate a full complement of electronic and visual air navigation aids and air traffic control facilities. The siting of these facilities shown on the master plan layout took into account the special grading and clearance requirements recommended by relevant Australian and international bodies. The various systems that might be used at a second Sydney airport are listed below:

- **Instrument landing system:** This provides aircraft with the lateral, longitudinal and vertical guidance necessary for a landing, and consists of the following elements:

  - localizer
  - glide slope
  - very high frequency marker beacon system comprising an outer, middle and inner beacon.

  For planning purposes, a complete instrument landing system has been shown on the master plan for each runway approach. Other radio navigational aids would include:

  - distance measuring equipment
  - non-directional beacons

- **Visual guidance systems:** These systems are associated with the instrument landing system and include:

  - high intensity approach lights
  - touchdown zone lighting
  - runway centreline lighting
  - high intensity runway edge lighting
  - runway visual range
  - visual approach slope indicators.

- **Air traffic control facilities:** The air traffic control facilities that would be provided include:

  - air traffic control tower
  - air traffic service centres
  - terminal area radar
  - route surveillance radar
  - surface movement radar
  - radio transmitter and receiver sites

- **Landing aids:** Other landing aids that could be included on the airport are:

  - wind cones
  - weather reporting systems
  - rotating beacons
  - wind shear detection equipment.

13.5.7 Other facilities

Planning provision has been made for the following supporting facilities which are commonly found at major airports and would be required at a second Sydney airport at the maximum level of development:

- car hire area
- Federal Police
- Customs
- Department of Aviation maintenance
- Department of Aviation administration
- access to railway and roads

- catering
- freight forwarders
- employee parking
- post office
- hotel/motel
- banking services
- utility corridors
- fuel storage
- wastewater treatment
- weather service
- flight service stations
- remote car parking

13.6 AIRSPACE ARRANGEMENTS

At present there are four types of designated airspace in the Sydney Region:

- control zones, which are established around busy airports to ensure the safe and orderly flow of traffic;
- a control area, which is a volume of airspace centred on Kingsford-Smith Airport, and is determined by the climb and descent performance of the variety of aircraft using that airport;
- restricted areas, which are volumes of airspace around military facilities, or civil installations such as the Fleurs Radio Observatory;
- danger areas, which are designated volumes of airspace to identify potentially hazardous areas (such as flying training or parachuting areas).

The development of a second major airport in the Sydney Region would require changes in the existing allocation of airspace to accommodate the different arrival and departure patterns at Kingsford-Smith Airport and the second airport. Arriving traffic would need to be split into flows towards either Kingsford-Smith Airport or the second Sydney airport at some point en route at a distance of perhaps 100 nautical miles from Sydney, while traffic departing from either airport and using a similar route to their destinations would need to join this common route at some distant point from the airports. Figure 13.5 shows an example of control zones with a combined control area for both Kingsford-Smith Airport and a future airport at Wilton. The radius of the control area at Wilton has been reduced in the northern sector to accommodate existing operations. The changes required to the existing airspace allocations are discussed below.

Military and restricted airspace

The restricted area around the Fleurs Radio Observatory (R515), the Kingswood/Orchard Hills defence facilities (R529A) and the restricted airspace associated with the munitions factory at St Marys (R512) would not affect operation of an airport at Wilton, since its control zone would be outside these areas. Neither would an airport at Wilton require changes to the control zone of RAAF Richmond Base, although increased civil use of the restricted airspace above 6,000 ft would be necessary. However, the continued use of the Holsworthy restricted airspace would impose some restrictions on operations at both Kingsford-Smith Airport and the proposed Wilton airport.

Aircraft operating outside controlled airspace are currently denied access to the coast for a distance of 20 nautical miles south of Bankstown because of the presence of the Holsworthy restricted area. The Wilton control zone would form another constraint and increase this distance to 40 nautical miles. It would also mean that aircraft travelling towards the south coast would have to first proceed south-west over rugged terrain until they cleared the Wilton control zone before turning south or towards the coast. If Holsworthy firing activities were eliminated and this airspace restriction removed, access to the south from Bankstown would be greatly improved. However this would affect the existing hang gliding activities along the coast south from Garie Beach.

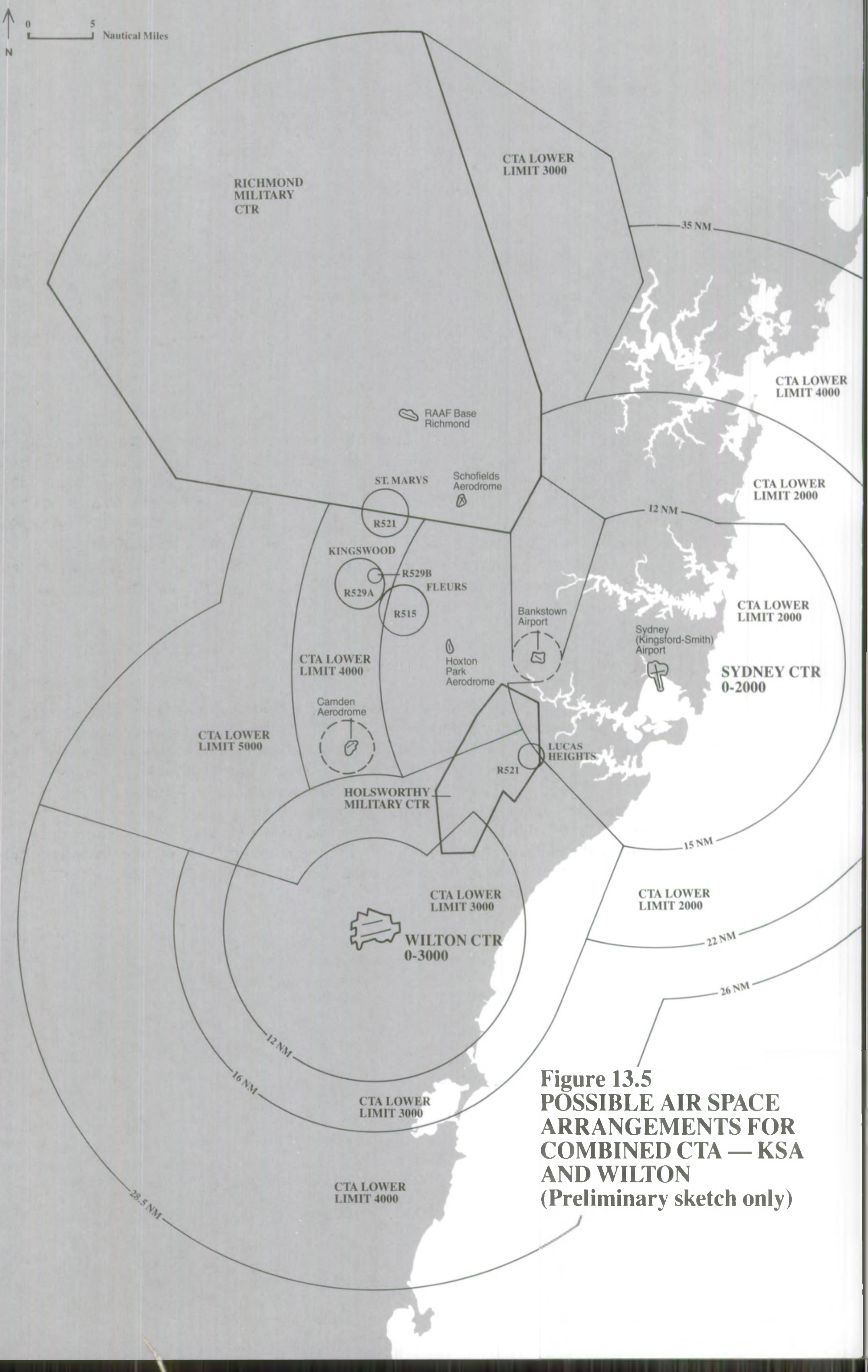


Figure 13.5
POSSIBLE AIR SPACE ARRANGEMENTS FOR COMBINED CTA — KSA AND WILTON
(Preliminary sketch only)

General aviation

The control zone for a future airport at Wilton would allow existing general aviation airports and their training areas to continue to operate, although some changes would be necessary. These changes would involve placing a 4,000 ft upper limit on training areas D503 and D504, eliminating the current restricted operations R507 at 4,000-6,000 ft above the training area D504, and reducing the current 4,000 ft upper limit over the training area D502 immediately to the south-west of Camden. The remainder of the training areas would be unaffected.

The existing airstrip at Wilton — not to be confused with the old wartime airstrip — is currently used for parachuting, chicken deliveries and crop dusting. Its continued operation would be incompatible with future operations of a second Sydney airport at Wilton. These operations could be transferred to the proposed airport, but the parachuting activity would have to occur outside the Wilton control zone once airport operations had reached a substantial level.

Kingsford-Smith Airport

If aircraft travelling to and from the Sydney Region used common routes to within a short distance of the two major airports, the spacing of traffic associated with Kingsford-Smith Airport would need to be greater than it is at present to ensure safe spacing between the two flows. Therefore, in order to take full advantage of the potential capacity of both Kingsford-Smith Airport and a second Sydney airport, independent routes to each airport would be necessary. The airspace needed to accommodate new routes to a future airport at Wilton may be different from that shown in Figure 13.5, and a continual review of airspace allocation would be needed, based on the changing requirements of users.

13.7 AIRCRAFT EMERGENCY PROCEDURES

Prior to the commencement of airport operations, a set of Aerodrome Emergency Procedures would be prepared — a normal practice for all major airports. These plans would be developed in consultation with all relevant local, State and Commonwealth authorities, and would detail the co-ordinated responses required in the event of any foreseeable type of emergency involving the airport. Key personnel would be familiarized with the actions required of them, and emergency drills would be practised. The procedures would be designed to minimize the harmful effects of any emergency or accident on people and property and would, for example, specifically take into account the protection of community services such as water supply.

CHAPTER 14

The Socio-Economic Environment and Effects of the Proposal

Introduction

This chapter describes the socio-economic environment and the likely effects of the proposal. Each of its principal sections describes the existing environment, assesses the likely effects of acquisition of an airport site and of its construction and operation, and outlines proposals for implementation of environmental safeguards and monitoring programmes.

The principal social effects of the proposal arise from site acquisition and from future noise impacts. These are the subject of the first two sections. Sections 14.3 and 14.4 then review the archaeological resources of the site and the concerns of Aboriginal people in the area. This is followed by a discussion of the European heritage resources of the site (Section 14.5). Sections 14.6 and 14.7 describe the economic and employment effects of the proposal and its impact on existing agricultural activities. Chapter 14 concludes with an assessment of the implication of airport development for regional planning (Section 14.8).

14.1 LAND ACQUISITION

On announcement of the selected site, one of the following two procedures would be implemented:

- If properties within the site were to be acquired by compulsory process:
  - Notices to Treat would be delivered to all land owners within the acquisition area;
  - the boundary of the area to be acquired would be published in the Commonwealth of Australia Gazette and placed on display locally;
  - complementary planning controls would be implemented by the New South Wales Government around the perimeter of the site to be acquired, and for other areas which may be affected by aircraft noise.

- If properties within the site were to be acquired by agreement:

  - all land owners within the acquisition area would be informed of the Commonwealth's desire to enter into negotiations to purchase land;

  - complementary planning controls would be gazetted by the New South Wales Government for the site to be acquired, and for other areas which may be affected by aircraft noise or by access proposals.

The procedures to be followed under either of these possible courses of action are described in the following sections.

14.1.1 The proposed Wilton airport site

Figure 14.1.1 shows the boundary of the proposed site at Wilton. The area enclosed by the boundary is approximately 1,440 ha. Of this, some 1,295 ha is in government ownership, with the balance of 145 ha being held by three private companies. There are approximately eighteen separate titles within the boundary. There is one private dwelling on the proposed site. The zoning is Rural A1 (minimum lot size 40 ha), Rural A2 (minimum lot size 16 ha) and Metropolitan Catchment Special Uses (C1).

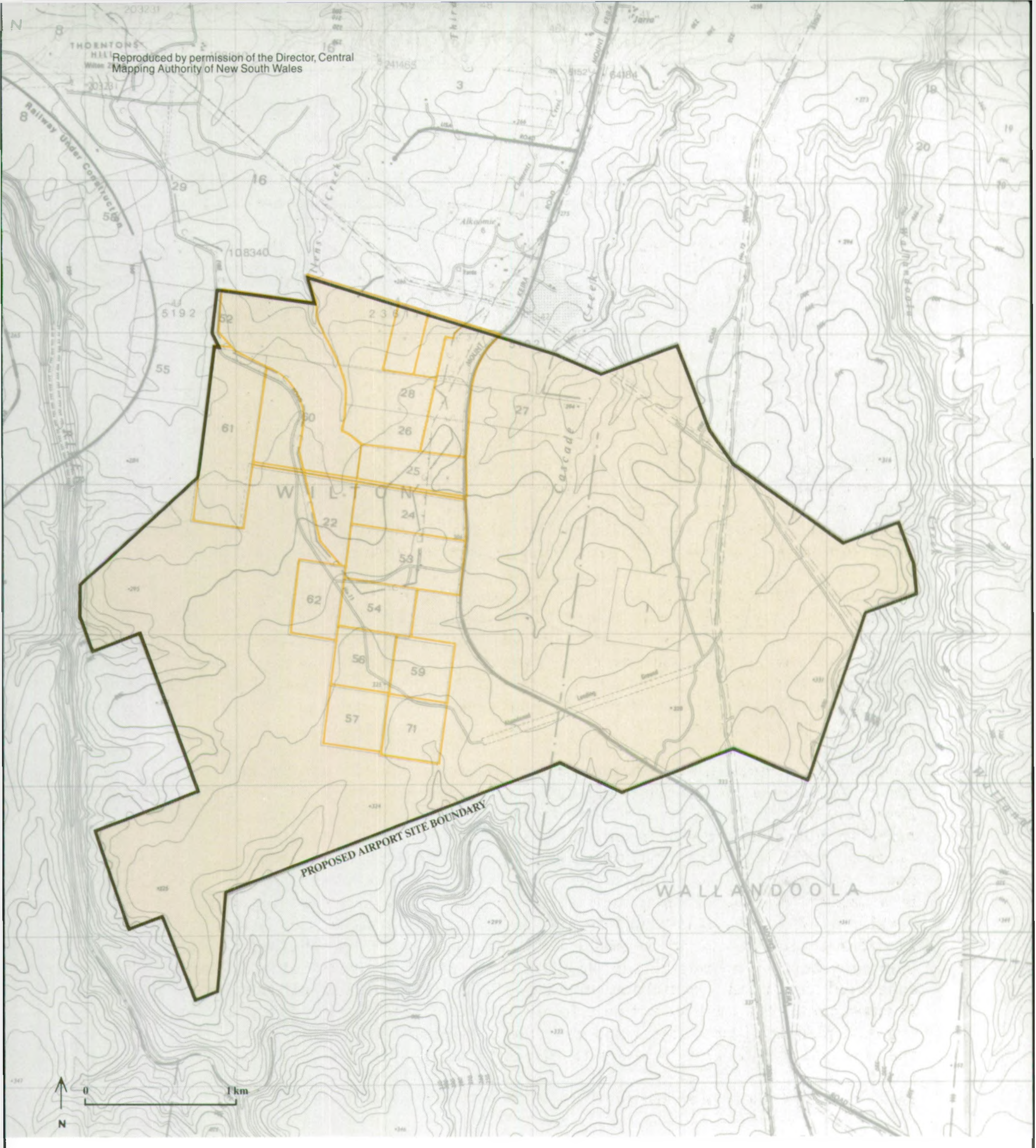
The market valuation of private land and improvements on the proposed Wilton site is estimated at approximately $1.8 million. However, this figure does not include consideration of special value to individual owners, injurious affection, disturbance, severance, costs arising out of court actions, or any other factors which might be important components of compensation for compulsory acquisition. For the land owned by the State, a Commonwealth—State land acquisition agreement would be negotiated and the terms of land transfer established after the site was announced.

There are no proposals at this time to acquire land for road or rail access routes, or for airport related land uses outside the boundary of the site shown in Figure 14.1.1. However, in the longer term if the Wilton site were selected, comprehensive land use planning measures would be required to direct development in the noise affected areas in order to prohibit inappropriate uses, to identify land for future airport associated uses and to address the relationship of the airport to other issues in the Macarthur Region. It is proposed that the development of a strategic land use plan for the area in the proximity of the selected airport site would be included in the Macarthur Regional Environmental Plan. The Regional Environmental Study for the Macarthur Region is currently being prepared by the NSW Department of Environment and Planning, and is scheduled for public exhibition in late 1985. Preparation of the Draft Regional Environmental Plan will commence following the exhibition. The study is examining the regional planning issues associated with the airport site selection and it is proposed that the plan will include appropriate strategic and regional planning controls.

14.1.2 Compulsory acquisition

As a first step in a compulsory land acquisition proposal, the Commonwealth would forward a Notice to Treat to each of the owners of the land and any other party known to have an interest in the land. This does not mean that the land has been compulsorily acquired, but serves as an early notification to property owners that the Commonwealth is interested in acquiring their land. The Notice to Treat invites people to negotiate with the Commonwealth for the sale of their property by agreement. If the Commonwealth cannot reach agreement with an owner for the purchase of the property, the Minister for Local Government and Administrative Services may, after twenty-eight days of the serving of the Notice to Treat, recommend to the Governor-General that the property be acquired by compulsory process.

Once compulsory acquisition is authorized by the Governor-General, a notice is published in the Commonwealth of Australia Gazette giving a full description of the land. Ownership of the property passes to the Commonwealth on the date of gazettal.



Approximate boundaries of existing titles within the proposed site

Area to be acquired by the Commonwealth

Figure 14.1.1 PROPOSED ACQUISITION AREA

The Minister for Local Government and Administrative Services must table before both Houses of Parliament a copy of the notice published in the Gazette. Either House of Parliament may pass a resolution that the acquisition is void and of no effect. If this occurs the land is deemed not to have been acquired by the Commonwealth.

Following gazettal, a formal Notice of Acquisition is sent to each party with an interest in the land, together with:

- a copy of the Notice of Gazettal;
- a diagram showing the total amount of acquired land and, where appropriate, the portions being acquired;
- a form on which to make a claim for compensation.

If a property is acquired by compulsory process, compensation is payable in accordance with the provisions of the Lands Acquisition Act 1955.

Authority responsible for compulsory acquisition

The process of compulsorily acquiring all properties within the designated Wilton airport site, including all negotiations with property owners (which includes co-owners, mortgagees, lessees, licensees, share farmers, easement holders — anyone with an interest in the land to be acquired), is carried out by the Commonwealth Department of Local Government and Administrative Services.

Parties entitled to compensation

Only people or organizations who own land or have an interest in land which is compulsorily acquired for public purposes have a right to compensation. 'Interest' here means a legal or equitable estate or interest in the land, or a right, power, or privilege over, or in connection with, the land. This generally includes owners, mortgagees and, under certain conditions, lessees, tenants or licensees. A lessee, for example, is usually entitled to reimbursement of removal expenses and may, especially in the case of a long-term lease, be entitled to substantial compensation for the acquisition of his or her interest in the land.

People from whom no land is acquired are not entitled to compensation, notwithstanding the fact that they may be affected by the public works carried out on the acquired land. People from whom some land is taken are entitled to claim compensation for the effect of the work on their retained land. As the law now stands, people cannot be compensated for 'injurious affection' such as increased noise, pollution, loss of privacy, or increased traffic flows, unless part of their land is taken.

In assessing compensation for the acquisition, regard shall be had to any variation in the value of the retained land because of the taking of the acquired land. If the major portion, say including buildings, is acquired and the residue is of little use or value to the owner, the acquiring authority would probably consider acquiring the whole property.

Compensation payable

Under the Constitution, the Commonwealth Parliament is empowered to make laws for the 'acquisition of property on just terms'. The Lands Acquisition Act 1955 meets this requirement by providing that, in the event of a dispute on the amount of compensation payable, a court may determine compensation or make such order as is necessary to ensure that acquisition is made on just terms.

Generally stated, the main principle of compensation is that the dispossessed owner is compensated to the full money equivalent of what he or she has been deprived of, plus reasonable relocation and disturbance expenses. In the case of a commercial enterprise, this would include the market value of the property and such things as the provision of telephone, electricity supply, and other specialist services. Generally these can be determined fairly readily. In the case of an individual deprived of his principal and primary place of residence, compensation would include the market value of the property and such things as removal expenses and the residual value of floor coverings, blinds and light fittings, which cannot readily be transferred from dwelling to dwelling.

No compensation is payable, however, for such unquantifiable effects as loss of attachment, removal from a sympathetic socio-economic community or possible adverse effect on the education progress of school-going children, all of which involve a considerable element of subjective assessment.

The value of the property is determined as at the date of gazettal, i.e. the date at which the acquisition of the property is published in the Commonwealth of Australia Gazette which legally vests it in the Commonwealth. The market value of a property estimated by the Commonwealth valuers is based on evidence from sales of similar properties in a free market at the date of gazettal.

Compensation process

When copies of the Gazette are received from the Government Printer, the Department of Local Government and Administrative Services sends a copy to each party with an interest in the land, together with a Notice of Acquisition, a diagram or plan of the total land taken (where appropriate), and a compensation claim form. The Notice informs the former owner that the land has been acquired, and that he or she is consequently entitled to compensation, which must be claimed, specifying the amount, in accordance with the claim form. The Department of Local Government and Administrative Services requests the Valuation Branch of the Australian Taxation Office to provide an assessment of the compensation in accordance with the principles set out in Section 23 of the Lands Acquisition Act 1955, taking into account any particular matters raised by the former owner in the claim. Negotiations over the amount of compensation are commenced. Usually the negotiations are conducted in consultation with the valuers advising each party, and generally they result in an agreement, which must be confirmed by the Minister or his delegate. The Act provides for payment of statutory interest on the agreed compensation from the date of gazettal to the date of settlement. If agreement on compensation is reached between the Commonwealth and the property owner, the Director of Legal Services is instructed to attend to the final legal formalities and is provided with funds to effect payment of compensation.

If agreement has not been reached on the amount, further negotiations may take place, and both parties may obtain further valuations by qualified valuers if necessary. There are two courses of action open on the amount of compensation payable if final agreement cannot be reached:

- Either the property owner or the Commonwealth institutes proceedings for a court to determine the amount of compensation payable; this is the usual course of action. The courts also have the power to determine which of the parties involved in the court action is required to meet the costs of that action.

- The owner and the Commonwealth agree to submit the matter to arbitration, usually by a mutually agreed professional valuer.

Once all the compensation claims regarding a particular property have been determined, the Director of Legal Services has been satisfied as to title, and all appropriate documents have been executed and delivered, compensation including statutory interest is paid to the former owner. Where an unusual delay in the determination or payment of compensation is expected, an advance of up to 90% of the Commonwealth valuation may be paid to the claimant, provided the Director of Legal Services is satisified as to title. There is no legal obligation on the Commonwealth to make that advance.

Assessment of compensation

Value of land

Before property value negotiations are initiated, the Department of Local Government and Administrative Services will request the Commonwealth Valuers to undertake property valuations. If no agreement on the value of a property can be reached between the owner and the Commonwealth, the property owner is usually advised to obtain a private valuation of the property from a registered valuer for use in the court or arbitration action. Reasonable valuation fees incurred by the property owner will be repaid by the Commonwealth as a compensatable item.

Legal fees

The Commonwealth also meets the cost of reasonable legal fees incurred by a property owner for legal advice and representation during negotiations.

Allowable expenses

The Commonwealth is required to compensate property owners for certain other costs incurred as a consequence of the acquisition process. These are:

- costs for title transfer documents and any other legal documentation;
- furniture removal costs;
- telephone reconnection charges;
- mail redirection costs;
- the cost of new school uniforms;
- incidental costs in buying a replacement property of the same standard, including the legal costs of conveyancing, survey fees, real estate agents' fees, and costs in connection with the transfer of any outstanding mortgage from the acquired property to the new property or with the raising of a new mortgage for a similar amount;
- the loss on a forced sale of stock and equipment;
- costs of notifying change of address to suppliers and customers;
- any other reasonable expenses and losses directly attributed to the acquisition as agreed by the Commonwealth.

Expenses not allowable

Certain expenses which may be associated with the acquisition process do not qualify as allowable expenses available to affected property owners. For example:

- If the price paid by a land owner for a replacement property is higher than the market price of the acquired property, no compensation will be paid to cover the price difference.
- Similarly, if legal or other costs associated with the purchase of a more expensive property are higher than those for a property of equivalent price to the previous holding, no compensation is available to cover the price difference.
- Nor is compensation allowable for:
    - increased rates and rent for a new property;
    - increased travelling costs;

- new furnishings, fittings and appliances over and above the existing valuation figure;
- losses incurred due to selling stock without taking prudent steps to obtain proper prices.

14.1.3 Acquisition by agreement

Under this alternative where acquisition of properties is effected by agreement, Notices to Treat may not be issued to land owners at the time of the announcement of the selected site; however, the site boundary would be appropriately publicized, complementary planning controls around the perimeter of the site to be acquired would be gazetted by the New South Wales Government, and land owners within the site boundary would be informed that the Commonwealth wished to enter into negotiations to acquire properties. The properties would then be progressively acquired by agreement between the owners and the Commonwealth.

It could be expected that a number of land owners may wish to enter immediately into negotiations with the Commonwealth leading to acquisition of their property, and to vacate their land on settlement. However, other owners may choose to continue living on their former properties after acquisition under negotiated arrangements until airport construction commences.

Other landowners may choose not to sell their properties immediately to the Commonwealth. Their land would therefore remain in private ownership until it was sold to the Commonwealth or compulsorily acquired. However, the Commonwealth would request the State Government to consider the implementation of land use controls over this private land to enable the site to be protected in accordance with Commonwealth requirements.

The Commonwealth's offer to purchase properties would remain open, and property owners would be at liberty to approach the Commonwealth to negotiate a sale at any time. Once a decision had been made to develop the site for airport purposes, the owners of remaining unacquired land would be issued with a Notice to Treat, and compulsory acquisition formalities would be initiated.

14.1.4 The effects of land acquisition

As the proposed site at Wilton is wholly in government or private company ownership, the effects of acquisition or transfer of ownership would be minimal. However, it is possible that some severance of private land could ultimately be involved.

Severance

The site boundary at Wilton has been drawn to minimize severance of properties. (Severance of property occurs when it is necessary to locate a site boundary line through a property rather than around the property boundary, thus cutting the property into two sections. An alternative form of property severance would be the establishment of an easement or reserve through a property, such as pipeline easements or road reserves.)

Property owners have the right to claim compensation from the Commonwealth for severance of land in accordance with provisions outlined in Section 23 of the Lands Acquisition Act 1955. Property owners whose land is affected by such severance are entitled to several forms of compensation, including payment for any extra fencing which may have to be erected, reimbursement for land value depreciation, and compensation for damage (if any) to property or fixtures.

Agreement on the amount of compensation is usually achieved through negotiation between the property owner and the Commonwealth. The Commonwealth official responsible for the negotiation of compensation matters is the Chief Property Officer attached to the New South Wales office of the Department of Local Government and Administrative Services. If agreement cannot be reached on the amount of compensation payable for severance, the same two courses of action open to property owners claiming compensation for acquisition are available — either court proceedings or arbitration.

Although the Commonwealth is not obliged to purchase the balance of a property affected by severance, the Chief Property Officer may, under certain circumstances, recommend that the land not required be purchased as part of the negotiated property sale.

14.1.5 Safeguards and monitoring

Provision for lease-back following acquisition

In the interim period between acquisition of the selected site and commencement of construction of an airport, the Commonwealth would ensure that the land acquired was managed in a responsible manner, and without adverse effect on surrounding land. The most effective way of achieving this objective is to retain the land in productive use. For the small area of privately owned land within the proposed Wilton site, two options are available to the Commonwealth, through the Department of Local Government and Administrative Services:

- to lease back the properties to the original owners;
- to lease the properties through the invitation of public tenders.

The Commonwealth's preferred course of action would be to lease land back to original owners, at fair market rental, in all instances where the original owner requested continued occupation of the property pending construction of the airport. Where a lease-back arrangement was not required, the property would be revenue-leased through the invitation of public tenders based on fair market rents. The term of each lease would have regard to the construction stages and timetables for the airport development, none of which is known at this time.

The Commonwealth would consider tenancy agreements on their merits. This would involve detailed inspections and valuations as well as the drawing up of lease documents. A periodic review and inspection of properties may be required to ensure that the properties are being managed and maintained to the standards required by the Commonwealth.

The terms and conditions of the leases would prohibit redevelopment or extension of buildings on the leased land unless agreed to by the Commonwealth. Ultimately, such investments would have to be surrendered to the Commonwealth, without compensation, at the expiry of the lease term.

Management of land in the metropolitan catchment area

Until such time as a decision had been made to develop the site for airport purposes, it is not envisaged that any change would be required as far as the management of the section of the proposed Wilton site within the metropolitan catchment area or currently owned by the Metropolitan Water Sewerage and Drainage Board is concerned. Responsibility for the management of the land would be covered under the Commonwealth-State government agreement for the transfer of the land to the Commonwealth, and it is expected that the Commonwealth would request the Metropolitan Water Sewerage and Drainage Board to retain this management responsibility until airport construction works were initiated. Once construction was authorized, the environmental monitoring and other land management measures discussed in Chapters 15 and 16 would be implemented.

14.2 NOISE

Noise from aircraft is consistently identified as the most significant adverse environmental effect of existing airport operations. Social surveys undertaken for the Second Sydney Airport Site Selection Programme also identify noise as the major perceived disadvantage of a second Sydney airport. For these reasons, the examination of noise effects in this section relates almost entirely to possible future noise effects from aircraft operations under a set of worst case assumptions.

The basis of the worst case assumptions was a level of aircraft operations of 275,000 movements per year. While this level is appropriate for assessing the maximum possible environmental effects, it is nevertheless a level that is unlikely to be reached for many years, if ever.

For a given level and pattern of aircraft operations, the noise effects will depend on the position and orientation of the runways. An objective during the preparation of the preliminary master plan (Section 14.4) was to minimize the impact of aircraft noise on residential areas. To evaluate the success of the preliminary master plan in meeting this objective, the potential noise effects under the proposed east—west runway alignment were compared with those under an alternative north/south alignment originally shown in the Minister for Aviation's press release of 18 September 1984 announcing the short-listing of Badgerys Creek and Wilton.

14.2.1 Relevant government guidelines

In Australia there have been three major government investigations concerned with the effects of aircraft noise:

- the 1970 report of the Parliamentary Select Committee on Aircraft Noise which inquired into the effects of aircraft noise on people, properties, institutions and communities;

- a major socio-acoustic investigation of the impact of aircraft noise on residential communities undertaken by the National Acoustic Laboratories of the Commonwealth Department of Health (National Acoustic Laboratories 1982);

- the investigation by the House of Representatives Standing Committee on Environment and Conservation into the effects of aircraft operations on the environment surrounding airports, begun in 1982.

As far as practicable, the method of assessment of potential noise effects from airport development at Wilton is based on findings of the National Acoustic Laboratories study and subsequent official guidelines. These cover three fundamental aspects of the assessment of aircraft noise effects:

- methods of measuring aircraft noise exposure
- criteria for determining land use compatibility with different noise exposure levels
- reference data on subjective reaction to aircraft noise exposure levels.

However, the Terms of Reference of the House of Representatives Standing Committee covered several important matters outside the established guidelines and scope of the National Acoustic Laboratories study, including:

- the extent of the impact of aircraft noise on:

  - the health and welfare of people, institutions and communities
  - property and property values adjacent to major metropolitan airports;

- the effectiveness of administrative procedures and regulations (including curfews) designed to lessen noise, and the monitoring of such procedures and regulations;

- the extent to which aircraft noise should be taken into account in establishing priorities and programmes for the development of existing airports and the building of new airports within and adjacent to major urban areas;

- compensation schemes for aircraft noise operating in the United Kingdom and other countries and the effect of those schemes on airport planning and development;

- the constitutional powers of the Commonwealth, State and local governments to legislate for the adequate control of aircraft noise and ways in which these powers could be used for that purpose.

The Committee received over 3,000 pages of evidence and 600 submissions and technical documents. However, the Committee reported (13 September 1984) that it was unable to complete its inquiry within the term of the Parliament. Because membership of standing committees changes following an election, the Committee recommended that a Select Committee, with similar terms of reference to the former Committee, should be established by the new Parliament to carry on the work, and a Select Committee has recently been established. Thus, in this Draft Environmental Impact Statement, the assessment of noise effects and possible ameliorative measures is made within the context of uncertainties as to future government policies, guidelines and regulations, as well as the uncertainties surrounding the timing, scale and nature of future aircraft operations.

14.2.2 Methods of measuring aircraft noise exposure

Various measures of cumulative noise exposure have been developed internationally. The Noise Exposure Forecast (NEF) system, developed by the United States Federal Aviation Administration, was recommended by the 1968 Parliamentary Select Committee on Aircraft Noise for use in Australia as a guide to aircraft noise exposure, and was subsequently adopted. The NEF system involves construction of contours that link together points of equal cumulative noise exposure. The contours are generated from the following input data: airport flight patterns, number of daily aircraft operations by type of aircraft and time of day or night, noise characteristics of each aircraft during take-off and landing, and typical runway utilization patterns. The contours usually plotted were for 40, 35, 30, and 25 NEF units, the severity of noise effect increasing with the NEF value. These four contours, when overlaid on a map of land uses, defined those areas potentially subject to aircraft noise exposure levels that would be incompatible with existing land uses.

The appropriateness of the NEF system was generally confirmed by the study undertaken by the National Acoustic Laboratories, which compared various measures of noise exposure. However, this study identified the following ways in which the NEF index could be improved:

- The penalty applied to 'night' flights (between the hours of 10.00 p.m. and 7.00 a.m.) should be reduced. Under the NEF system, one flight during these hours is considered to be equivalent to about seventeen flights at other times; however, among the Australian populations studied, one night flight appears to be equivalent to about two 'day' flights in its effects.

- A penalty should be introduced for aircraft flying in the 'evening' (between the hours of 7.00 p.m. and 10.00 p.m.). One flight in these hours appears to be equivalent in its effect on residents to about four 'day' flights.

- Noise from aircraft that are at the airport itself rather than flying overhead should not be included in the calculation of the NEF.

With the publication of the National Acoustic Laboratories report in 1982, the Department of Aviation amended the method of calculating NEF contours for Australian airports to take account of that report's findings (Appendix C). The resultant index has been named the Australian Noise Exposure Forecast (ANEF) to distinguish it from the NEF index.

The ANEF computation is based on forecasts of air traffic movements on an average day. If the 20 ANEF contour were calculated day by day, its position would vary considerably according to traffic patterns, although this variation would be less in the case of the higher contours.

Noise exposure on a particular day will also be affected by temperature, wind, humidity and meteorological conditions. Temperature differences from point to point and wind velocity can affect the speed at which sound travels by bending it from its normal straight line path.

If sound is propagated in a medium containing a temperature gradient, the sound waves are deflected towards the lower temperature region. Temperature generally decreases with elevation and therefore sound waves tend to bend upward. Since the ground retains heat in the daytime, the sound wave attenuation is greater than at night; when the earth cools at night, sound travels along the ground more readily.

Temperature inversions, which are quite common at Wilton (Section 14.3), can sometimes trap sound waves between the earth and the inversion layer, resulting in a 'sporadic bounce' effect. If the inversion layer is low, alternate sound shadow zones and intensification zones can be created, with the result that people farther from an airport may hear an aircraft more easily than others closer to it.

Similarly, once aircraft descend below the inversion layer, the sound energy radiated upward will be partially reflected towards earth, producing a reinforced ground impact. Cloud layers have an effect similar to that of an inversion layer.

Humidity affects the absorptive quality of air, its effect increasing with the increasing frequency of the sound waves.

14.2.3 Land use compatibility

In the light of the National Acoustic Laboratories report, the Department of Aviation prepared land use compatibility advice for use by State and local governments when planning land uses for areas near airports. This advice (Appendix C) is summarized in Table 14.2.1.

The advice supports the use of the 25 ANEF contour as the appropriate criterion for limiting residential land use in the vicinity of airports, while recognizing that, as shown in the National Acoustic Laboratories report, some people with a higher sensitivity to noise may find noise exposure at the 20 ANEF level still unacceptable.

As it would not be feasible to apply the recommendations in Table 14.2.1 to land uses around existing airports where residential development has been established for some time, the principal applications for the criteria are in determining the appropriateness of new urban development around existing airports and guiding planning for suitable land uses around new airports.

The table may be used for the broad scale evaluation of the effects of a new airport on noise sensitive land uses in conjunction with the National Acoustic Laboratories findings with respect to people's reaction to airport noise.

Table 14.2.1 Land use compatibility advice by the Department of Aviation for areas in the vicinity of Australian airports

Land use	ANEF range			
	Below 20	20-25	25-30	Above 30
Residential	Yes	Yes (Note 1)	No	No
Hotels, motels, offices, public buildings	Yes	Yes	(Note 2)	No
Schools, churches	Yes	No	No	No
Hospitals, theatres	Yes	Yes (Note 2)	No	No
Commercial, industrial	Yes	Yes	Yes	(Note 2)
Outdoor recreational (non-spectator)	Yes	Yes	Yes	Yes

Notes:

(1) Some people may find the areas within the 20 to 25 ANEF contours to be unsuitable for residential use, and land use authorities may consider it appropriate to incorporate noise control features in the construction of residences in such zones.

(2) An analysis of building noise reduction requirements should be made by an acoustic consultant for such land uses within these ANEF contours and any necessary noise control features included in building design.

(3) The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variations in aircraft flight paths.

Source: Department of Aviation, 1982a.

For non-residential land uses, the table is used here as a source of recognized criteria for identifying schools, churches and other land uses that would be incompatible with the assumed level and pattern of aircraft operations.

14.2.4 Subjective reaction to aircraft noise

In a residential area subject to aircraft noise, the number of residents affected will depend on two factors not covered in the compatibility advice:

- the population density

- the ANEF level (e.g. if the ANEF level is 30 instead of 25, more people will be severely affected).

The National Acoustic Laboratories report contains research findings which allow an estimate to be made of the number of people exposed to noise levels over 20 ANEF who will be moderately or severely affected by noise. For that study, personal interviews were conducted with 3,575 residents around the commercial airports in Sydney, Adelaide, Perth and Melbourne, and the RAAF Richmond Base.

From the responses to the questionnaire, it was concluded that subjective reaction to aircraft noise could best be measured in terms of a 'general reaction' (GR) rating, which was a composite of a number of ratings of dissatisfaction, annoyance and fear as well as reports of activity disturbance and complaint disposition. GR is a single score with an 0-10 range which provides an accurate and reliable measure of an individual's overall subjective reaction to aircraft noise.

Figure 14.2.1 illustrates the points on the GR scale at which more than 50% of the respondents to the National Acoustic Laboratories survey reported a variety of negative opinions and behaviours related to aircraft noise reaction. The study report proposed that a score of 4GR or more be taken as indicating that a respondent was 'moderately affected' while a score of 8GR or more be taken as indicating that a respondent was 'seriously affected'.

This study also correlated GR scores with the locations of respondents within the 15, 20, 25, 30, 35 and 40 ANEF contours at each of the airport locations where surveys were conducted. The percentages of respondents who were seriously affected and moderately affected in relation to the noise to which they were exposed (in ANEF units) is shown in Figure 14.2.2.

In areas with a noise exposure level of 20 ANEF, almost half the residential population were at least moderately affected and 12% of residents were seriously affected by aircraft noise. On this basis, the National Acoustic Laboratories report judged that to describe 20 ANEF as an 'excessive' amount of aircraft noise would be to offer a reasonable interpretation of the scientific relationship between aircraft noise and subjective response.

The relationships shown in Figure 14.2.2 have been used to estimate the number of existing and potential future residents of areas likely to be exposed to ANEF levels of 20 or more under the worst case assumptions who would be seriously or moderately affected by aircraft noise.

14.2.5 Method of assessing effects

A worst case for the purposes of calculating ANEF contours for a second Sydney airport was defined as follows:

- the airfield was assumed to operate at a maximum capacity of 275,000 annual aircraft movements, with these movements divided into the following aircraft types:
  - B747 type: 37,500 movements
  - A300 type: 87,500 movements
  - F27 type: 60,000 movements
  - General aviation: 90,000 movements (60% single engine piston, 30% multi-engine piston, 10% business jet);
- evening operations (7 p.m. to 10 p.m.) were assumed to comprise 15% of the general aviation and F27 movements and 20% of the A300 and B747 movements;
- night operations (10 p.m. to 7 a.m.) were assumed to comprise 5% of the general aviation and F27 movements, and 10% of the A300 and B747 movements;
- flight paths for aircraft movements were assigned as shown in Table 14.2.2 and Figure 14.2.3.

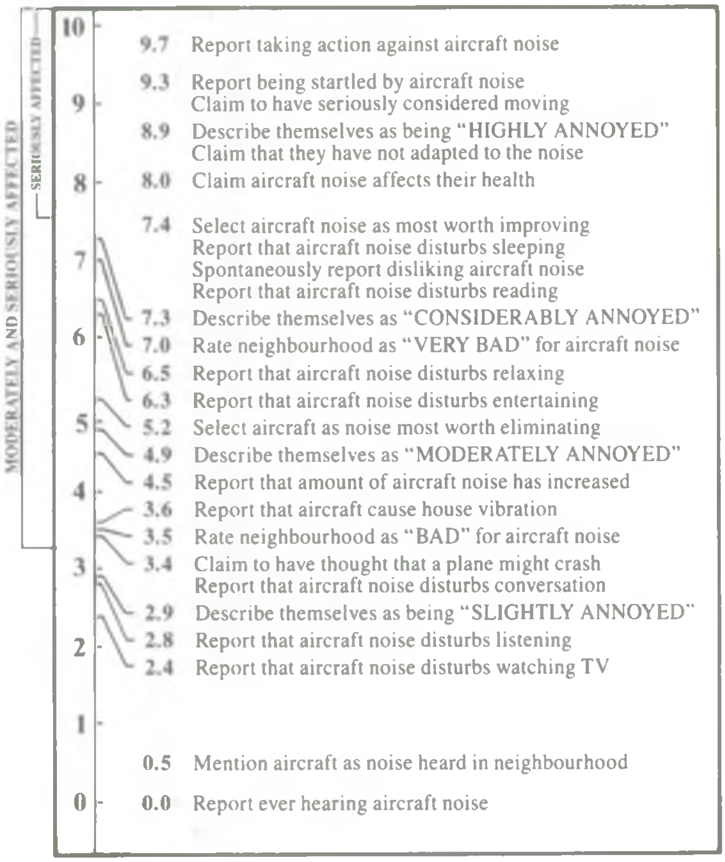


Figure 14.2.1
POINTS ON THE GR SCALE AT WHICH 50% OF RESPONDENTS TO NAL SURVEY QUESTIONS REPORTED VARIOUS REACTIONS

Source: Adapted from National Acoustic Laboratories, 1982

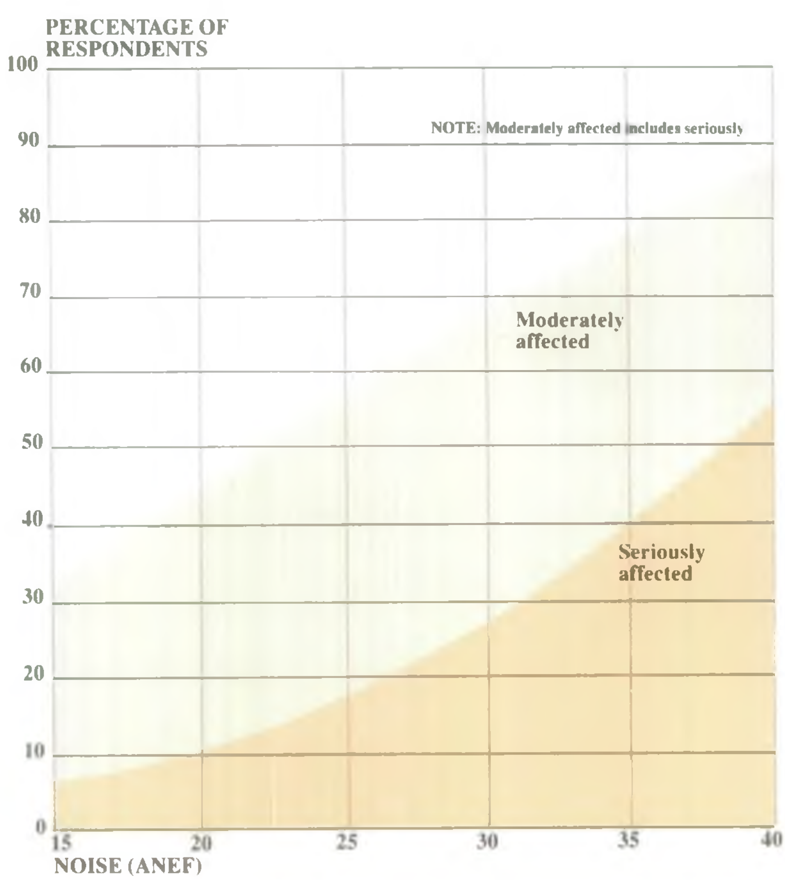


Figure 14.2.2
RELATIONSHIP BETWEEN NOISE EXPOSURE FORECAST LEVEL AND COMMUNITY REACTION IN RESIDENTIAL AREAS

Source: Draft Australian Standard Acoustics: Aircraft Noise Intrusion Building Siting and Construction (Revision 8 AS 2021 – 1977) adapted from NAL reports

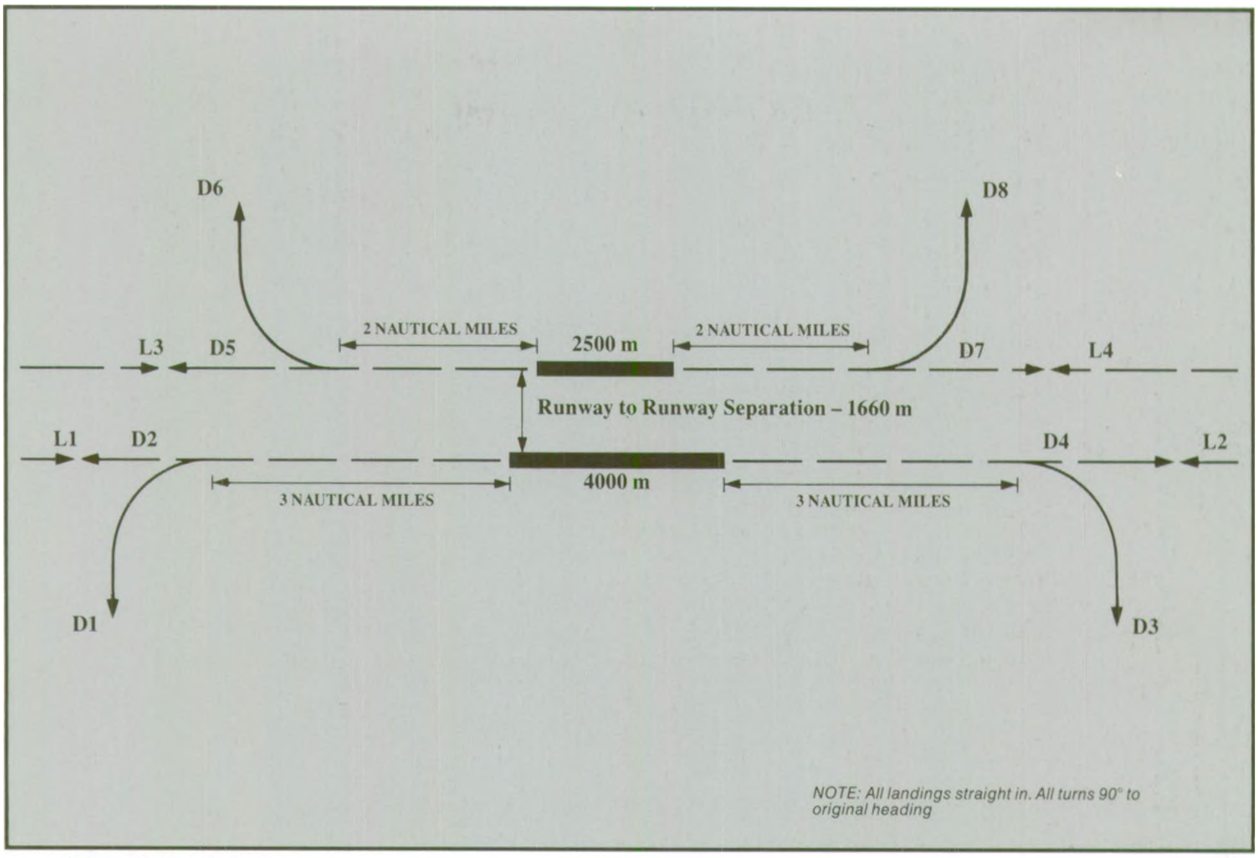


Figure 14.2.3
FLIGHT PATHS

Table 14.2.2 Flight path assignment

Flight path	Percentage operation by class							
	General aviation		F27 type		A300 type		B747 type	
	Day	Ev/night	Day	Ev/Night	Day	Ev/night	Day	Ev/night
L1	8	0	8	0	30	7	35	15
L2	8	0	8	0	30	8	35	15
L3	32	10	32	10	5	7	0	0
L4	32	10	32	10	5	8	0	0
% Total daily landings	80	20	80	20	70	30	70	30
D1	4	0	4	0	7	3	5	4
D2	4	0	4	0	20	6	30	4
D3	4	0	4	0	7	3	5	4
D4	4	0	4	0	20	6	30	4
D5	20	5	20	5	4	3	0	4
D6	12	5	12	5	4	3	0	3
D7	20	5	20	5	4	3	0	4
D8	12	5	12	5	4	3	0	3
% Total daily departures	80	20	80	20	70	30	70	30

The resulting ANEF contours were then used to estimate the maximum future numbers of residents likely to be seriously or moderately affected under the worst case assumptions. Estimates were made for both the proposed east/west and the alternative north/south runway alignments, which involved the following steps:

- superimposition of the ANEF contours on maps of existing land use zoning in the region;
- estimation by reference to maps and aerial photographs of the extent and nature of any existing subdivision less than the prevailing minimum subdivision size;
- estimation of the maximum number of allotments that could result from further subdivision under existing zoning controls (the unlikely prospect of areas within the 20 ANEF contour other than nominated urban release areas being rezoned to permit urban residential development was not considered);
- application of an average household size for the area from the 1981 Census (3.7 persons) to the maximum number of allotments, in order to derive the maximum population that could be expected within each ANEF contour;
- estimation of the population within each ANEF contour likely to be seriously or moderately affected by aircraft noise based on the findings of the National Acoustic Laboratories study;

This analysis was carried out for the north/south and the east/west runway alignment alternatives at Wilton. The effects of noise on agricultural activities are described in Sections 14.8 and 14.5 respectively.

14.2.6 Comparison of noise effects of proposed and alternative runway alignments

Figure 14.2.4 shows the 20, 25, 30 and 40 ANEF contours for the proposed (east/west) and alternative (north/south) runway alignments at Wilton.

In both cases a total area of approximately 6,700 ha outside the proposed airport boundary could potentially be subject to noise exposure levels in excess of 20 ANEF under the worst case assumptions.

Proposed alignment (east/west)

Noise-affected land
Table 14.2.3 gives a breakdown, by zoning category and ANEF level, of the area outside the airport but within the 20 ANEF contour. Present zoning controls already greatly restrict the possible future extent of land uses incompatible with the worst case level of airport operations. Water catchment land accounts for 93% of the off-site area within the 20 ANEF contour, while land zoned with a minimum permitted subdivision size of 40 ha accounts for a further 3% of the off-site noise-affected area. All the off-site area within the 25 ANEF contour is water catchment land. There are no schools, hospitals or other noise-sensitive uses covered by the Department of Aviation's land use compatibility advice (Table 14.2.1) located within the 20 ANEF contour.

Maximum future noise-affected population
Table 14.2.4 provides a summary of the projected number of people who could potentially be affected by aircraft noise under the worst case assumptions for aircraft operations and assuming dwellings are built on all existing or future subdivisions. It is estimated that in the future there could be about 130 people living within the 20 ANEF contour. The future population within the 20 ANEF contour potentially seriously or moderately affected by aircraft noise within the 20 ANEF contour is shown in Table 14.2.5, and has been calculated from the information given in Table 14.2.4 and Figure 14.2.2.

ANEF contour for proposed runway alignment (east/west)

ANEF contour for alternative runway alignment (north/south)

Figure 14.2.4
ANEF CONTOURS FOR WILTON, PROPOSED AND ALTERNATIVE RUNWAY ALIGNMENTS

Table 14.2.3 East/west alignment: potential noise-affected areas (ha)*

Zoning category**	ANEF				Total
	20-25	25-30	30-40	40+	
2 ha minimum	27	-	-	-	27
16 ha minimum	263	-	-	-	263
40 ha minimum	200	-	-	-	200
100 ha minimum	-	-	-	-	-
Water catchment	3,306	1,949	1,019	22	6,296
Total	3,796	1,949	1,019	22	6,786

* Within 20 ANEF contour and outside site boundary.

** The land use zoning categories are derived from information on local planning schemes supplied by the Department of Environment and Planning. The urban/urban release category relates to land included in village zones or shown in the NSW Urban Development Programme (Department of Environment and Planning 1983) as existing urban land or urban development programme release areas. The 2 ha minimum category relates to land zoned Rural 'C1' having a minimum allowable subdivision size of 2 ha. The 16 ha minimum category relates to a land zoned Rural 'A2' having a minimum subdivision size of 16 ha. The 40 ha minimum category relates to Rural 'A1' land having a minimum allowable subdivision size of 40 ha. The 100 ha minimum category relates to land zoned Rural 'A3' land having a minimum subdivision size of 100 ha. The water catchment category relates to Special Uses zones 5(C1) Water Catchment (MWS&DB). The zones in the planning schemes do not necessarily correspond to existing land uses.

Table 14.2.4 East/west alignment: potential noise-affected population within 20 ANEF contour

Zoning category**	ANEF				Total
	20-25	25-30	30-40	40+	
2 ha minimum	50	-	-	-	50
16 ha minimum	61	-	-	-	61
40 ha minimum	19	-	-	-	19
100 ha minimum	-	-	-	-	-
Water catchment	-	-	-	-	-
Total	130	-	-	-	130

** See note to Table 9.2.3 for explanation of these zoning categories.

Alternative alignment (north-south)

Noise-affected land
Table 14.2.6 gives a breakdown, by zoning category and ANEF level, of the total area within the 20 ANEF contour around the alternative runway alignment. As with the east/west alignment existing zoning controls already greatly restrict the possible future extent of land uses incompatible with the worst case level of airport operations. Water catchment land accounts for 51% of the off-site area within the 20 ANEF contour, while land zoned with a minimum subdivision size of 40 ha or greater accounts for a further 47% of the off-site area, leaving a balance of about 2% accounted for land subject to a 16 ha minimum subdivision size.

Table 14.2.5 East/west alignment: number of people potentially noise-affected, by ANEF level and how much affected

Population	ANEF contour				Total
	20-25	25-30	30-40	40+	
Estimated maximum future population	130	-	-	-	130
No. seriously affected	18	-	-	-	18
No. moderately affected*	68	-	-	-	68

* Includes those seriously affected.

Maximum future noise-affected population

Table 14.2.7 provides a summary of the projected number of people who could potentially be affected by aircraft noise in the surrounding areas. It is estimated that there could be approximately 240 people living within the 20 ANEF contour. Potentially, up to about 50 people could live in areas affected by noise levels in excess of 30 ANEF. The future population potentially seriously or moderately affected by aircraft noise in terms of the National Acoustic Laboratories GR index is shown in Table 14.2.8 below, and has been calculated from the information given in Table 14.2.7 and Figure 14.2.2.

A comparison of the proposed and alternative alignments

Table 14.2.9 compares the north/south and east/west alignments. The proposed east/west runway alignment at the Wilton site would affect significantly fewer people. However, in both cases the numbers are at a level where it could be argued that, by themselves, the noise effects advantages of the proposed east-west alignment are not sufficient justification for preference over the north-south alignment given other important considerations. The potential noise effects could be limited by planning controls to restrict further development, and this could make the difference between the noise effects of the two alignments insignificant. Equally, though, planning controls on subdivision might be relaxed. Wilton is one of the potential areas for further urban development identified by the Department of Environment and Planning (Section 9.8). A north-south alignment could be a signficant constraint on this, whereas the proposed east/west alignment has the advantage that 93% of the potential noise-affected land is water catchment and therefore without potential for urban development. This is one reason for the Department of Aviation preferring the east-west alignment.

14.2.7 Evaluation of noise effects of the proposed alignment

The ANEF contours for the proposed east/west alignment are shown on a 1:25,000 scale fold-out map at the rear of this report (Appendix U). The noise effects of the proposed alignment may be evaluated by comparison with those of existing major Australian airports. Table 14.2.10, which compares the future maximum population within the 20 ANEF contour around Wilton with the existing populations within the 20 ANEF contours around four major Australian airports, shows the numbers likely to be seriously or moderately affected by noise to be much lower than at the existing airports. This is despite the following worst case assumptions:

- a level of aircraft operations that is 62% higher than the level at Kingsford-Smith Airport;

- a continued population increase within the 20 ANEF contour (...% increase over the estimated 1981 population) around Wilton up to the maximum allowable given existing zoning controls;

- no allowance for possible beneficial effects from any future modifications to aircraft or operating practices, or both, to minimize noise impacts.

Table 14.2.6 North/south alignment: potential noise-affected areas (ha)*

Zoning category**	ANEF				Total
	20-25	25-30	30-40	40+	
2 ha minimum	-	-	-	-	-
16 ha minimum	80	53	31	1	165
40 ha minimum	524	634	415	8	1,581
100 ha minimum	1,318	214	-	-	1,532
Water catchment	1,939	978	487	8	3,412
Total	3,861	1,879	933	17	6,690

* Within 20 ANEF contour and outside site boundary.

** The land use zoning categories are derived from information on local planning schemes supplied by the Department of Environment and Planning. The urban/urban release category relates to land included in village zones or shown in the NSW Urban Development Programme (Department of Environment and Planning 1983) as existing urban land or urban development programme release areas. The 2 ha minimum category relates to land zoned Rural 'C1' having a minimum allowable subdivision size of 2 ha. The 16 ha minimum category relates to a land zoned Rural 'A2' having a minimum subdivision size of 16 ha. The 40 ha minimum category relates to Rural 'A1' land having a minimum allowable subdivision size of 40 ha. The 100 ha minimum category relates to land zoned Rural 'A3' land having a minimum subdivision size of 100 ha. The water catchment category relates to Special Uses zones 5(C1) Water Catchment (MWS&DB). The zones in the planning schemes do not necessarily correspond to existing land uses.

Table 14.2.7 North/south alignment: potential noise-affected population within 20 ANEF contour

Zoning category**	ANEF				Total
	20-25	25-30	30-40	40+	
2 ha minimum	-	-	-	-	-
16 ha minimum	19	12	7	-	38
40 ha minimum	48	58	38	4	148
100 ha minimum	48	8	-	-	56
Water catchment	-	-	-	-	-
Total	115	78	45	4	242

** See note to Table 9.2.6 for explanation of these zoning categories.

Table 14.2.8 North/south alignment: number of people potentially noise-affected

Population	ANEF contour				Total
	20-25	25-30	30-40	40	
Estimated maximum future population	115	78	45	4	242
No. seriously affected	16	18	18	2	54
No. moderately affected*	60	49	35	3	147

* Includes those seriously affected.

Table 14.2.9 Comparison of Wilton runway alignment alternatives in terms of noise-affected population

Population criterion*	Number of people potentially affected	
	East/west alignment	North/south alternative
Population within 40 ANEF contour	-	4
Population within 30-40 ANEF contour	-	45
Population within 25-30 ANEF contour	-	78
Population within 20-25 ANEF contour	130	115
Total population within 20 ANEF contour	130	242
Total population seriously affected	18	54
Total population moderately or or seriously affected	68	147

* In each case, the maximum future population estimate is based on the assumption that existing zoning arrangements will continue.

Nevertheless, should the worst case eventuate, the noise effects on those few people seriously affected would be severe, as illustrated by the GR index in Figure 14.2.1. Prior to the stage at which worst case levels were reached, and possibly long before, adverse effects of noise could be felt in two ways:

- direct noise effects of a lower order of magnitude
- effects on property values.

Past studies of the impacts of aircraft noise have not been conclusive. A review of thirteen empirical studies of airport noise and property values (Nelson 1980) concluded that the weight of evidence was that two houses with different noise environments but otherwise identical would differ in value in proportion to the noise level difference. However, the studies related mainly to properties exposed to 30 ANEF or more; also, the 'otherwise identical' basis for the conclusion leaves open the possibility that at a second Sydney airport the negative effects of airport noise will be outweighed by the positive effects of increased demand for residential properties created by airport employment opportunities. Since for a given airport location and scale of development the increased land demands are constant whatever the noise impacts, a situation such as that which would apply at Wilton (where noise impacts would be slight compared with those at other airports) makes it more likely that the adverse effects of noise would be outweighed by the effects of increased land demand. For individual properties potentially subject to high noise levels, this generalization may not hold. Even in these cases, however, decisions by the State Government with respect to new road and rail works (Section 14.4) and land use zoning (Section 14.2.10) could have a more significant influence on property values.

Table 14.2.10 Comparison of populations within 20 ANEF contour

Airport	Average number of aircraft movements*		Number of people within 20 ANEF**			
	Per day	Per night	Seriously affected by noise	Moderately+ affected by noise	Others	Total population
Wilton east/west alignment	371.2	135.6	18	68	62	130
Sydney, Kingsford-Smith	218.1	76.3	62,198	141,436	67,374	208,810
Melbourne, Tullamarine	166.0	55.0	2,238	8,188	6,374	14,562
Adelaide	49.3	21.5	10,005	31,586	19,347	50,933
Perth	27.6	24.4	3,438	9,812	9,234	19,046

* F27 size and over; day - 7 a.m. to 7 p.m; night - 7 p.m. to 7 a.m.

** For Wilton, numbers are estimated future maximum populations assuming continuity of existing land use zoning and construction of dwellings on all existing subdivisions; for major Australian airports, numbers are 1981 estimates.

\+ Includes seriously affected.

Source: Numbers for Wilton have been estimated by methods described in the text; numbers for other airports have been calculated from data contained in the National Acoustic Laboratories report, 1982. Although this data relates to NEF 3,6 contours which differ from ANEF contours, these differences are not significant. Aircraft movements for Tullamarine are as provided by the Department of Aviation.

14.2.8 Ameliorative measures

The principal ameliorative measures that may be considered for application to potential noise-affected areas are:

- source and operational controls
- land use controls
- building controls.

Source and operational controls

The current generation of jet aircraft, which are expected to be operational to at least the year 2000, incorporate advanced engine technology that has significantly reduced noise output. It is unlikely that further significant engine noise reductions could be achieved without a major step forward in the technology of engine design.

There are also some operational and administrative controls that could be introduced to minimize the number of people affected by airport noise. They include the method of using the runways and the flight paths that aircraft use. It is possible that new technology may allow use of new techniques that lead to a reduction of noise effects.

However, none of the above controls can be counted on to significantly reduce the estimates of the maximum potential noise-affected population under the worst case assumptions.

Land use controls

Stringent land use controls over potentially noise-affected areas can be used to prevent the number of people who could be seriously or moderately affected by aircraft noise reaching the maximum levels estimated above for the worst case conditions. As the Commonwealth has no power to implement and maintain the necessary land use controls, the present practice of the Department of Aviation for protecting airport environs is to issue the relevant land use control authorities with an ANEF contour map along with its land use compatibility advice. Directions made in 1983 under Section 117(2) of the NSW Environmental Planning and Assessment Act, 1979, restrict the powers of councils to rezone land in areas where the ANEF level advised by the Department of Aviation exceeds 20.

The Department of Environment and Planning is currently investigating interim planning measures to control and protect the two sites short-listed for Sydney's second airport and the surrounding areas that may be noise-affected. It is proposed that the interim planning measures would take effect at the time of the public release of the Draft Environmental Impact Statement and that, upon announcement of the selected site, they would be revoked for the site not selected. The interim measures would relate to the ANEF noise contours map for the east/west alignment, included as a fold-out map in Appendix U of this report.

After a site has been selected, more comprehensive land use planning measures will be required in order to direct development in the noise-affected areas, to prohibit inappropriate uses, to identify land for future airport associated uses and also to address the relationship of the airport to other issues in the Macarthur Sub-Region. It is proposed that a strategic land use plan for the area in the proximity of the selected airport site will be included in the Macarthur Regional Environmental Plan (Section 14.8).

In the long term, when future aircraft numbers, types and flight paths become less uncertain, it is likely that revised ANEF maps will be issued by the Department of Aviation showing less extensive potential noise effect.

Building controls

In parallel with the above land use controls, those local councils with areas affected by aircraft noise should also implement building standards such as those set out in the draft Australian Standard for Acoustics: Aircraft Noise Intrusion - Building Siting and Construction (revision of AS 2021-1977). This draft standard, like the Department of Aviation's land use compatibility advice, is based on the findings of the National Acoustic Laboratories report on Aircraft Noise in Australia. It defines building site acceptability by ANEF zone (Table 14.2.11), and provides recommendations on appropriate building construction techniques to ensure that desired indoor sound levels can be achieved.

The classes of building site acceptability specified in the draft Standard are:

- Acceptable: If the building site is classified as 'acceptable', there is usually no need to provide protection specifically against aircraft noise in the building's construction.

- Conditional: If the building site is classified as 'conditional', the maximum aircraft noise levels for the relevant aircraft should be determined and the aircraft noise attenuation to be expected from the proposed construction should be determined. (The procedure for making these determinations is set out in the draft Standard.)

- Unacceptable: If the building site is classified as 'unacceptable', construction of the proposed building(s) should not normally be considered.

Table 14.2.11 Building site acceptability for noise reduction assessment

Building type	Building site acceptability based on ANEF zones		
	Acceptable	Conditional	Unacceptable
Houses, home units, flats	Less than 20 ANEF (Note 1)	20-25 ANEF (Note 2)	Greater than 25 ANEF
Hotels, motels, hostels	Less than 25 ANEF	25-30 ANEF (Note 3)	Greater than 30 ANEF
Schools, universities	Less than 20 ANEF (Note 1)	20-25 ANEF (Note 3)	Greater than 25 ANEF
Hospitals, nursing homes	Less than 20 ANEF (Note 1)	20-25 ANEF (Note 3)	Greater than 25 ANEF
Public buildings	Less than 20 ANEF (Note 1)	20-25 ANEF (Note 3)	Greater than 25 ANEF
Commercial buildings	Less than 25 ANEF	25-30 ANEF (Note 3)	Greater than 30 ANEF
Light industrial buildings	Less than 30 ANEF	30-35 ANEF	Greater than 35 ANEF
Heavy industrial buildings	Acceptable in all ANEF zones		

Notes:

1. The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight paths.
2. Some people may find the areas within the 20-25 ANEF contour to be unsuitable for residential use. Land use authorities may consider that the incorporation of noise control features in the construction of residences is appropriate.
3. An analysis of building noise reduction requirements should be made by an acoustic consultant and any necessary noise control features included in the design of the building.

Source: Draft Australian Standard for Acoustics: Aircraft Noise Intrusion - Building Siting and Construction (revision of AS 2021-1977).

Acquisition of potentially noise-affected land

Section 51(XXXI) of the Australian Constitution confers on the Australian Parliament the power to make laws for 'the acquisition of property on just terms from any State or person for any purpose in respect of which the Parliament has power to make laws'.

However, there is some doubt about the validity of acquiring land that is not required for a specific public purpose; in other words if the Commonwealth Government acquired land and then disposed of it subject to restrictions on noise sensitive development, such action might be challenged. The proposed acquisition boundaries outlined in this Draft Environmental Impact Statement are based on those areas required for aircraft operations and related activities, and do not include the acquisition of additional areas which could be affected by aircraft noise. Nevertheless, the principle of purchasing buffer zones was considered in detail by the House of Representatives Standing Committee on Environment and Conservation in the last Parliament, and it may be that there could be changes in practice after the Select Committee in the present Parliament has reported.

Compensation for injurious affection

There is no provision under the Lands Acquisition Act 1955 or other Commonwealth legislation for the payment of compensation for injurious affection such as may be caused by aircraft noise.

14.2.9 Construction noise

Construction noise likely to be heard beyond the boundaries of the site would be that associated with the major earthworks required for the runways and terminal areas.

This phase of construction could be expected to last for two to three years. Typical equipment would include scrapers, front-end loaders, bulldozers and heavy haul trucks.

The source noise levels of this machinery are in the range 70-100 dBA, depending on equipment type and operating load. Given the quantities of earth to be moved (and hence the number of vehicles required), it could be expected that construction noise levels (L10) of 55-60 dBA could be experienced for periods at points along the boundary of the site depending upon when and where earthworks were in progress.

This noise level could be 10-15 dBA higher than background levels which would be noticeable.

14.3 ARCHAEOLOGY

This section discusses the results of the archaeological assessment of the proposed airport site and its surrounds. The principal objectives of this assessment were to determine the nature and distribution of Aboriginal archaeological sites in the area, to assess their significance, and to evaluate the potential effects of airport development upon these sites.

In achieving these objectives, the following methods were used:

- Previous archaeological investigations relevant to the area were reviewed.
- A concise, environmentally based predictive statement was prepared, based on this archaeological review and on environmental information, geological and topographic maps and air photos.
- This information enabled appropriate fieldwork methods to be devised which were then refined in the field to take account of site conditions affecting archaeological visibility, such as ground surface visibility and exposure.

- In considering the results of the field survey of each area, the following points were addressed:

  - the representativeness of the survey in determining the nature and distribution of the archaeological resource, and in particular the degree to which the field results fitted the expected patterns;

  - the significance of the archaeological sites located, and of the archaeological resource as a whole.

14.3.1 Existing site data

Environmental setting

The study of the potential archaeological resources of the ten proposed airport sites used a subdivision of landscape types based on bedrock geology and landform to identify environmental zones of differing archaeological sensitivity. For Wilton, the zones identified were:

- plateau on Wianamatta Shale with some Hawkesbury Sandstone outcrops;
- plateau on Hawkesbury Sandstone with some Wianamatta Shale;
- valleys and gullies in Hawkesbury Sandstone.

The more detailed archaeological study of Wilton proceeded on the basis of archaeological fieldwork, in which the above zones were refined to reflect more closely the likely distribution of archaeological sites within the proposed airport site and environs. This allowed a more homogeneous assessment to be made of the archaeological sensitivity of individual environmental zones. The modified system used to describe the environmental zones (Figure 14.3.1) was as follows:

- plateau on Hawkesbury Sandstone or Wianamatta Shale;

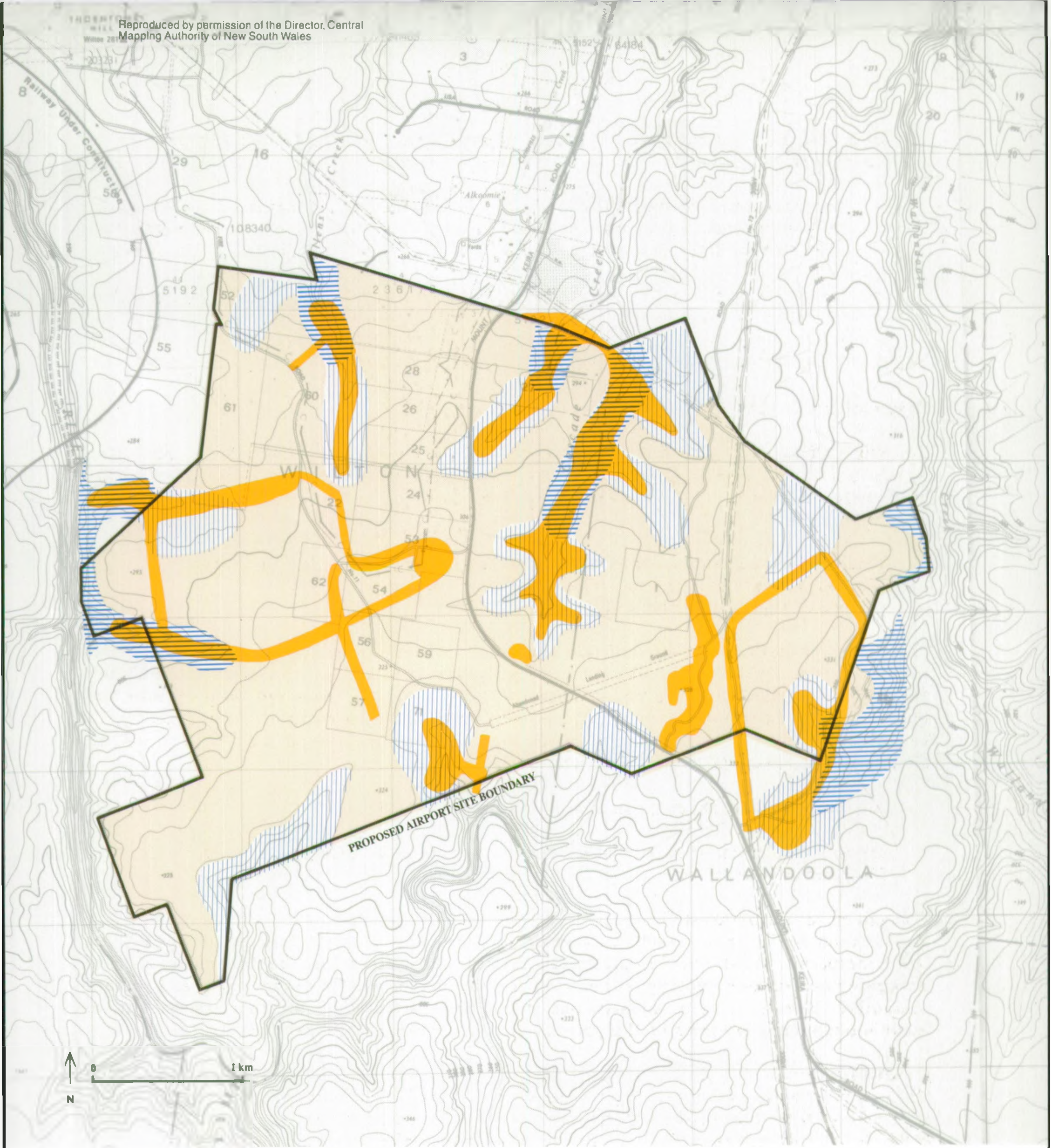
- creek-lines, consisting of broad upper valleys and entrenched lower valleys in Hawkesbury Sandstone.

Plateau on sandstone or shale
The plateau landform is gently undulating in this area and has a dense vegetation cover of eucalypt woodland and forest. This environmental zone can be further subdivided according to bedrock geology, vegetation formations, extent of groundcover and surface visibility. However, these subdivisions would have little value for this assessment, as each is equivalent in terms of the potential for detection of archaeological sites.

Creek lines
There are a number of creeks in the proposed airport site and its environs. In the higher reaches of these creeks the valleys are broad, with gently sloping banks and sandstone outcrops in the creek beds. In the lower reaches the creeks are entrenched in the underlying sandstones, producing steep slopes and escarpments containing rock shelters and overhangs.

Previous investigations

Generally, the majority of archaeological sites in sandstone areas of the Sydney Basin have been located either in shelters produced by the cavernous weathering of sandstone cliffs (occupation deposits and painted art), on outcrops of sandstone (engraving and grinding grooves) or on escarpments, in creek beds, or on sandy ground near creek-lines (artefact scatters). Other sites which may occur include burials, scarred or carved trees, and stone arrangements, but the locations of these cannot be generalized.



Sampling locations

ENVIRONMENTAL ZONE

ZONE	LANDFORM AND GEOLOGY
	Plateau on Hawkesbury Sandstone and Wianamatta Shale
	Creeklines in broad upper valleys in Hawkesbury Sandstone
	Creeklines in entrenched lower valleys in Hawkesbury Sandstone

Figure 14.3.1
ABORIGINAL ARCHAEOLOGICAL ZONES AND SAMPLING LOCATIONS

NOTE: Specific locations of sites are not shown in order to ensure their protection

There have been few systematic archaeological surveys in the Wilton district. Of the surveys which have been conducted, all but one have been transects, covering only small portions of the environmental zones which occur within the boundaries of the proposed airport site (Haglund 1974; Attenbrow and Happ 1983; Kamminga 1981). These surveys located several sandstone shelters with charcoal drawings, and a number of other shelters that would have been suitable for occupation but which had no evidence of having been used.

An archaeological survey conducted by Haglund in 1982 included the examination of part of Allens Creek, some of which lies within the boundaries of the proposed airport site. Eight sites were recorded by Haglund in the gorge of Allens Creek. Of these, two shelter sites occur within the proposed airport boundary; these contain charcoal and ochre line drawings and white hand-stencils.

In addition to sites recorded during systematic survey, several others have been identified in the Wilton district. These are primarily shelter sites with drawings on protected walls, although other sites including grinding grooves and rock engravings have also been found. The most notable is the Wilton site, 4 km to the north of the proposed airport site. This has been described by Sim (1964), and has extensive charcoal drawings along approximately 30 m of rock shelter wall.

14.3.2 Archaeological survey

Predictive statement

Based on the results of these earlier investigations and other relevant information, predictions were developed concerning the likely nature, location, and frequency of occurrence of prehistoric archaeological sites in the area of the proposed airport site and its environs. The predictions made were as follows:

- On the plateau, only low density scatters of stone artefacts will be found, depending on the conditions of exposure of the ground surface and the surface visibility.

- As a result of past logging activities and bushfires, it is unlikely that there will be any scarred or carved trees remaining in the area.

- Sites along the creeks where sandstone outcrops will include artefact scatters along the creek beds, and art sites and occupation deposits in shelters in sandstone outcrops in the entrenched reaches of the creeks.

Fieldwork strategy

Given the results of previous archaeological investigations in the region, the distribution of archaeological sites was expected to be strongly correlated with outcrops of sandstone. Because of this, the field survey was concentrated in areas where these occurred, which were primarily along the major drainage lines.

Each of the main creeks in the proposed airport site was therefore examined, as well as sandstone outcrops in the valleys, particularly those exposed in creek beds and on the hillslopes overlooking creeks. Sandstone outcrops in which cavernous weathering had produced rock overhangs were closely inspected both for drawings on rock faces and for artefacts on shelter floors. A close inspection of sandy soil on level ground beside creeks was also made for artefact scatters. In addition, several transects were made across areas of forested country on shale and sandstone derived soils to investigate site occurrence on the plateau.

The sample survey areas examined during the field study are shown on Figure 14.3.1.

Results of the field survey

Two of the rock shelters with Aboriginal drawings located adjacent to Allens Creek that had been identified by Haglund in her 1982 survey were visited and found to be within the area of the proposed airport site. In addition, two rock shelters with possible stone artefacts were located adjacent to Cascade Creek. One shelter contains two quartz fragments while the other contains four. However, because these artefacts lie in a surface lag of quartz pebbles, some of which are fractured, it is possible that they are naturally occurring. The quartz pebbles would have been eroded from the sandstone of the rock shelters.

No other archaeological materials were observed in the proposed airport site, although a shelter site with charcoal drawings was located by other field workers in the gorge of the Cordeaux River just beyond the proposed airport site boundary.

Assessment of archaeological sensitivity

The likely archaeological characteristics and sensitivity of the different environmental zones were reassessed in the light of fieldwork results and the previous investigations discussed above.

- **Plateau on sandstone and shale:** The soil and vegetation cover in both the shale and sandstone areas in this zone has been disturbed to a limited degree only and, because of this, archaeological sites that may be present would not have been detected. However, although this zone contains a wide variety of edible plant species, there is an absence of adequate shelter for sustained occupation, and it is likely therefore that the Aboriginal exploitation of this area was largely restricted to the use of these food resources. Thus, there would probably be little or no archaeological traces left. It is considered that, despite the poor surface exposure, the fact that no sites were found in this zone is a true reflection of the low frequency of sites on the plateau. The relative uniformity of landform in the plateau areas suggests that this low site frequency can be generalized to areas that were not examined in the field.

  There may once have been scarred and carved trees in this zone. However, the extensive logging and clearing of the area have resulted in the loss of trees of sufficient age to have retained scars of Aboriginal origin.

- **Creek-lines:**

  - **Broad upper valleys in sandstone:** In the upper reaches of the watercourses in this zone the creeks are not deeply incised into the underlying rocks. Of the creeks that were examined, all have outcrops of sandstone which would have been suitable for sharpening hatchet-heads, but no evidence of this activity was found. Some artefact scatters are probably present, although the lack of surface visibility and exposure have prevented such sites being located. It is considered that the archaeological sensitivity of this zone is low.

  - **Entrenched creek-lines in sandstone:** The lower portions of several creeks within the proposed airport site have been deeply entrenched into the sandstone. These include each of the western creeks flowing into the Cordeaux River, Allens Creek and Cascade Creek in the north, and one creek in the southern portion of the site.

    This environmental zone was considered to be potentially the most sensitive in the area. The incision of streams into the underlying sandstones has created cliffs into which cavernous weathering has formed rock overhangs of the type which prehistoric Aborigines used for shelter. The exposed sandstone would also have been suitable for the grinding of stone hatchet-heads. It is in this environmental zone that the two art sites previously recorded by Haglund (1982) and the shelters with stone artefacts were located. Nevertheless, despite a complete survey, no further sites were found, indicating that the sensitivity of this zone is in fact low.

Each Aboriginal art site is considered to be unique, and these sites are widely perceived as having greater aesthetic or heritage significance than sites with scatters of stone artefacts. Because of this and the relative visibility of art sites in rock shelters, such art sites have inevitably become over-represented in the National Parks and Wildlife Service site register (which lists all Aboriginal sites discovered) in comparison with records of the open campsites which would have been used more frequently by the prehistoric Aborigines living in the sandstone areas.

However, while each archaeological site containing scatters of stone artefacts is also considered to be unique, the information that can be derived from one artefact scatter can be used to provide generalized statements about the nature of Aboriginal stone working procedures. It is therefore possible to speak of representative samples of sites with stone artefacts and to preserve much of the information on Aboriginal stone working from only a small number of these sites in any one area.

14.3.3 Assessment of effects and safeguards

The archaeological assessment of effects is confined to the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further investigation once the locations for these facilities were determined.

Archaeological sites which may occur on sandstone and shale derived soils on the plateau would be disturbed or totally destroyed by the construction of an airport. The conclusion drawn from the field survey is, however, that the number and significance of these sites is not high and that representative samples occur in stable settings in areas immediately outside the proposed site which would not be affected by the construction of an airport.

The rock shelter sites adjacent to Allens Creek are within the boundary of the proposed airport site, although preliminary airport design indicates that these would not be directly affected by airport construction. The floor of one of these rock shelter sites is, however, as little as 1 m above the creek bed and if there were any change in the hydrology of this creek which resulted in the water level rising permanently by this amount the Aboriginal drawings in this site would be threatened.

In contrast to art sites which have previously been located in the district (such as the Wilton art site), the two shelter sites adjacent to Allens Creek are poorly preserved. Wind and water erosion in the shelters has resulted in flaking of the sandstone on which the charcoal and ochre drawings are found, while staining caused by the redeposition of minerals on to the shelter walls has obscured some of the art. In segments of the shelter walls where there has been no substantial damage to the art, the pigments used for the drawings have faded, and in many cases the motifs are indistinct.

As the sites are not well preserved and as the art within the shelters continues to deteriorate, their value in terms of scientific, aesthetic or heritage significance decreases with time. No artefacts were observed on the floor of the shelter on the eastern side of Allens Creek, although there were several level areas apparently free from rockfall that may contain occupation deposits of archaeological significance.

Should it be determined after further detailed design that the art sites might be affected by airport development, the Department of Aviation would consult with the local Aboriginal land council and the National Parks and Wildlife Service to determine what action was necessary. Considering the unlikely long-term survival of the art within the rock shelters it is recommended that, if the shelters were to be affected by airport construction, detailed recording of the remaining art should occur, and test excavation of the deposits should be undertaken prior to development to determine the extent and significance of any archaeological materials.

Provided that this programme were followed, no further archaeological investigation is considered to be necessary. However, if any additional information concerning the archaeological sensitivity of the site became available before construction, the Department of Aviation would review the need to appoint a qualified archaeologist to monitor the development during ground disturbance.

All Aboriginal sites in New South Wales are protected under the National Parks and Wildlife Act, 1974, and come under the jurisdiction of the National Parks and Wildlife Service. Before any site can be destroyed, permission must be obtained from the Director of the Service. National Parks and Wildlife policy also requires that developers consult with the local Aboriginal people to ascertain whether a site affected by development is of significance to them.

14.4 CONCERNS OF ABORIGINAL PEOPLE

The principal aim of this section is to describe the views and concerns of Aboriginal people who may be affected by the acquisition proposal or by future airport development at the Wilton site. Contact was made with officers of the Western Metropolitan and the South Coast regional Aboriginal land councils, who referred consideration of the project to the relevant local Aboriginal land councils. These were the Tharawal (Western Metropolitan) and Illawarra (South Coast) local Aboriginal land councils: as Figure 14.4.1 shows, the proposed site is near the boundary of these two land council areas.

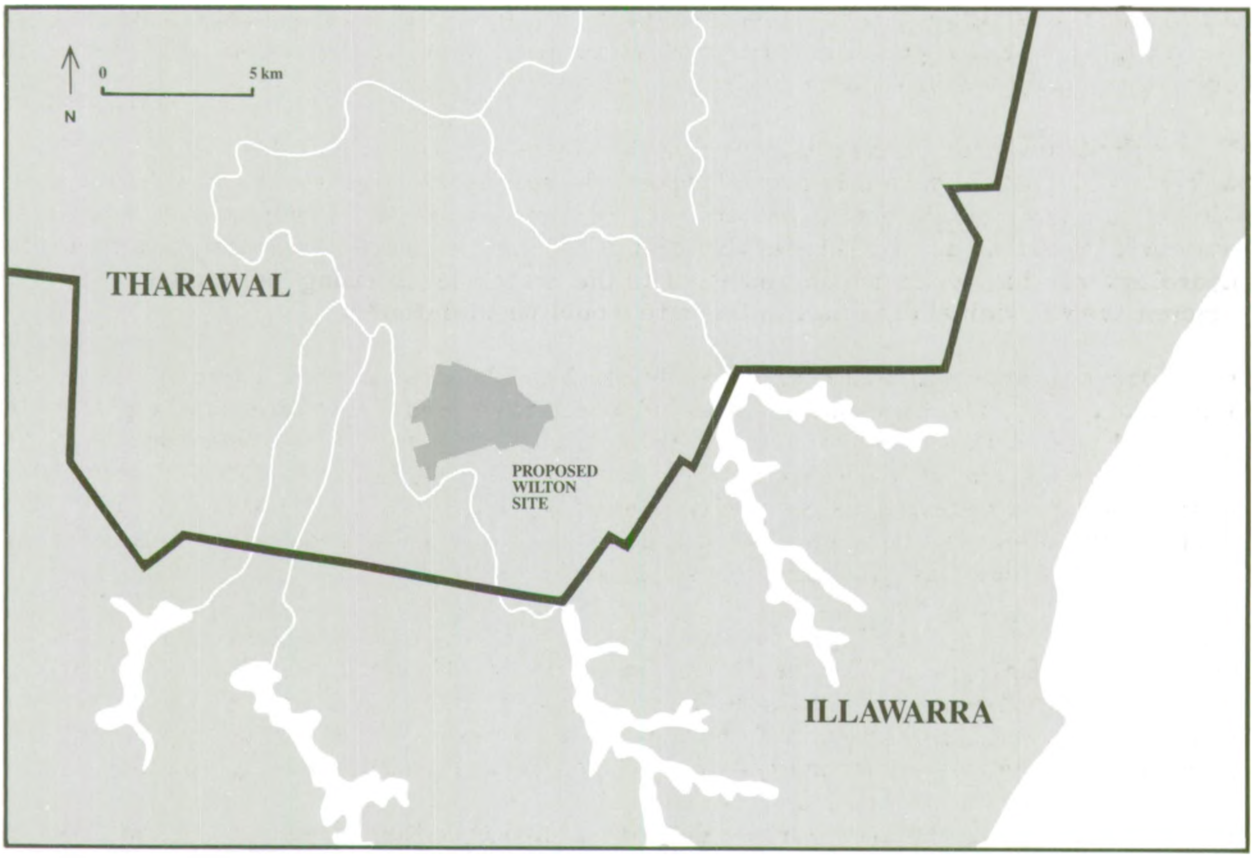


Figure 14.4.1
LOCAL ABORIGINAL LAND COUNCIL AREAS

The Anthropological Consultant attended meetings of the Western Metropolitan Regional Land Council and the Tharawal Local Aboriginal Land Council. There was no meeting held of the South Coast Regional Land Council during this period, and a scheduled meeting of the Illawarra Local Aboriginal Land Council was cancelled.

Each local Aboriginal land council appointed a liaison officer to conduct interviews under the direction of the Anthropological Consultant (in the case of Illawarra, the liaison officer was appointed by the Land Council Secretary). The liaison officers, who were briefed as to the required content and conduct of interviews by the Anthropological Consultant, compiled lists of land council members to be contacted. These lists were then approved by an officer of the relevant land council as being sufficiently representative of the area concerned.

The estimated total Aboriginal population of the Tharawal and Illawarra land council areas is 6,500 (based on Commonwealth Department of Aboriginal Affairs Community Profiles). Of this, some 400 Aboriginal people are recorded on these land councils' membership rolls.

Discussions were held with forty-one members of these land councils (10% of the total membership of both land councils, or 0.6% of the estimated total Aboriginal population within these land council areas). The average age of those interviewed was thirty-six, and their average time of residence in the area was six years. While the number of people interviewed forms only a small percentage of the total Aboriginal population, it is a significant sample of the local population who have involved themselves with the land councils since their formation early in 1984.

Those interviewed were asked for their views on airport development, and what knowledge they had of the area concerned, particularly with regard to places of significance to Aboriginal people. In this regard, a distinction was made in this assessment between:

- an archaeological survey which is concerned with the physical evidence of past human activity;

- an anthropological survey which is concerned with observable and written evidence of past and present human activity. Thus, it encompasses the significance of a particular area in historical and contemporary terms, both as part of a people's cultural expression and as an influence on lifestyles.

The fact that Aboriginal people currently living in the areas with which this study is concerned may not, until recently, have had access to information about the history and traditions of the area is not considered significant in presenting their contemporary perspectives. There are various ways in which a people hand down or receive cultural facts over generations. Facts which are able to be discerned through anthropological studies of the past and present become cultural facts of significance to contemporary Aboriginal people once they are absorbed into Aboriginal consciousness. Direct oral or written transmission through the generations of particular local descent groups is not a prerequisite. The heavy emphasis which tends to be placed by non-Aboriginal people on tangible physical objects as being indicative of past Aboriginal activity obscures these cultural aspects of past and present associations with particular areas.

14.4.1 Description of existing conditions

The Aboriginal people of the area include those who have been born and brought up there as well as those (the majority) who have resettled in the area from other parts of New South Wales during the past twenty years. There are several sites of historical and cultural significance to Aboriginal people in the Wilton area which are known through site surveys organized by local Aboriginal people and through records made available by the National Parks and Wildlife Service. Some of these sites have already been tampered with and are in need of greater protection.

However, while there is a great deal of interest in the traditional life of the Dharawal* people, very little is known by Aboriginal residents about the history of the local area. Given this comparative lack of information, they feel strongly that any sites associated with the history and traditions of Aboriginal people in the area should be the subject of careful preservation and treated as a significant part of the Dharawal heritage. Such sites are regarded as a major means by which Aboriginal people of the area may rediscover the past they have been denied.

Andrews and Bodkin-Andrews (1984) have shown that the Cataract River and gorge are particularly significant areas, both in terms of their sacred meaning to the traditional Dharawal people and as the locations where a great many of the Dharawal people died in their confrontations with Europeans.

14.4.2 Assessment of effects

The anthropological assessment of effects is confined to the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further consultation once the locations for these facilities were determined.

None of the forty-one people interviewed was able to identify any sites of significance within the proposed airport site. Section 14.3 also concludes that there are no sites of archaeological significance to Aboriginal people within the boundary of the proposed site, although there are two art sites (one possibly containing stone scatters) near the northern boundary.

However, there are a large number of Aboriginal sites which have been recorded by the National Parks and Wildlife Service in areas beyond the proposed airport site, and officers of the Service have described the general area as highly archaeologically sensitive. Members of both the Tharawal and the Illawarra local Aboriginal land councils have also expressed concern about the possibility of environmental impacts on sites of historical and cultural significance to Aboriginal people that are outside the proposed airport site but that could be affected by noise, air and water pollution, or changes to stream levels. There is also concern about subsidiary development, such as land being made available for private development in the region. Nevertheless, a majority of those Aboriginals contacted had no objection to the proposed acquisition and airport development provided that this did not cause, either directly or indirectly, any damage to sites of significance. In this context, assurance was requested that there would be no further destruction of the Aboriginal heritage in this area, particularly in view of the little that does remain intact. The possibility of employment opportunities through airport development was welcomed.

There were some Aboriginals, however, who expressed opposition to airport development on the grounds that it would be destructive of very attractive bushland and much wildlife, it would increase urban development, noise and traffic problems, and could pose a pollution threat to the river system. As the peace and quiet of the area had been amajor reason for people having moved there, this potential change in the nature of the area was of considerable concern.

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*Note: Various spellings of this language name are recorded in the early literature. 'Dharawal' is the spelling adopted by the Australian Institute of Aboriginal Studies and has been used in this report when referring to the traditional people of this area. The spelling 'Tharawal' has been adopted by the Local Aboriginal Land Council as being more consistent with conventional English spelling practice for this lamino-dental (Eades 1976).

Indications were given that delegates of the Tharawal Local Aboriginal Land Council to the Western Metropolitan Regional Aboriginal Land Council would seek to amend the motion carried by the Gandangara Local Aboriginal Land Council (Section 9.4.2) to delete any reference to the proposed Wilton site from that motion (which opposed airport development) until such time as the Tharawal Local Aboriginal Land Council has determined its final position regarding the proposed airport site.

14.4.3 Environmental safeguards and monitoring

If the Wilton site were selected for the second Sydney airport, it could be expected that the officers of the local Aboriginal land councils would act to claim and ensure protection of any sites of significance to Aboriginal people in the area to be acquired or any other affected area under the National Parks and Wildlife Service Act, 1974, and/or the Commonwealth Aboriginal and Torres Strait Islander (Interim) Heritage Protection Act 1984.

The Allens Creek sites described in Section 14.3.2 are already recorded Aboriginal Places under the National Parks and Wildlife Act, 1974. If, in the interim period between selection of the site and airport construction, any sites of archaeological significance or of significance to Aboriginal people were identified, steps would be taken where possible by the Department of Aviation to salvage any artefacts or relics or to protect sites.

In addition to the above measures, during the course of preparation of this Draft Environmental Impact Statement the Tharawal Local Aboriginal Land Council made the following submission to the Department of Aviation.

- That all lands not essential to the airport's actual operational needs e.g. buffer zones, etc. should be declared as memorial parkland to the Dharawal nation, and said memorial parkland be managed in perpetuity jointly by the Airport Authority and the Tharawal Local Aboriginal Land Council.

- That the airport be given an appropriate name drawn from the traditional Dharawal language, with such name being acceptable to the Tharawal Local Aboriginal Land Council.

- That within the airport site a museum of Aboriginal artefacts and arts be established and that this museum be managed by the Tharawal Local Aboriginal Land Council and be funded by the Department of Aviation and/or the Federal Government.

- That a scholarship, to be funded by the Department of Aviation and Federal Government, be established to train a suitable person, nominated by the Tharawal Local Aboriginal Land Council, as a professional archaeologist (Aboriginal). This scholarship is to commence within one year of the Government's announcement of the selection of the Wilton site, to be for a maximum tenure of five years, and be financially equivalent (as a minimum) annually to the nominee's previous year's gross income and increased by 10% per annum for the duration of the scholarship.

- That, at the completion of the nominee's archaeological studies, the Department of Aviation employ the said person on site as resident Aboriginal archaeologist up to the end of the airport construction period and thereafter appoint them to the permanent position of Curator of the airport museum at a level no less than the scholarship income annually adjusted by CPI.

- That the Department of Aviation undertake to train and employ Aboriginal staff in permanent positions once the airport becomes operational, at a level no less than 1% of the total permanent staff.

- That the Department of Aviation undertake to ensure the employment of Aboriginal workers during the construction phase of the airport's development at a level of no less than 1% of the full workforce employed at the airport site.

- That the Department of Aviation grant to the Tharawal Local Aboriginal Land Council sole trading rights for the sale of Aboriginal art and souvenirs at the airport site.

- That during the total construction phase of the development, the Department of Aviation employ an Aboriginal Sites Officer to assist the Aboriginal archaeologist. Any Aboriginal Sites Officer employed should have completed the Sites Officer Training Course (organized by Tranby College, Glebe) and be appointed after consultation with the local Aboriginal land councils.

- In addition, during construction, contractors should be made aware that all Aboriginal sites and relics are protected under the National Parks and Wildlife Act, 1974, and any sites, relics or skeletal remains uncovered during construction work must immediately be reported to the National Parks and Wildlife Service. In the event of such finds, any plans for mitigation work should be checked with the National Parks and Wildlife Service and the local Aboriginal land councils prior to such plans being put into effect. This process should be clearly understood in contracts entered into with the Department of Aviation. (The local Aboriginal land councils or the regional or State land councils may invoke the Commonwealth Aboriginal and Torres Strait (Interim) Heritage Protection Act 1984, should they be dissatisfied with action taken which may damage such finds.)

It should be noted that the time available for preparation of this Draft Environmental Impact Statement was insufficient to enable the normal negotiating processes required for full consultation with Aboriginal communities to be followed.

14.5 EUROPEAN HERITAGE

The proposed site and its surrounds have had a relatively short history of European settlement. This section discusses the results of an inquiry into what elements of European heritage, if any, may still remain within the area. The primary research objectives were:

- to determine the dominant strands of European historical development;

- to make a prediction of the archaeological potential, based on an assessment of the remains likely to be found, given that continuing land use and development have possibly substantially altered or destroyed the archaeological resource;

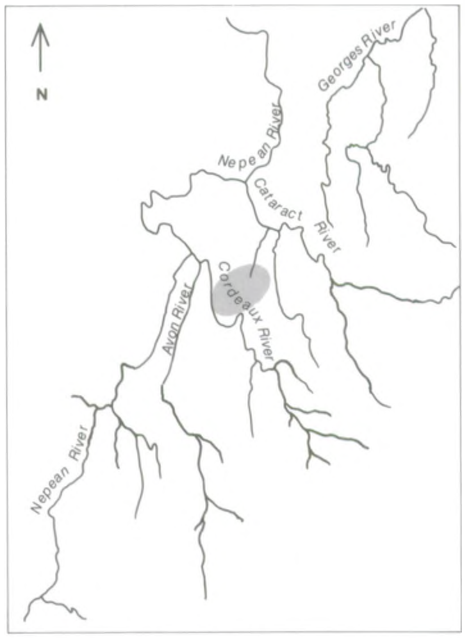
- to locate physical elements representative of the development, and/or significant heritage items;

- to assess the potential effects of airport development on the historical resources, and determine appropriate safeguards.

There have been no previous surveys of the European historical archaeology of the site. Archival research of both primary and secondary sources and titles searches were therefore carried out to determine the primary historical developments within the proposed site and surrounds. Also, in order to provide a context for the site survey and the investigative research, inquiries directed towards identifying areas around and within the site that might be potentially sensitive were made of heritage groups, the Metropolitan Water Sewerage and Drainage Board, and local people. Registers of historical sites were also examined to find out whether any listed sites occurred within the proposed site or the 25 ANEF contour.

Figure 14.5.1 DEVELOPMENT HISTORY OF WILTON

Location of proposed airport site

	PRE-EUROPEAN SETTLEMENT	Phase 1 INITIAL EUROPEAN SETTLEMENT (1850-1890)
		
NATURAL RESOURCES	Water, bush, shelter, wildlife	Good water, pockets of fertile soil, coal
SOCIAL STRUCTURE	Tribal and community living	Small scattered farms and larger homesteads
TECHNOLOGY AND INDUSTRY	Stone implements, axes, blades, spears, fire	Water supply, coal, grazing
TRANSPORT	Walking via creeks and ridges	Difficult access, dirt tracks, horses and carts
SETTLEMENT PATTERN	Scattered campsites along creeks in rock shelters	Scattered farmhouses and homesteads
ECONOMY AND RELICS	Subsistence living, art sites, isolated occupation sites	Coal mining and grazing

14.5.1 Environmental setting

The site is located in an area of plateaux and gullies on a combination of Wianamatta Shale and Hawkesbury Sandstone. Soils range from very poor to good and the site has plenty of available water. The dominant factors that have influenced settlement patterns are geographic and environmental: difficulties of access and terrain, together with infertile soils, have imposed severe limitations on agricultural activities and stock grazing and have meant that development of the area has been minimal and late.

14.5.2 Historical themes of development

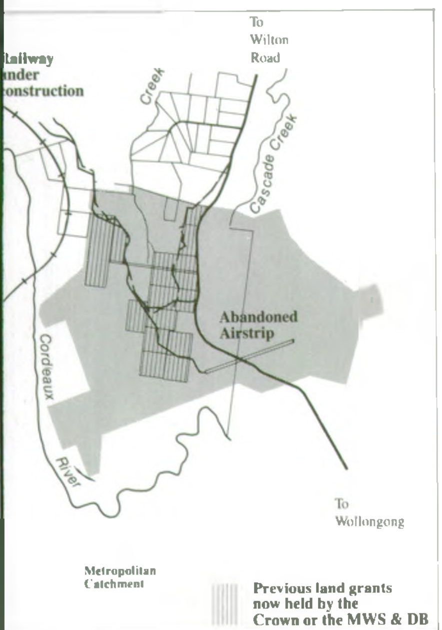
The site lies primarily within the Parish of Wilton, in the County of Camden. Small sections are contained within the adjoining parishes of Banksia and Wallandoola. Within the Parish of Wilton, Portions 2, 22, 24, 25, 26, 27, 28, 52, 53, 54, 56, 57, 59, 60, 61 and 71 are relevant, as well as Portion 1 in the Parish of Wallandoola.

Two main historical themes of development (Figure 14.5.1) may be perceived from archival research and historical survey:

- small-scale domestic settlement, often with associated cattle runs;
- appropriation of land for catchment areas by the Metropolitan Water Sewerage and Drainage Board, from as early as the 1880s.

ase 2

)NSOLIDATION (1900 to date)



od water, pockets of fertile soil, coal, gas

occupation of proposed site. Previous
mesteads cleared

ater supply, coal, gas, horse spelling

eeway, few local roads, railway (under
nstruction)

bdivision and development of small scale
tle farms and subsequent acquisition of
me of this land by the Water Board for
tchment protection. Today land used for
azing, pasture and horse spelling

ater supply, coal mining, some agriculture
sed on horse spelling

Both these themes are confined to the late nineteenth and early twentieth centuries. The use of land for water catchment has had an overriding effect on attempts at domestic settlement, as the extent of Water Board appropriations has inhibited subsequent development.

Domestic settlement

The proposed site and the land within the 20 ANEF contour adjoin many centres of early settlement. Land adjoining the site on the north was issued to the surveyor Thomas Mitchell in 1835, and a very small section of this grant (Portion No. 2) intrudes into the site. However, the area was not associated with early nineteenth-century historical developments; the major settlements were further north where geographic and environmental factors were more favourable.

Some parish portions were allocated in the mid and later nineteenth century, but there is very little to suggest that any important developments took place during this time; the predominant use appears to have been only as scattered grazing runs.

The early twentieth century from about 1920 onwards saw an increase in the subdivision and sale of land, and more farms, still mainly for cattle grazing, were established. However, the physical constraints prevented these from developing into large or permanent concerns and this is the case even today.

The only departure from the pattern of domestic settlement has come with some limited infrastructure associated with industrial development. Land within the site is owned by the Bellambi Coal Company for the purpose of establishing a proposed new mine surface complex. There are also two easements passing through the site: one incorporates the Australian Gas Light Company's gas pipeline, and the other a 330 kV transmission line.

Appropriation for water catchment

The second major theme of development in the area has been appropriation of land by the Metropolitan Water Sewerage and Drainage Board, which has had a significant influence on the landscape. Terrain that had proved largely unsuitable for settled occupation and development was ideal for use for water supply purposes. All areas outside the parish portions already allocated were proclaimed as part of the Metropolitan Catchment in the late nineteenth and early twentieth centuries, and additional portions have at different times been acquired by the Board to increase the catchment area and provide additional protection. Once the Water Board purchased land, the area was totally cleared of existing structures and was allowed to revegetate, so as to ensure an uncontaminated water supply. In this way all traces of earlier settlement were removed.

14.5.3 Assessment of the archaeological evidence

Prediction of potential archaeological evidence

It may be inferred from the problems of access, terrain and frequently poor soils that non-Aboriginal historical development of this area would have been severely limited, and it is unlikely that evidence of very early settlement would be found. The earliest physical development of the area by Europeans appears to date back to the later nineteenth century and this was on a very small scale, probably comprising small houses, outbuildings, fences, and some clearing for grazing and dams. This pattern continued into the twentieth century, although some marginal activities ceased as the Metropolitan Water Sewerage and Drainage Board consolidated its holdings of land around the perimeter of the catchment. However, physical evidence even of this later period of development is unlikely to be found, given the clearance and revegetation policies of the Metropolitan Water Sewerage and Drainage Board.

Principles for determining significance

The significance of an area or of individual elements within an area in terms of heritage value may be estimated according to relevant historical, scientific or cultural criteria. However, the key determinant must always be that the element selected is either unique or rare or else is an outstanding example of the particular type of heritage that it exemplifies. Furthermore, the significance of the item or area should be considered within the local, regional and national contexts.

Therefore, for the purpose of this study, if any area or item of possible significance were found, it would be analysed to determine whether it exemplified or illustrated:

- in terms of historical value:
  - strong association with acknowledged important figures or events;
  - a significant or determining effect on local, regional or national history;
- in terms of scientific value:
  - excellence, rarity or uniqueness in technical, industrial or creative achievement;
  - potential for future scientific, archaeological, architectural or environmental investigation;

- in terms of cultural and/or aesthetic value:
  - a way of life, an ethnic group, or a set of customs that are unique, rare, or of particular interest;
  - a notable townscape, landscape or individual setting that contributes to the area or is illustrative of the development of the locality.

Results of field survey and assessment of archaeological sensitivity

There are no surviving structures of any kind relating to the early farming and grazing development of the proposed site. Aerial photographs indicate very little potential for sub-surface evidence to be found. The only nineteenth-century house surviving until relatively recently was on Wonson Hill, but it was demolished by the Metropolitan Water Sewerage and Drainage Board a number of years ago and no evidence of any foundations could be located during this survey.

A landing strip dating from World War II is still in existence, although it is not used. There is also evidence of more recent phases of development, primarily from the 1950s onwards, on property not owned by the Metropolitan Water Sewerage and Drainage Board. However, liaison with local historical associations and informants, as well as a review of existing heritage registers, indicate that there are no sites or buildings of heritage value that were registered, recorded or known to be still in existence within the 25 ANEF contour.

As the proposed site and immediately adjacent areas are located outside the major areas of nineteenth-century development, it may be concluded that they are of minimal heritage significance. The small portion of land granted to Thomas Mitchell in 1835 contained within the site has been noted, but is not considered to be of any great significance.

The structures remaining within the site largely represent later twentieth-century development and, although they are of some minor local significance, this pattern of development is well represented elsewhere.

14.5.4 Assessment of effects and safeguards

This discussion is confined to the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further investigation once the locations for these facilities were determined.

The conclusions established by the field survey and documentary research are that the historical resource on the proposed site is minimal and that similar patterns of development could be expected outside the area. Hence, even though the development would remove all evidence of occupation during earlier periods, it could not be considered a significant impact in historical terms.

If the proposed site were acquired, and if any additional information concerning the archaeological sensitivity of the area came to light prior to the commencement of construction, the Department of Aviation would review the need to appoint a qualified archaeologist to monitor the development during ground disturbance, and to retrieve and record material that might be revealed.

During airport operation, the Department of Aviation would undertake an assessment of the possibility of any adverse effects of aircraft noise on any items of heritage significance that might have been subsequently identified within the 25 ANEF contour.

14.6 ECONOMIC EFFECTS

This section assesses the economic effects of acquisition of the proposed site, and of future construction and operation of an airport there. There is also discussion of the likely changes to the social and economic characteristics of the region in which the proposed airport is located. In the case of airport operation, the assessment relates to a worst case of 13 million passenger movements per year and the maximum additional employment that could be expected with this level of airport operations. The effects are considered at three spatial levels:

- the regional level (i.e. the Sydney Region);

- the sub-regional level (i.e. the economic sub-region around Wilton defined for study purposes as comprising the local government areas of Campbelltown, Wollondilly and Wollongong);

- the airport locality (i.e. the immediate locality of the site defined for study purposes by reference to the boundaries of the Census Collection District most closely corresponding to the site boundary).

The boundaries of these areas are shown on Figure 14.6.1. Also shown on Figure 14.6.1 is the Kingsford-Smith economic sub-region, defined for study purposes as being the same as the Department of Environment and Planning's Botany Bay Sub-Region. This sub-region was used when analysing the economic effects of Kingsford-Smith Airport, the results of which were a guide to the assessment of the possible effects of an airport at Wilton.

14.6.1 The existing economic effects of Kingsford-Smith Airport

As a guide to the possible scale and nature of the economic effects of a second Sydney airport, a detailed study of the employment characteristics and economic effects of Kingsford-Smith Airport was undertaken.

Methodology

The study involved two stages:

- The economic activities directly related to the operation of the airport, or closely associated with it, were identified and measured. The directly related activities were grouped into five categories: international airlines; domestic airlines; general aviation; airport commerce (commercial services including fuel supply, security, parking, retailing, car rental, catering and banking); and airport administration. The closely associated activities, which comprise activities such as freight forwarding, accommodation and transport, were treated as a single group. The level of output and employment for each of these categories was estimated following detailed surveys.

- The indirect or flow-on effects of these activities were calculated on an industry sector basis using input-output tables for the Sydney Region and the Kingsford-Smith economic sub-region. These input-output tables set out the estimated total dollar value of transactions between industry sectors, from which multipliers were calculated for both the Region and the sub-region.

Results

The results of this study in respect of employment are summarized in Table 14.6.1. Direct employment in the airport industry at Kingsford-Smith Airport was estimated to be about 12,900 people in 1983, with airport associated employment estimated to be about 1,400. Using the multipliers, the flow-on employment in the Sydney Region was

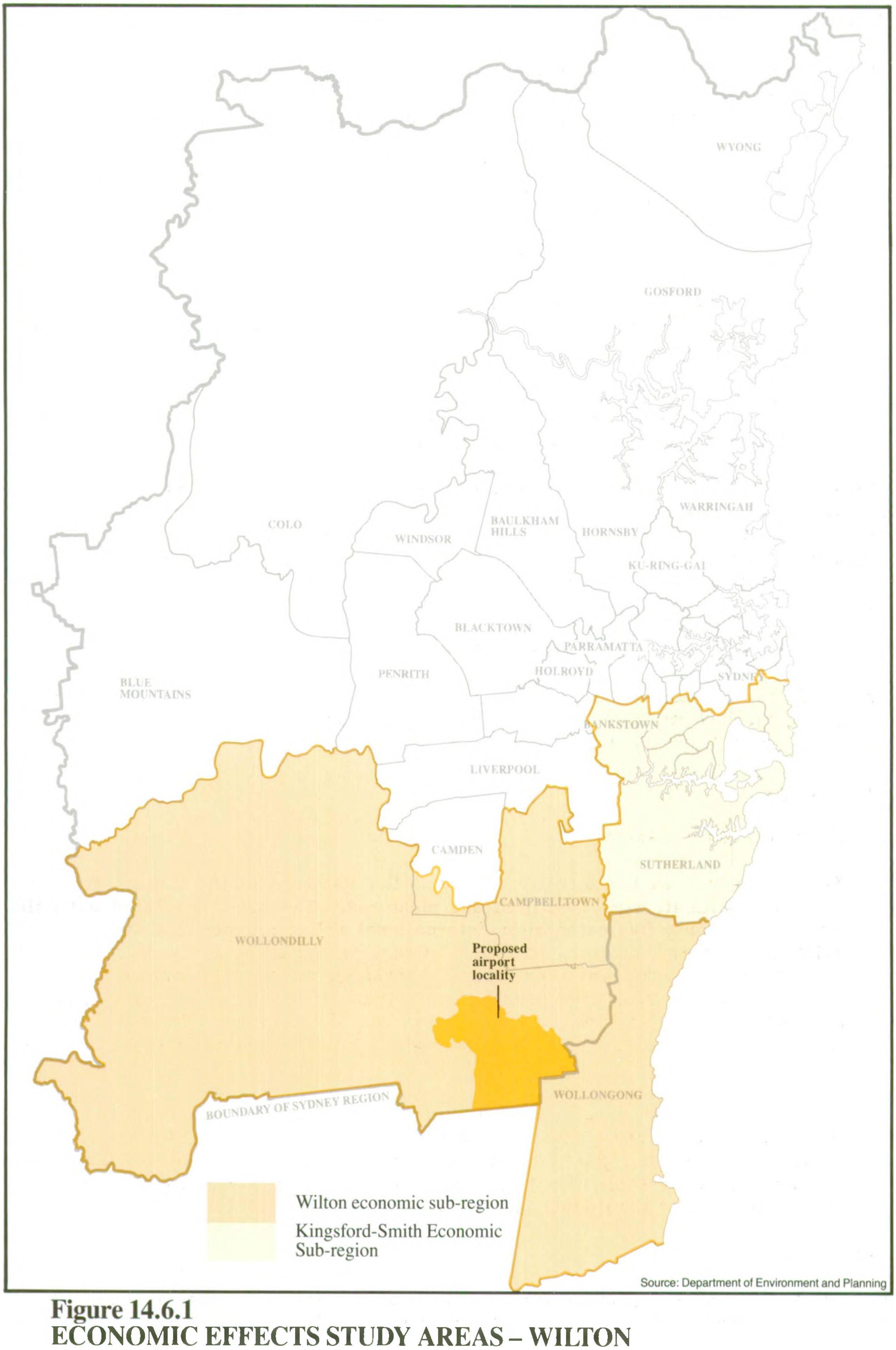


Figure 14.6.1
ECONOMIC EFFECTS STUDY AREAS – WILTON

estimated at 14,200, of which 4,500 was estimated to occur in the sub-region. In total, Kingsford-Smith Airport accounts for approximately 28,500 employees in the Sydney Region, comprising 18,800 in the sub-region and approximately 9,700 in the remainder of the Sydney Region.

Table 14.6.1 Summary of the employment effects of Kingsford-Smith Airport

Employment	Sydney Region	Kingsford-Smith sub-region	Rest of Sydney Region
Initial effect*	14,300	14,300	Nil
Flow-on effect	14,200	4,500	9,700
Total effect	28,500	18,800	9,700

* Direct employment plus airport associated employment.

Sectoral distribution of employment effects

An important finding from the study of Kingsford-Smith Airport was that the employment effects are concentrated in a relatively few industry sectors (Table 14.6.2). Some 47% of the employment effects on the sub-region are in the manufacturing sector (Sectors 4A to 4F), and a further 24% are in the trade sector (Sector 7).

Table 14.6.2 Sectoral distribution of flow-on employment effects of each segment of airport industry at Kingsford-Smith Airport — Sydney Region and Kingsford-Smith economic sub-region

Sector classification**		International airlines		Domestic airlines		Airport commerce		Airport associated		Airport administration		Total airport activity	
		Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)	Sydney Region (%)	Sub-region (%)
1	Animal industries	*	*	*	*	*	*	*	*	*	*	*	*
2	Other agriculture	*	*	*	*	*	*	*	*	*	*	*	*
2B	Forestry, fishing	*	*	*	*	*	*	*	*	*	*	*	*
3A	Coal mining	*	*	*	*	*	*	*	*	*	*	*	*
3B	Other mining	*	*	*	*	*	*	*	*	*	*	*	*
4A	Food manufacturing	4.1	5.0	3.4	3.9	3.3	3.2	3.2	3.1	3.1	3.1	3.8	4.4
4B	Wood, paper manufacturing	3.1	3.1	3.0	3.3	6.6	9.8	5.8	9.2	3.8	5.4	3.4	4.2
4C	Machinery, equipment	4.0	4.2	4.0	4.0	7.6	11.2	5.0	5.8	6.4	7.5	4.4	4.8
4D	Metals, metal projects	1.9	2.2	2.0	2.2	1.8	2.6	1.2	1.3	1.4	2.0	1.9	2.1
4E	Non-metallic minerals	*	*	*	*	*	*	*	*	*	*	*	*
4F	Other manufacturing	27.9	34.6	34.6	41.8	7.0	7.8	5.5	5.3	5.4	5.4	25.9	31.1
5	Electricity, gas	2.6	2.0	2.6	1.9	3.7	3.0	3.4	3.2	12.7	15.7	3.6	3.6
6	Building, construction	1.3	*	1.4	1.0	1.9	1.6	1.7	1.2	2.5	3.5	1.5	1.2
7	Trade	25.1	23.9	21.9	21.4	28.6	27.8	26.1	23.3	26.0	25.8	24.6	23.9
8	Transport, communication	4.0	3.7	4.0	3.6	6.7	7.6	17.2	24.6	5.7	6.3	4.9	5.4
9	Finance	10.7	5.0	10.1	4.6	15.3	7.4	15.4	9.1	17.4	9.7	11.5	5.8
10	Public administration	1.3	*	1.2	*	1.8	*	1.7	*	1.8	1.1	1.4	*
11A	Community services	3.8	4.4	3.4	3.7	4.8	5.1	4.5	4.4	4.5	4.9	3.8	4.4
11B	Personal services	8.5	9.0	6.6	7.1	9.4	11.4	7.8	8.0	7.8	8.7	8.0	8.6
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* Less than 1%.
** Based on Australian Standard Industrial Classification.

Employment effects on the transport and communications, finance, building and construction, and public administration sectors are comparatively unimportant. The implications of this finding for a second Sydney airport are that the scale of its employment effects on its sub-region will be largely determined by the industrial structure of the sub-region.

Although it may be argued that the development of a second Sydney airport would lead suppliers to locate in its vicinity, the Industry Incidence Survey undertaken for the Major Airport Needs of Sydney Study (Planning Workshop 1978) suggests that this is unlikely to occur, mainly because of the small proportion of the total revenue of suppliers that is attributable to airport business. A similar view was expressed by a number of airline purchasing officers at Kingsford-Smith Airport who indicated that suppliers are often national suppliers selected through a competitive tendering process.

Airport role

Other findings from the Kingsford-Smith Airport study suggest that the flow-on employment effects per million dollars of output at a second Sydney airport would in some respects be relatively insensitive to the airport's function (as distinct from its level of operations). For example, there is comparatively little difference at Kingsford-Smith Airport between the flow-on employment effects per million dollars of output of international airlines and those of domestic airlines (Table 14.6.2).

14.6.2 Existing social and economic characteristics

The economic and social characteristics of Wilton are predominantly those associated with rapid population growth in an area not far beyond the present limits of Sydney's urban expansion.

Social characteristics

Table 14.6.3 presents key social indicators for Wilton derived from the 1981 Census. While on some social indicators Wilton was comparable to the averages for the Sydney Region, it had the following distinguishing features:

- only 37% of the 1981 residents had been there in 1976
- 34% of residents were aged under 15
- the 1981 population was 52% higher than the 1976 population
- 80% of households owned or were purchasing their homes.

Table 14.6.3 Social indicators, 1981

Indicator	Wilton	Wilton sub-region	Kingsford-Smith sub-region	Sydney Region
Percentage of people in same dwelling as in 1976	37	49	52	52
Percentage of people aged under 15	34	29	20	24
Average no. of people per household	3.7	3.3	3.0	3.0
Percentage population growth, (or decline) 1976 to 1981	52	19	(7)	4
Percentage of people born overseas	26	26	34	26
Percentage of house-holds owning or purchasing home	80	66	67	67

Source: Australian Bureau of Statistics, 1981 Census.

Economic characteristics

Table 14.6.4 presents key economic indicators for Wilton derived from the 1981 Census. These indicate important differences in the local economy compared with those of the Kingsford-Smith sub-region and the Sydney Region. These economic differences, which were mainly related to the area's distinctive social features, were as follows:

- the overall participation rate (the number of employed plus unemployed expressed as a percentage of the population aged 15 and over) was comparatively high;
- the unemployment rate was comparatively high in the sub-region as a whole but low in Wilton itself;
- the proportion of the labour force working locally (i.e. within the same local government area as their place of residence) was comparatively high, although this partly reflects the geographic extent of the local government areas of Campbelltown, Wollondilly and Wollongong;
- there were hardly any jobs in Wilton but local jobs in the sub-region tended to be held by local residents to an above average extent;
- despite Wilton's apparent rural character, agriculture was not the major economic activity in terms of employment, and in the shire of Wollondilly there were more jobs in mining and manufacturing than in agriculture;
- at the sub-regional level, manufacturing employment was proportionately more important than in the Kingsford-Smith sub-region, but in terms of numbers only half the size;
- employment in community services and entertainment was proportionately less important than in the Sydney Region and Kingsford-Smith sub-region.

If these differences were to persist into the future, they would influence the employment and other economic effects of airport operations at Wilton. For example, the manufacturing employment in the Wilton sub-region being only half that in the Kingsford-Smith sub-region would result in lower multiplier effects than those of Kingsford-Smith Airport. High unemployment in parts of the sub-region (the June 1984 unemployment rate for Wollongong was 14.2% in comparison with the Sydney estimate of 11.0%) might be partially alleviated if the airport reached a high level of operations.

14.6.3 Future social and economic characteristics without airport development

The Wilton economic sub-region would have undergone substantial changes by the time an airport at Wilton became fully operational. By 2001, the 1981 population is forecast by the Department of Environment and Planning to have increased by 139% in the City of Campbelltown (from 92,950 to 222,000) and by 143% in the Shire of Wollondilly (from 20,150 to 49,000). The areas of urbanization in the short-term are mostly located on the urban fringes closest to the proposed site. In the medium and longer term (to beyond 2001), rapid population growth could continue in some or all of the potential areas in the sub-region identified by the Department of Environment and Planning for urban development: Appin, Cawdor, Douglas Park, Menangle, and Wilton itself.

While the scale of population increase makes it difficult to predict future social characteristics, three changes seem likely:

- it is probable that local employment will grow at least as fast as the population and, while it will not reach the level in the Kingsford-Smith sub-region, it will increase the prospects of significant multiplier effects in the sub-region as compared with the situation at present;

- even without the airport, Wilton will lose some of its rural characteristics;
- the continued rapid population increase will help maintain some of the social characteristics associated with rapid population growth, although the age structure will become closer to the average for the Sydney Region as the existing residents age, and the labour force participation rates can be expected to stay high.

Table 14.6.4 Economic indicators, 1981*

Indicator	Wilton	Wilton sub-region	Kingsford-Smith sub-region	Sydney Region
Participation rate (%)	67.5	61.5	62.1	62.3
Unemployment rate (%)	4.4	6.5	4.5	4.9
Ratio of labour force to employment	n.a.	1:0.92	1:0.71	1:1
Proportion of labour force employed locally (%)+	51**	72	29	31
Residents employed locally, as a proportion of total local employment (%)	n.a.	78	41	31
Employment in agriculture (% of total employment)	++	1	<1	1
Employment in manufacturing (% of total employment)	++	36	32	23
Employment in trade (% of total employment)	++	15	21	20

* The indicators are calculated direct from data in 1981 Census tables, without any adjustments for such factors as underenumeration, absence on Census night, and responses not given.

** This figure relates to the Tahmoor journey-to-work zone, which covers a larger area than the Census Collection District.

\+ Within the same local government area.

++ The Census journey-to-work tables indicate that there were hardly any jobs in Wilton in 1981.

Source: Australian Bureau of Statistics, 1981 Census.

14.6.4 Effects at acquisition stage

There is a range of possible economic effects of site acquisition on the sub-region to be considered. These include the effects of compensation payments, displacement of existing economic activity, effect on land prices, expenditures associated with acquisition and effect on rate income.

Effects of compensation payments

A project involving extensive land purchase can sometimes have significant effects on a sub-region through funds paid to existing land owners for the purchase of land. However, as land purchases per se constitute a transfer transaction rather than an economic transaction, they contribute to the local economy only if vendors reinvest their sale proceeds in productive processes in the sub-region. As most of the site is in public ownership this would not occur to any significant extent, and therefore it is presumed that the economic effect of land purchase on the sub-region would be insignificant.

Displacement of existing economic activity

Prior to airport construction, it is possible that the land acquired by the Commonwealth might be used for economic activities that are less productive than those for which the land is presently being used. Any such loss of production would have negative regional flow-on effects in the local region and in the Sydney Region as a whole. While the extent of these flow-on effects on an absolute basis is not known, it is likely to be only very small or even non-existent given the Commonwealth's proposals for management of the land following acquisition (Section 14.1).

Effect on land prices

The acquisition of the privately owned section of the proposed Wilton site could affect the local land market by increasing the demand for similar properties. However, only five properties are privately owned and this possibility would be further reduced by the Department of Aviation's intention to lease back acquired properties to those owners who wished to continue under such an arrangement. Even if demand for similar properties were to increase, it would only be one of many factors affecting the property market in the sub-region and the effect would thus not be significant.

Expenditures associated with land acquisition

It is anticipated that any expenditure associated with the land acquisition process, such as for surveying and legal fees, would be inconsequential in terms of economic effects on the sub-region.

Effects on council income from rates

Prior to airport development, acquired properties would be leased back to the present owners or, where this was not required, leased by public tender (Section 14.1). In either circumstance, the Commonwealth would make ex gratia payments to the shire in lieu of rates.

14.6.5 Effects at construction stage

Construction of an airport at Wilton at the level of development described in the preliminary master plan would have significant economic effects on the locality, the sub-region, and the Sydney Region.

Displacement of existing economic activity

Construction would mean the displacement of the existing economic activities on the site, which would be accompanied by negative flow-on effects in the sub-region. These displacement effects are assessed in Section 14.7.

Estimating the direct economic effects

On the basis of data from recently constructed airports, it is estimated that airport construction at Wilton would require approximately 7,000 person-years of work, with the construction workforce in the peak year reaching about 1,600 people.

Estimating the economic multiplier effects

Since it is not practicable to construct input-output tables for the future economy of the Wilton economic sub-region at a construction date not yet determined, it is difficult to specify accurately the employment flow-on or multiplier effects on the sub-region of airport construction. Nevertheless, using the multiplier for the building and construction sector of the Kingsford-Smith sub-region, it is possible to postulate a range of employment multipliers for airport construction (Table 14.6.5). This range of multipliers was defined as follows:

- high multipliers: accepting without alteration the Kingsford-Smith sub-region multipliers;
- medium multipliers: discounting the consumption induced flow-ons by 20% to reflect the higher leakages of expenditure from the sub-region for the Wilton case;
- low multipliers: discounting the consumption indexed flow-ons by 40% to reflect the higher leakages of expenditure from the sub-region.

Table 14.6.5 Construction sector employment multipliers

Effect*	No. of employees per thousand dollars of construction output			
	Kingsford-Smith sub-region	Wilton sub-region		
		High	Medium	Low
Initial	0.018	0.018	0.018	0.018
First round	0.006	0.006	0.006	0.006
Industrial support	0.002	0.002	0.002	0.002
Consumption induced	0.006	0.006	0.005	0.003
Total effects**	0.031	0.031	0.030	0.029
Total effects divided by initial effect** (= multiplier)	1.71	1.71	1.67	1.61

* The initial effect is the initial stimulus (i.e. the construction activity) , the effect of which is being measured. The first-round effect refers to the direct purchases from other sectors to produce the construction output. The industrial support effect refers to the further industrial flow-on effects triggered by the purchases in the first round. The consumption-induced effects stem from the spending of household income received as payments for labour used in producing the additional output.

** Because of rounding effects, these numbers do not check precisely with numbers above.

Applying these multipliers to the Wilton sub-region indicates that the peak year employment of 1,600 would generate employment flow-ons in the sub-region of between about 950 and 1,100 jobs.

An employment flow-on in the Sydney Region of about 1,800 jobs was calculated by applying the Sydney Region building and construction multiplier from the Sydney Region input-output table (Jensen et al. 1985) to the estimated peak year construction workforce. This figure of 1,800 jobs for the Sydney Region includes the 950 to 1,100 jobs in the sub-region.

14.6.6 Effects at operational stage

Direct employment

The maximum direct employment levels that could be associated with a second Sydney airport operating at a level of 13 million passengers per year were estimated by reference to the present numbers of employees per million passengers and per thousand aircraft movements at Australian airports (Table 14.6.6) and assumptions as to the maximum likely ratios of employment to traffic in the future. The result of this exercise was an estimated maximum direct employment of 10,500.

Table 14.6.6 Ratios of employees to air traffic at three Australian airports, 1983

Airport sector	Ratio	Airport		
		Kingsford-Smith	Tullamarine	Brisbane*
International airlines	Employees per million passengers	3,393	563	285
Domestic airlines	Employees per million passengers	472	1,113	665
Airport commerce	Employees per million passengers	95	113	133
Airport administration	Employees per million passengers	185	249	198
	Employees per thousand aircraft movements**	15.8	20.1	16.0
General aviation	Employees per thousand aircraft movements	1.9	n.a	2.3

n.a. Not applicable.

* 1981 data.

** Excluding commuter and general aviation aircraft movements.

Source: Department of Aviation statistics and surveys.

The employment ratios used and their derivations from Table 14.6.6 were as follows:

- **Airlines:** A maximum ratio of 540 employees per million passengers was assumed. Although there are normally more international airline employees per million passengers than domestic airline employees, a single ratio had to be assumed because the balance between domestic and international traffic at a second Sydney airport is not known at this stage. Also, in the case of both domestic and international airlines, the number of employees per million passengers is strongly influenced by the location of major airlines' headquarters and maintenance bases. Thus the high number of international airline employees per million passengers at Kingsford-Smith Airport is a consequence of the airport being the location of the headquarters of Qantas, as well as of most of its maintenance activity, its Australian Flight Catering Centre, and the home base of most of its flight and cabin staff. Similarly, the high number of domestic airline employees per million passengers at Tullamarine reflects the location there of the headquarters of the two major domestic airlines, as well as of most of their maintenance activities and home bases for flight and cabin staff.

It was considered possible that a second Sydney airport could be the base for a major domestic or international airline. The future number of employees per million passengers would also depend on the extent to which productivity improvements had been achieved in the airline industry by the time the airport reached its maximum traffic level. The ratio of 540 airline employees per million passengers can thus be taken as representing either of two possible situations:

- no improvement in airline productivity and limited maintenance activity;

- significant improvement in productivity but a high level of maintenance activity.

- **Airport commerce:** A ratio of 60 employees in airport commercial activities per million passengers was assumed. This is less than the ratios at Kingsford-Smith, Tullamarine and Brisbane airports to allow for some economies of scale for a larger airport. Economies of scale largely explain the lower Kingsford-Smith Airport ratio. In estimating the maximum likely employment, it was considered that no allowance should be made for future economies of scale or economies through improved layout of facilities, as present ratios for airport commerce are less likely to change than those in other airline industry sectors. This is because the nature of the activities in this sector, especially the catering and retail activities, limits the possibilities of significant productivity improvements, particularly given the marked productivity changes already achieved in these activities over the last twenty years. Also, any move to 'no-frills' flights is likely to lead to increased retail and catering facilities at the terminal as passengers substitute pre-departure purchases for goods such as food and magazines previously provided in-flight. Thus, the effects on employment of productivity improvements would be offset by the effect of greater sales.

- **Airport administration:** A ratio of 180 employees per million passengers in airport administration was assumed.

- **General aviation:** A ratio of 4 employees per thousand aircraft movements was assumed for general aviation. This is more than at Kingsford-Smith Airport, but Table 14.6.5 does not include data for Bankstown, by far the most important general aviation airport in the Sydney Region, which has 7.6 employees per thousand aircraft movements. The more important the general aviation airport, the higher the employment ratio is likely to be. Compared with Kingsford-Smith Airport, a second Sydney airport would both have more traffic (under the worst case assumptions) and be without the physical constraints on accommodating ground facilities for general aviation.

Airport associated employment

Airport associated employment is employment that is directly related to the operation of the airport, and required to be in close proximity to it but not necessarily on site. It includes those people employed in car rental firms, passenger transport and accommodation, and the air freight industry. In the case of Kingsford-Smith Airport, it was estimated that 1,400 people are employed in the airport associated sector, with 900 of this total being employed in the air freight and customs clearance industry.

However, it would seem unlikely that airport associated employment would reach this level at a second airport. This is because, although it is difficult to gauge the magnitude of employment in the freight sector, especially given the dependence of the industry on Australian Customs Service regulations, it seems unlikely that freight forwarders and customs agents would duplicate their operations at a second airport. The more likely outcome would involve either some minor warehousing operations at a second airport or the transfer of freight directly from the aircraft for bulk removal to a central processing point elsewhere.

Thus, it is assumed that airport associated employment would total between 500 and 900 people.

Airport induced employment

Airport induced employment is employment in firms attracted to an area by the presence of an airport, but not necessarily connected with it. Although it has been suggested that airports attract substantial amounts of industry to the surrounding area, the little empirical evidence that is available suggests that these effects have been greatly exaggerated (Fordham 1970; Hoare 1979). This evidence, together with the decentralized location at Wilton, suggest that it is unlikely that any airport induced employment would occur. Thus a maximum induced employment level of 100 people is assumed.

Multiplier effects

The multiplier or flow-on employment effects of a second airport are the impacts resulting from expenditure by those firms included in the direct and airport associated employment sectors and from the expenditure by the employees in these sectors. A starting point for the multiplier estimates for a second airport are the estimates of the multiplier for the Kingsford-Smith sub-region outlined in Section 14.6.1. However, this multiplier value will overestimate the second airport multipliers for two reasons.

First, unlike the Wilton area, the Kingsford-Smith sub-region has a larger and more highly developed manufacturing base.

Second, the Kingsford-Smith sub-region multiplier will overestimate the proposed airport flow-on effects because the consumption induced flow-ons (i.e. the flow-ons associated with the expenditure of employees) will be smaller in the case of a second Sydney airport. This is because there would be a greater leakage of wage and salary payments out of the Wilton sub-region and a greater propensity to import goods and services into the sub-region. It is not possible to specify accurately the multipliers for a second airport without an input-output table for the sub-region, but an estimate can be made by discounting the components of the Kingsford-Smith Airport multipliers.

Applying the Kingsford-Smith sub-region multipliers to the maximum direct employment estimates without modification would give estimates of flow-on employment that are unlikely to be reached. However, for the purposes of arriving at a maximum estimate, the Kingsford-Smith multipliers were discounted only to reflect the absence of an oil refinery in the Wilton sub-region. Under this assumption, the maximum flow-on employment in the sub-region would be approximately 2,300.

Assuming that the Sydney Region flow-on multiplier for the proposed airport was identical to the Kingsford-Smith Airport case, the flow-on employment for the Sydney Region resulting from the operation of a second airport at full capacity would be 10,500.

Effects on rates

As the Commonwealth Government does not normally pay rates to local councils on Commonwealth land used for airports, the Shire of Wollondilly would suffer a loss of rate income. However, in 1982 rates levied accounted for only 34% of the Shire's income, and, as airport development would reduce the number of rateable properties in the Shire by less than 0.2%, the loss to the Shire would be very small. As against the loss of rate income in respect of existing properties and uses, the Shire would gain through the ex gratia payments that the Commonwealth normally makes in lieu of rates for those sections of land within the airport that are revenue earning, e.g. concessionaire operations, airline facilities, leased car parks, and other facilities leased to commercial operators. The Shire would also gain rate income from property development resulting from multiplier effects within the Shire.

14.7 AGRICULTURE

This section assesses the nature and extent of agricultural activities now being undertaken within the proposed site and the surrounding area within the 25 ANEF contour. Data were collected by visiting farms in the area and from information provided by personnel from the NSW Department of Agriculture, the Soil Conservation Service, the Wollondilly Shire Council, the Moss Vale Pastures Protection Board and the Australian Bureau of Statistics. Use was also made of recent aerial colour photographs of the area.

14.7.1 Description of the existing environment

The majority of the proposed site is contained within the Metropolitan Water Sewerage and Drainage Board's Metropolitan Water Catchment, which is mostly uncleared. About 65 ha of the site consist of improved pastures used for the grazing of cattle and for the agistment and spelling of horses. Almost the entire area within the 25 ANEF contour comprises uncleared forest, most of which is also part of the Metropolitan Water Catchment.

Rural land capability

Both the Soil Conservation Service and the Department of Agriculture have adopted systems for classifying land according to its suitability for agricultural use.

The Soil Conservation Service has developed a standard eight-class rural land capability classification system which ranks the potential safe use of land for general rural purposes. This classification system, which is set out in Table 14.7.1, consists of a hierarchical sequence based on the type of land management practices necessary to prevent soil erosion and maintain the productivity of the land.

The Department of Agriculture uses a five-class system, set out in Table 14.7.2, which ranks land according to a number of factors. These include the general productive capacity of the land, as well as the effects of climate, topography and soil characteristics in limiting land suitability for agricultural use.

Most of the land within the proposed site and within the 25 ANEF contour occurs in association with Hawkesbury Sandstone. A small portion of land within the proposed airport site and 25 ANEF contour has been classified and is used for agricultural purposes. However, the majority of the area has not been classified for agricultural suitability, but would probably be classed as belonging to Class VII (Soil Conservation Service) and Class 5 (Department of Agriculture). Figure 14.7.1 shows the land classification as it relates to the proposed site and 25 ANEF contour, while Table 14.7.3 shows the proportions of land within the different capability classes.

Agricultural land use

Of the 65 ha of grazing land that lie within the proposed airport site, about 35 ha are used for the grazing of beef cattle and the remainder for the agistment or spelling of racehorses (Figure 14.7.1). Recently, some properties near the proposed site have been subdivided into 16 ha hobby farms, with such development being particularly apparent along Lisa Road. However, this has not led to an overall decline in stock numbers, as the consequent increase in horse numbers has more than compensated for the reduction in cattle numbers (B.E. Young, Secretary, Moss Vale Pastures Protection Board, pers. com.). The trend towards subdivision appears to be continuing, except in those cases where existing properties are being developed further by the installation of irrigation and the building of stable and yard complexes to enable horses to be run on a more intensive basis. Such intensive development is taking place, for example, on the property adjoining Alkoomie Place. In the absence of either airport or coal resource development at Wilton, it could be expected that further subdivision would take place.

Table 14.7.1 Rural land capability classification (Soil Conservation Service)

	Land classification and soil conservation practices	Interpretations and implications
Suitable for regular cultivation		
I	No special soil conservation works or practices.	Land suitable for a wide variety of uses. Where soils are fertile, this land has the highest potential for agriculture, and may be cultivated for vegetable and fruit production, cereal and other grain crops, energy crops, fodder and forage crops, and sugar cane in specific areas. Includes 'prime agricultural land'.
II	Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotation.	Usually gently sloping land suitable for a wide variety of agricultural uses. Has a high potential for production of crops on fertile soils similar to Class I but increasing limitations to production due to site conditions. Includes 'prime agricultural land'.
III	Structural soil conservation works such as graded banks, waterways and diversion banks, together with soil conservation practices such as conservation tillage and adequate crop rotation.	Sloping land suitable for cropping on a rotational basis. Generally used for the production of the same type of crops as listed for Class I, although productivity will vary depending upon soil fertility. Individual yields may be the same as for Classes I and II, but increasing restrictions due to the erosion hazard will reduce the total yield over time. Soil erosion problems are often severe. Generally fair to good agricultural land.
Suitable for grazing		
Occasional cultivation		
IV	Soil conservation practices such as pasture improvement, stock control, application of fertilizer and minimal cultivation for the establishment or re-establishment of permanent pasture.	Land not suitable for cultivation on a regular basis owing to limitations of slope, gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Comprises the better classes of grazing land of the State and can be cultivated for an occasional crop, particularly a fodder crop or for pasture renewal. Not suited to the range of agricultural uses listed for Classes I to III. If used for hobby farms, adequate provision should be made for water supply, effluent disposal and selection of safe building sites and access roads.
V	Structural soil conservation works such as absorption banks, diversion banks and contour ripping, together with the practices as in Class IV.	Land not suitable for cultivation on a regular basis owing to considerable limitations of slope, gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Soil erosion problems are often severe. Production is generally lower than for grazing lands in Class IV. Can be cultivated for an occasional crop, particularly a fodder crop, or for pasture renewal. Not suited to the range of agricultural uses listed for Classes I to III. If used for hobby farms, adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads.
No cultivation		
VI	Soil conservation practices including limitation of stock, broadcasting of seed and fertilizer, prevention of fire and destruction of vermin. May include some isolated structural works.	Productivity will vary due to soil depth and soil fertility. Comprises the less productive grazing lands. If used for hobby farms, adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads.
Others		
VII	Land best suited for green timber. Generally stock should be excluded.	Generally comprises areas of steep slopes with shallow soils. Clearing of timber from these sites is not recommended. Where clearing has occurred, the area should be allowed to revert to timber.
VIII	Cliffs, lakes or swamps.	Land unusable for agricultural or pastoral uses. Recommended uses are those compatible with the preservation of the natural vegetation, namely: water supply catchments, wildlife refuges, national and State parks, and scenic areas.
U	Urban areas.	
M	Mining and quarrying areas.	

Source: Soil Conservation Service 1982.

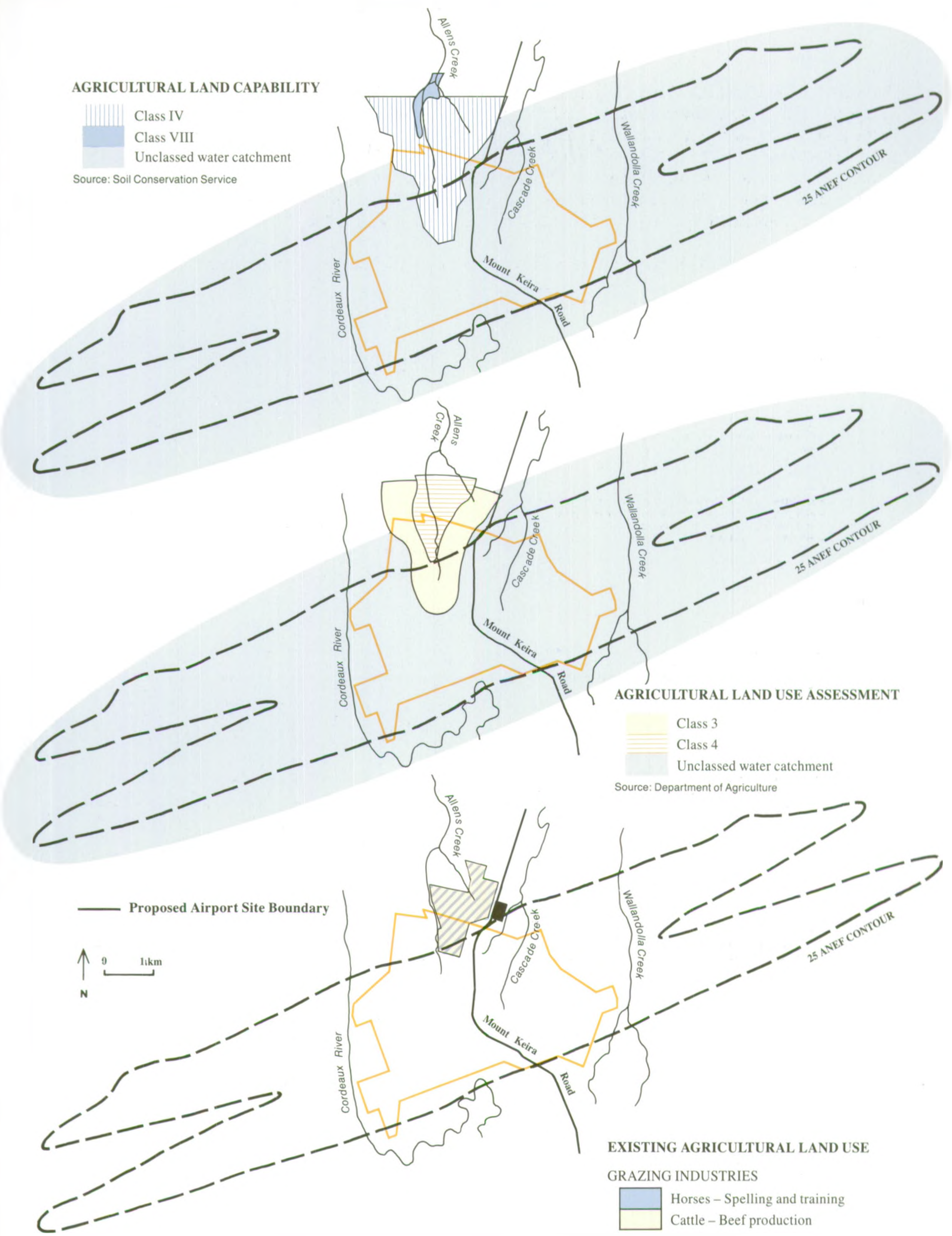


Figure 14.7.1
AGRICULTURE

Table 14.7.2 Guide to agricultural suitability classification (Department of Agriculture)

Suitability classes	Horticulture				Field crops				Grazing: Pasture			
	Vegetables		Tree crops		Regular		Rotation	Occasional	Improved			Native
	Irrigated	Rain-fed	Sensitive	Tolerant	Irrigated	Rain-fed			Irrigated	Rain-fed	Seasonal	Rough
Class 1 Land capable of regular cultivation for cropping (cereals, oilseeds, fodder, etc.) or intensive horticulture (vegetables, orchards). It has a very good capability for agriculture, and there are only minor or no constraints to sustained high levels of production. It includes irrigated areas with high production.	**	*	**	*	*	*	*	*	*	*	*	*
Class 2 Land suitable for cultivation for cropping, but not suited to continuous cropping or intensive horticulture. It has good capability for agriculture, but constraints limit the cropping phase to a rotation with improved pastures and thus reduce the overall level of production.	+	**	+	*	**	**	*	*	**	*	*	*
Class 3 Land suitable for grazing — well suited to pasture improvement and can be cultivated for an occasional cash crop or forage crop in conjunction with pasture management. The overall level of production is moderate as a result of high environmental costs which limit the frequency of ground disturbance. Has a moderate capability for agriculture. Pasture land capable of sustained high levels of production, although conservation measures may be required.	+	+	+	**	+	+	**	**	+	**	*	*
Class 4 Land suitable for grazing and not suitable for cultivation. Agriculture is based on native pastures or improved pastures relying on minimum tillage techniques. The overall level of production is low. Environmental constraints make arable agriculture uneconomic.	++	++	++	+	++	++	++	++	++	+	**	*
Class 5 Land suited for only rough grazing or land not suited to agriculture. Agricultural production is very low or zero. Severe or absolute constraints to production are imposed by environmental factors.	++	++	++	++	++	++	++	++	++	++	++	+

* Class having requirements in excess of those needed for sustained production from the land use.
** Class having the minimum requirements for sustained production from the land use.
\+ Class may be suited to the land use depending on the nature of the limiting factors to cultivation and crop production.
++ Class not suited to land use because of limiting factors to cultivation and/or production.

The trend towards an increase in the number of horses at the expense of cattle numbers is also expected to continue, although cattle are unlikely to be completely replaced by horses. This is because cattle and horse grazing is complementary to a certain extent, as cattle can be grazed on small areas at high stocking rates for short periods of time to eat down rank growth which horses leave untouched.

A survey of areas within the 25 ANEF contour indicates that there are no significant agricultural activities in this zone. Almost the entire area within this noise contour is covered with forest, much of it within the Metropolitan Catchment for water supply.

14.7.2 Agricultural production

Beef cattle

The beef cattle operations within the proposed airport site vary from a trading enterprise where steers are purchased in store condition and fattened ready for slaughter, to a breeding enterprise where cows and calves are run together and the latter sold (except some heifers for breeding replacement) when ten to twelve months of age. On a dry sheep equivalent (DSE) basis over a twelve-month period, the gross margin (gross returns less variable costs) of each enterprise is similar, at around $10 per DSE. The gross margin for a breeding herd has been estimated at $185 per cow, and this figure has been used to determine the returns from the grazing of beef cattle in the area.

Table 14.7.3 Proportion of land within the proposed site and 25 ANEF contour, by capability class

Land class		Area (ha)			
		Airport site		25 ANEF coutour	
SCS*	Dept of Ag.**	SCS	Dept of Ag.	SCS	Dept of Ag.
I	1	-	-	-	-
II	2	-	-	-	-
III		-	-	-	-
IV	3	221	221	120	130
V					
VI	4		33		
VII	5	+	+	+	+
VIII					
Total		1,440	1,440	2,990	2,990

* Soil Conservation Service
** Department of Agriculture
\+ Balance of area unclassified but likely to fall within this classification.

Improved pasture is estimated to cost $142 per hectare to establish. It has been assumed that, because of the moderate levels of phosphorus available in the soil, the pasture is topdressed annually with 250 kg/ha of superphosphate. On the further assumption that improved pastures are resown every six years, the total annual cost of pasture maintenance has been estimated to be $59 per hectare. Improved pastures are estimated to carry about 15 DSE per hectare, so a 100-cow beef breeding herd with replacement stock would require an area of 120 ha. The annual pasture costs for a property of this size would therefore be $7,080. The overhead costs of a 120 ha property running a 100-cow beef herd are estimated to be about $10,600 per annum, the main component of which is rates at $7,200 per annum. Since the gross margin of a 100-cow beef herd is $18,500, the net income for a beef grazing property is $820, or $7 per hectare.

Thoroughbred horse spelling

There is a racehorse spelling enterprise located partly on the proposed site. At present, racehorses are agisted or spelled in paddocks, but a more intensive system of management is being implemented there, and during the latter part of 1984 a large sum of money was spent on improvements such as stables and yards. This development is taking place on part of the property only and the remainder of the area will be used for spelling racehorses on improved pasture in paddocks.

The returns from this enterprise have been estimated using as a model a racehorse spelling establishment of 20 ha with forty horses being spelled at a time. The gross margin for such an establishment has been estimated to be $35,000, or $875 per horse. Pasture maintenance costs are estimated to be $59 per hectare, or $1,180 per annum for the property. Overhead costs are estimated to be $10,500 per annum, leaving a net income of $23,320, or $1,166 per hectare.

14.7.3 Significance of agricultural production

A comparison of livestock numbers within the proposed airport site with those in the wider region is presented in Table 14.7.4.

This table indicates that the number of beef cattle within the proposed site is insignificant when compared to the number within the Wollondilly Shire, while the number of horses within the airport site represents only 4% of those recorded by the Bureau of Statistics for the Wollondilly Shire.

Table 14.7.4 Comparison of livestock numbers

Livestock type	Area of site utilized (ha)	Livestock numbers			
		Airport* site	Wollondilly Shire**	Sydney Subdivision**	New South Wales**
Beef cattle	35	25	6,817	20,436	2,416,817
Horses	30	60	1,480	8,206	122,346
Total	65	85	8,297	28,642	2,539,163

* Estimate based on site survey.

** These figures are taken from Australian Bureau of Statistics agricultural census data for 1982-83.

14.7.4 Value of agricultural production

A summary of the gross margins used to determine the value of production in the area is presented in Table 14.7.5, while the annual net incomes after deduction of labour costs for the farms used as models for the analysis are presented in Table 14.7.6.

Table 14.7.5 Gross margins

Enterprise	Gross income ($)	Variable costs including labour ($)	Gross margin ($)	Gross margin per unit ($)	Gross margin per DSE ($)
Beef cattle (vealer production), 100-cow unit	24,180	5,680	18,500	185/cow	10
Thoroughbred horse spelling, 40 horses	125,000	90,000	35,000	875/horse	88

Table 14.7.6 Annual net farm income (after labour costs)

Enterprise	Total gross margin ($)	Pasture costs ($)	Overhead costs ($)	Net farm income ($)	Net income per unit ($)
Beef cattle, 100-cow unit	18,500	7,080	10,600	820	7
Thoroughbred horse spelling, 40 horses	35,000	1,180	10,500	23,320	1,166

Table 14.7.7 presents an estimate of the current value of agricultural production within the proposed airport site. The estimated gross value of agricultural production from the 65 ha of grazing land within the airport site is approximately $195,000; the net value, after deduction of all costs including labour and depreciation but excluding interest on capital, is estimated to be about $35,000. It can be seen that the net income from horses represents about 99% of the total net value of production.

Table 14.7.7 Current annual value of agricultural production within proposed airport site

Enterprise	Area (ha)	Gross value of production ($)	Variable costs including labour ($)	Aggregate gross margin ($)	Pasture costs ($)	Overhead costs ($)	Net value of production ($)
Beef cattle	35	7,053	1,645	5,396	2,065	3,092	239
Thoroughbred horse spelling	30	187,500	135,000	52,500	1,770	15,750	34,980
Total	65	194,553	136,645	57,896	3,835	18,842	35,219

In the absence of acquisition and airport development, the value of production is likely to remain much the same as at present if the practice of running cattle in conjunction with horses is continued. If the horse spelling enterprise were to be expanded and intensified at the expense of the cattle enterprise, the net value of production from the area would almost double. However, this is unlikely to happen given the high capital and labour requirements, and the fact that these types of establishments appear to be developing at a rate that will lead to an oversupply in the future.

14.7.5 Agricultural economics

The figures for the regional value of agricultural commodities published by the Australian Bureau of Statistics are shown in Table 14.7.8. The $6,000 gross value of beef cattle production within the proposed airport site is insignificant compared to the estimated value of $1.5 million from beef cattle in the Shire of Wollondilly. The value of production from within the proposed airport site is even more insignificant when compared to the value of beef cattle production in the Sydney Subdivision and in the State as a whole.

The regional value of horse production is not included in the Australian Bureau of Statistics data. However, the $187,500 gross value of horse production from the area within the airport site is insignificant when compared to the estimate of $38 million for all commodities from the Wollondilly Shire.

Table 14.7.8 Beef production compared to regional value of agricultural commodities produced

Commodity	Commodity value*		
	Wollondilly Shire ($000)	Sydney Subdivision ($000)	New South Wales ($000)
Beef	1,551	5,354	521,628
Total value of commodities	63,481	293,527	3,953,569

* These figures are taken from the Australian Bureau of Statistics agricultural census data for 1982-83.

14.7.6 Assessment of effects and safeguards

If airport development were to proceed, agricultural land use within the proposed airport site could continue until the land was required for airport construction or would be progressively scaled down from the date of acquisition. The rate of such scaling down would be dependent on the desire of the owner to relocate and the time at which construction interfered with the agricultural activities. In some cases it may be feasible for agricultural use to be continued on a lease-back arrangement until the latter stages of construction. For example, in the case of the owners of the horse spelling establishment, it is unlikely that they would wish to move the existing complex to another area on the same property, but would opt to relocate outside the area associated with the airport. A lease-back arrangement would therefore provide them with time in which to develop a new horse spelling complex elsewhere to which their operations could be transferred when airport construction affecting their property began.

The gross value of production which would be lost from the land being used for agriculture within the airport site has been estimated to be about $195,000. However, development of a similar horse spelling enterprise elsewhere in the region (if sufficient demand continues for such services) could result in much of this amount being recouped.

In addition to the loss of agricultural production from within the airport site itself, there would also potentially be other production losses from nearby land through indirect effects (such as the siting of industries associated with the airport) on land presently being used for agriculture. The extent of these indirect effects is difficult to quantify at this stage, as the area to be set aside for airport related uses and associated urban development would be dependent on a subsequent regional environmental plan to be prepared for the Macarthur region by the Department of Environment and Planning (Section 14.8).

14.8 REGIONAL PLANNING AND DEVELOPMENT

This section considers the implications of the site acquisition and possible airport development at Wilton for the regional planning of the Sydney Region, and for the development of the Macarthur and Wollongong Sub-Regions. The site lies wholly within the Macarthur Sub-Region, but lies close to the boundary of the Wollongong Sub-Region of the Illawarra Region. In the ensuing discussion, the main emphasis is on the probable effects of airport development on the potential for changes in land use in the two Sub-

Regions. Some effects might restrict development in certain places, most would encourage it. These effects on land use relate mainly not to the acquisition of a site but to the possible development of the airport and to its economic and social effects (Section 14.6), and its access needs (Section 15.4). Potential noise effects from airport operations at Wilton are unlikely to have any significant consequences for land use. The appropriateness of any particular changes in land-use zoning will, however, also depend on the present policies of state and local planning authorities, and on changes in land use that may take place prior to airport development, as a result of metropolitan growth. For this reason, it is necessary to review both the recent history of planning in the Sydney Region and its likely future direction.

14.8.1 Recent history of Sydney's growth

Any assessment of the effects of airport development must take into consideration Sydney's size, as one of the fifty largest cities in the world, with a population (Sydney Region) estimated in 1981 at 3.28 million. Within the Sydney Region, which has an area of 12,407 km^2, the urban area extends almost uninterrupted from the city centre, 90 km westward to Katoomba, 75 km northward to Gosford-Wyong and 32 km southward to Heathcote. Recent development in the City of Campbelltown has extended the urban area in that city to a distance of 45 km south-west from the city centre. The proposed airport site at Wilton is located in the Shire of Wollondilly about 25 km south of this new urban area.

Sydney Region Outline Plan

Planning for future urban expansion and development in the Sydney Region dates back to 1948, with the completion of the County of Cumberland Planning Scheme. This plan was given statutory effect in 1951 and remained the blueprint for development for the ensuing fifteen years; even so, substantial modifications were made to the principles of the plan as the population increased at an unexpected rate. In view of the higher rate of population growth, the Sydney Region Outline Plan, adopted in 1968 (State Planning Authority of New South Wales 1968), was intended to provide for an expected 5.5 million people in the year 2000.

Under the provisions of the Plan, urban development was intended to occur in linear sectors along communication corridors. This basic framework was established because of transport and other development in the Parramatta—Blacktown—Penrith corridor. New sectors added were the south-west sector focusing on Campbelltown, the Fairfield—Hoxton Park sector focusing on Wetherill Park—Bonnyrigg, the south sector focusing on Menai and the north-west sector focusing on the Rouse Hill—Maraylya area.

Sydney Region Outline Plan review

During the late 1970s the Sydney Region Outline Plan came under critical review and this culminated in the publication of a report in 1980 (NSW Planning and Environment Commission 1980). Undertaken at a time when economic conditions and population growth were somewhat different from those of 1968, and when greater emphasis was being placed on environmental issues, the review report concluded in relation to urban development and growth that:

- as was hoped when the Sydney Regional Outline Plan was prepared, the phasing plan for urban development had provided a reliable guide for the extension of sewerage and other reticulated services;
- however, it had also proved a guide to private investors in a time of land boom and thereby contributed to the increase in the price of housing land;

- there was thus a conflict between the need to restrain development in new areas until existing serviced lands were fully developed, and the need to subdivide and service new land on an extensive scale in order to create and maintain a continuing supply of low-priced residential land;

- the objective expressed in the Plan, of ensuring a wider and more balanced distribution of commercial activity and avoiding over-concentration of employment in the metropolitan centre, should be redefined in terms of developing a balance between homes and jobs, community facilities and services.

The report concluded that the phasing plan contained in the Sydney Region Outline Plan should be discontinued and, in its place, it proposed that an inter-departmental committee should be established to manage the release of new urban land and the extension of reticulated services and community facilities in phase with changes in population. It was recognized that one task particularly appropriate to such a group would be to identify, co-ordinate and implement the necessary State Government funding for carrying out urban development. This proposal was put into effect when the Urban Development Committee was set up in September 1980, under the Environmental Planning and Assessment Act, 1979, to advise the Government on all matters relating to urban development and in particular on the supply of residential land.

14.8.2 Future urban development in the medium term

The remaining areas identified for urban development under the Sydney Region Outline Plan will be insufficient to meet anticipated demand beyond about 1990, owing to the fact that much of the remaining land is subdivided into smallholdings and is unlikely within the time available to be further subdivided into residential lots. The Urban Development Committee reported to the Government on the priorities for urban development beyond the areas earmarked in the Plan or otherwise already approved. Four broad areas were identified to meet Sydney's requirement for further urban development in the medium term, i.e. from 1990 into the early part of the twenty-first century; these were:

- North-West Sector
- Macarthur South
- Bringelly
- Central Coast.

These areas are discussed below.

North-West Sector

The North-West Sector includes several localities where there are no physical constraints precluding the possibility of urban development. After excluding the Scheyville airport site defined in the Major Airport Needs of Sydney Study, the following four possible localities for urban development were identified by the Department of Environment and Planning (1984):

- Riverstone—Rouse Hill—Marsden Park
- Londonderry
- Glossodia
- Dural.

These localities could be expected to provide facilities for an estimated population of 370,000. Basing its decision on an assessment of transport costs, social and physical infrastructure and other issues affecting residents and local government, the Department of Environment and Planning concluded that the North-West Sector should have first priority for inclusion in the urban development programme. In July 1984 the Department of Environment and Planning completed the North-West Sector Regional Environment Study, and a Draft Regional Environmental Plan is expected to be exhibited in mid-1985.

Macarthur South

Macarthur South is a large area south of Campbelltown, lying mainly in the Shire of Wollondilly, and encompassing:

- land between Appin Road ridge, the Nepean and Cataract Rivers and Camden Park Conservation Area, including the catchments of Elladale, Oasedale and Mallaty Creeks;

- land at Menangle between the Nepean River and the railway line including Foot Onslow Creek catchment;

- land at Douglas Park between Picton Road and the Nepean River.

The initial plans for this area (State Planning Authority 1973) provided for an eventual population of 170,000 people, but in the medium term only an additional 50,000 were envisaged. The Department of Environment and Planning has recently decided to prepare a Draft Regional Environmental Plan for the whole of the Macarthur Sub-Region, comprising the local government areas of Campbelltown, Camden, Liverpool and Wollondilly, with the purpose of addressing major planning issues and determining future land uses.

Bringelly

The Bringelly area includes land near Kemps Creek and Cecil Park, and was initially assessed as eventually accommodating some 150,000 people. However, after investigation, the Department of Environment and Planning determined that, of the choices open to it, Bringelly was least suitable to meet requirements for medium-term urban development.

Central Coast

The Central Coast area, comprising the Gosford and Wyong local government areas, could accommodate about 280,000 people by 2001. However, there is continuing discussion between the Department of Environment and Planning, the Department of Mineral Resources, and the Wyong Council in relation to the conflicting requirements of coal-mining and urban development.

14.8.3 Future urban development in the long term

Following a study by the Department of Environment and Planning of potential areas for long-term urban development, the NSW Government in December 1982 requested the Department to prepare a metropolitan development strategy.

Sydney's population is expected to continue to expand over the next few decades and at present it is projected as reaching 4 million by about the turn of the century and 4.5 million by about 2011. However, rates of growth may increase or decline, in which case the populations of 4 million and 4.5 million may be reached sooner or later than these dates. Previously, the convention used in metropolitan planning has been to attempt to link proposed urban development with population growth on a time-scale, but the result has been confusing when the rate of population growth and hence the requirements for urban expansion have been either under or over-estimated. Because of these past experiences, the Department of Environment, while considering options for long-term urban development, does not discuss them in the context of any time frame.

The future strategic direction of metropolitan planning will depend on the optimization of a number of factors including:

- distribution of employment opportunities, including those related to the construction and operation of a second Sydney airport;

- provision of transport facilities;

- a range of social, demographic and economic factors.

The pattern of population distribution that is overall the optimum one is not likely to be the best pattern from any one perspective.

Potential areas for future urban development

The starting point for identifying potential areas for future urban development is the availability of land. Figure 14.8.1 shows which land within the Sydney Region is already being used for urban purposes or has been committed for urban development. Table 14.8.1 lists areas, including in this context the northern part of the Illawarra Region, that can be identified as possible sites for future urban development after taking account of environmental considerations and physical constraints. The rate of utilization of land will depend not only on the rate of population growth, but on whether the geographical pattern of growth is concentrated or dispersed.

Table 14.8.1 Potential areas for future urban development

Region/Sub-region	Potential areas
Sydney	
Gosford—Wyong	Somersby, Warnervale
Sydney Northern	Belrose, Duffys Forest, Ingleside, Terry Hills
Sydney Western	
North-West sector	Arcadia, Kurrajong, Londonderry, Marsden Park, Rouse Hill, Scheyville, Schofields, Riverstone
Fairfield sector	Cecil Park
Macarthur	Appin, Bringely, Cawdor, Cobbitty, Douglas Park, Menangle, Wilton
Illawarra	
Wollongong	Helensburgh

Source: Department of Environment and Planning.

Geographical pattern concentrated

Assuming the population in existing urban areas does not decline, and assuming a division of land in new areas into ten household lots per hectare (for the purpose of measuring residential density, a hectare includes residential land, local roads, local open space, local centres and schools) then the population increase to 4.5 million could be accommodated within the areas identified as suitable or possibly suitable for urban development in the Sydney Region Outline Plan (excluding Cobbitty and Kurrajong, which have been identified as suitable for urban development in the long term, but in which the capacity for urban development has not yet been firmly established). Beyond a figure of 4.5 million, the optimum sequence for new urban areas in terms of balancing homes and jobs and infrastructure investment would depend on the location selected for the airport.

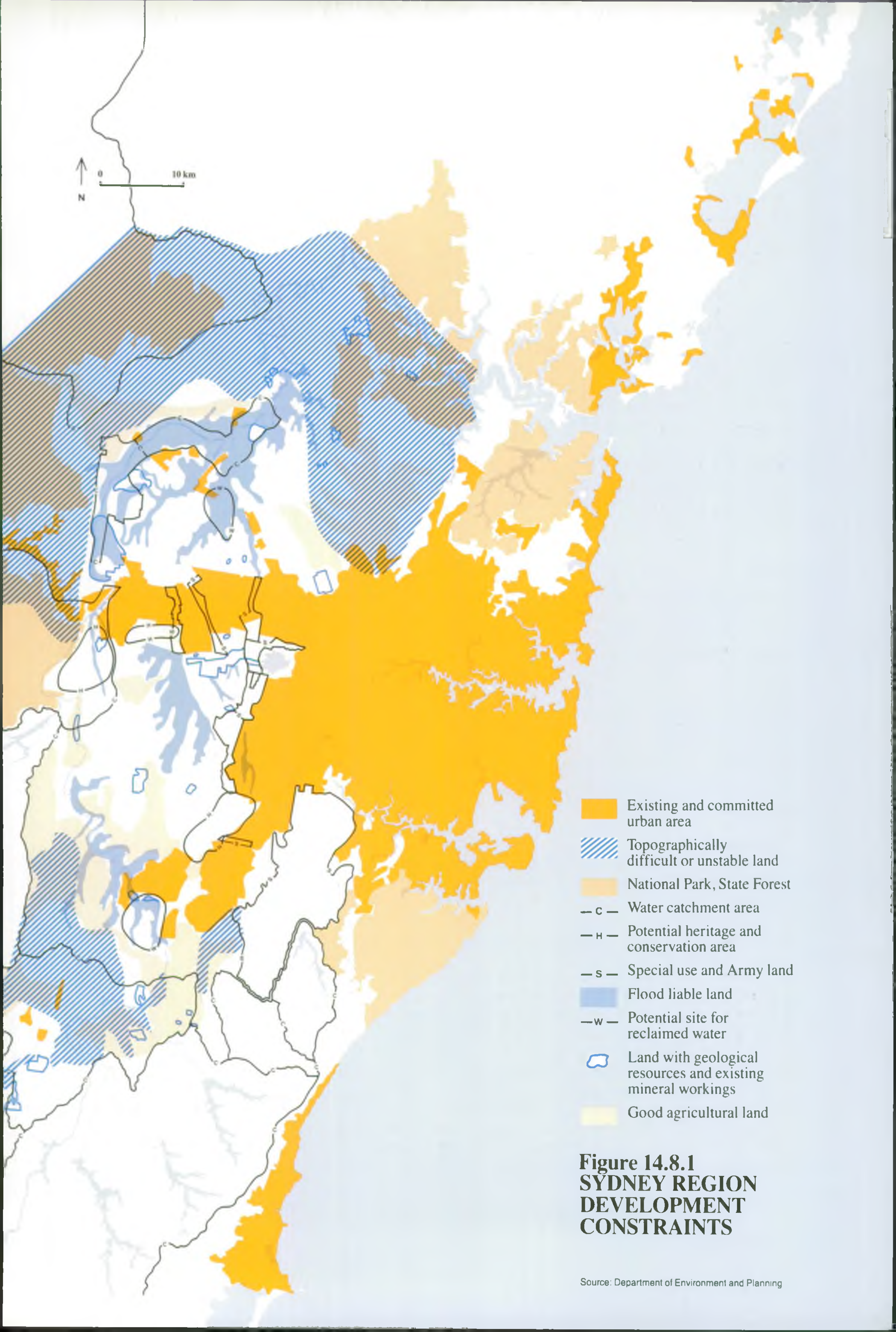


Figure 14.8.1
SYDNEY REGION DEVELOPMENT CONSTRAINTS

Source: Department of Environment and Planning

Geographical pattern dispersed

If the population were dispersed more widely as it grew in numbers, more land would be required to accommodate the same 4.5 million people, and Cobbitty, Cawdor, Scheyville, Kurrajong and areas north and south of the Sydney Region would be drawn in. Such a dispersal assumes a population decline in the inner areas, a population decline in established and already released outer areas, and that in the areas still to be developed there will be fewer dwelling units per hectare, an average of only eight lots instead of ten. The consequence would be that decisions both as to the location of the airport and as to its construction would be required earlier if the pattern and sequence of urban development were to be optimized.

Distribution of employment opportunities

Several possible future distribution patterns for employment are being investigated by the Department of Environment and Planning in relation to urban development strategies. The distribution patterns fall within a range between two conceptual alternatives:

- One alternative presupposes a high degree of government influence on employment location and hence a relatively limited distribution of jobs outside suburban centres, industrial areas and Special Uses Zones (e.g. hospitals, universities and so on), and a concentration of new employment in suburban centres, especially in the west and south-west;

- The other alternative presupposes a low degree of government influence on employment location, with a lower level of concentration in centres and greater dispersal throughout the metropolitan region, and a continuing trend to seek locations in the northern suburbs.

The size of the workforce currently estimated by the Department of Environment and Planning for a population of 4.5 million, reached about the year 2011, is 1.8 million. As with the population figure of 4.5 million, of course, a workforce of 1.8 million could be reached before or after 2011. Of this 1.8 million, a maximum of about 22,000 jobs would be attributable to the second Sydney airport and that only in the event that the maximum employment estimate for a fully operational airport, and maximum estimate of flow-on employment for a 13 million passengers a year airport (Section 14.6) were to be reached by that date. This figure of 22,000 jobs is made up of a maximum of about 11,500 people who would be located at or near the site (10,500 employed by airlines, administration and airport commercial services, and 1,000 by airport associated and airport induced activities), and a maximum of about 10,500 flow-on jobs in the Sydney Region of which about 2,300 could be in the economic sub-region around Wilton (defined for the purposes of this study as comprising the local government areas of Wollondilly, Campbelltown and Wollongong). Hence the future distribution of employment over the Sydney Region as a whole (as opposed to the future distribution of population) would be relatively unaffected by the location of the airport and the jobs located on or near it, as this employment would be less than 1% of total Region employment.

14.8.4 Effects of airport development that would encourage urban development

The immediate effect of acquiring a site at Wilton for a second Sydney airport would be to remove the necessity of restraining urban development near other candidate sites; in Chapter 1 it is estimated that some 200-300 km^2 of land within the Cumberland Plain is directly affected by the uncertainty associated with the location of a second airport site. At the sub-regional level subsequent airport development to handle 13 million passengers a year would, planning controls permitting, encourage earlier urban residential development near the airport by reason of the employment opportunities and associated infrastructure improvements. The airport would also encourage some commercial and industrial development. In order to discuss and assess the scale of these effects, the categories used in the assessment of economic effects (Section 14.6) are followed here:

- airport associated employment
- airport induced employment
- employment related to the multiplier or flow-on effects of the airport.

These are discussed in turn below, along with the possible need to revise the priorities with respect to potential areas for urban development, in order to reduce the distance of the journey to work for the airport workforce.

Airport associated activities

Airport associated activities are those directly related to the operation of the airport and requiring to be in close proximity to it, but not necessarily on the site. They include car rental firms, transport facilities and accommodation for passengers, and air freight facilities. The preliminary master plan for Wilton (Section 13.3) provides 158 ha for these uses. Airport associated jobs are estimated at a maximum of 900, and 158 ha would be more than adequate to accommodate activities on this scale.

Airport induced activities

Airport induced activities are activities attracted to an area by the presence of an airport, but not necessarily connected with it. Some commentators have suggested that airports act as growth-attracting poles and generate substantial amounts of industry in the surrounding area. However, the small amount of substantive empirical evidence that is available suggests that these growth-attracting effects have been greatly exaggerated (Fordham 1970; Hoare 1974). Firms regularly utilizing airport services find their needs best met by a location that is within, say, 45 minutes' drive, but that also meets other locational requirements. Firms that do establish nearer than this tend to be there because of the well developed infrastructure rather than because of the airport itself:

> Since airport development invariably requires major investments in infrastructure and public utilities, the surrounding area becomes a natural focus for urban development ... airports provide several essential ingredients that encourage urban growth: jobs, extensive roadway systems, a generally undeveloped setting where reasonably priced land is available, and public utilities which can be tapped by their users (US Department of Housing and Urban Development 1974).

This evidence, together with the non-central location of the site, suggests the unlikelihood of any activities (additional to airport associated activities) being attracted by the presence of an airport as distinct from the mere availability of serviced sites. Nevertheless, the NSW Government might decide to promote industrial and commercial development on sites near the airport for reasons of overall metropolitan strategy, and might decide to make infrastructure improvements beyond those strictly necessary for the operation of the airport.

Activities resulting from multiplier or flow-on effects

Activities related to the multiplier or flow-on effects of the airport are those resulting from the expenditures of organizations included in the airport and airport associated categories and the expenditures of employees in these sectors. The maximum likely sub-region flow-on employment for a level of airport operations of 13 million passengers per year has been estimated (Section 14.6) at 2,300. About half of the flow-on employment is likely to arise in activities requiring land zoned as industrial, and about half in activities usually associated with local, district or regional centres. Much of the flow-on employment could be located on land already developed, or committed for development, bearing in mind that Wollongong and Campbelltown are comparatively close. Even assuming that no flow-on employment were sited in existing developed areas, and assuming densities of twenty employees per hectare for industrial land and fifty per hectare for local or district centres, the land required would only amount to 115 ha. As such employment could be created anywhere up to 25 km from the airport, there is no possibility of any land shortage arising from the flow-on effects of the airport.

Residential land for the airport workforce

When projects remote from established population centres are proposed, it is often necessary for additional housing to be built. In the case of a project in the Sydney Region, the planning objective is the broader one of maintaining and if possible improving the balance of homes and jobs by influencing the location and timing of new industrial, commercial, and residential development. By the year 2011 there would be an estimated 320,000 people living within 20 km of the Wilton site, and in the short and medium term there may well be insufficient jobs in the same area for all those in the workforce; hence airport development would not necessitate a revision of urban development priorities in order to accommodate the airport workforce. However, the NSW Government may decide that, taking the Sydney Region as a whole, the best overall balance between homes and jobs would be achieved by accelerating residential development at places within easy commuting distance of the site; such a possibility cannot yet be definitely foreseen.

Consequences for regional planning

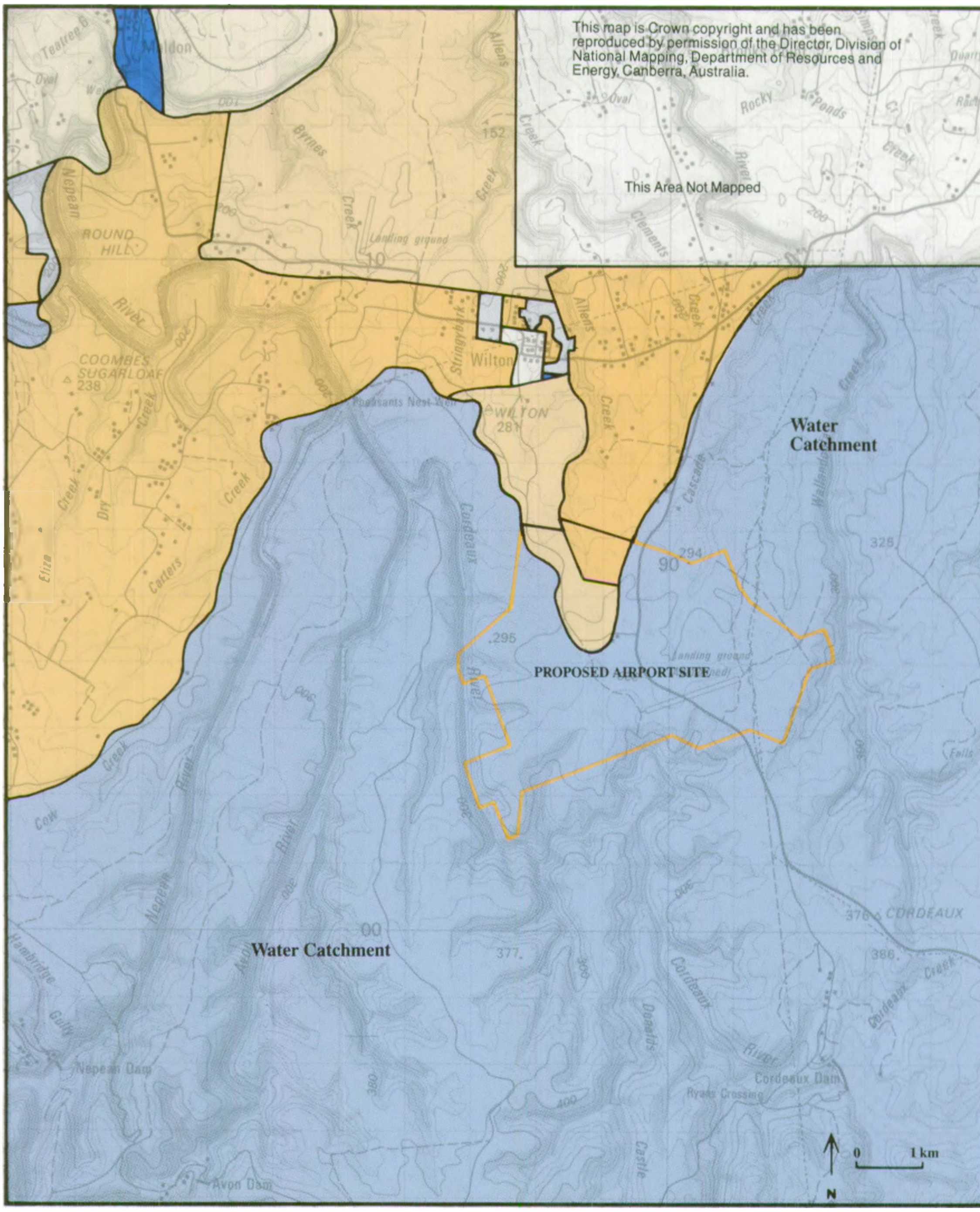
In so far as airport development was accompanied by additional urban development or by changes in the location of future urban development, a wide and divergent range of possible consequences can be imagined. For example, depending on the locations of urban development, there might or might not be additional loss of agricultural land; however, it must be remembered that the main effect of the future airport would be to change the sequence in which the potential urban areas already identified were developed rather than to add to the total extent of urban development. The likely changes in sequence if airport development were to proceed quickly are indicated by the fact that, of the potential future urban areas identified by the Department of Environment and Planning (Table 14.8.1), the ones nearest to Wilton are Appin, Douglas Park, Menangle, and Wilton itself. Depending on its timing, airport development could mean that urban development takes place in these areas earlier than would otherwise have been the case. But airport development might not occur until after urban development has already reached these places, including Wilton. Although urban development at Wilton might seem a distant prospect, it is probably inevitable given the freeway, an attractive environment, and the proximity to Wollongong, a city now almost without areas for further urban development. Along with other regional planning issues associated with airport site selection, the choices for urban development will be examined in the Macarthur Regional Environmental Study at present under preparation by the Department of Environment and Planning. Following public exhibition of the study, currently scheduled for late 1985, preparation of the Draft Regional Environmental Plan will commence. A strategic land-use plan will be included in this (both Wilton and Badgerys Creek sites fall within the Macarthur Sub-Region).

14.8.5 Effects of airport development that would restrict urban development

Hardly any existing or potential land uses would be incompatible with aircraft operations at Wilton. All but 590 ha of the potential noise-affected area under worst case conditions (Section 14.2) lies within the Metropolitan Catchment and so is not capable of being developed (Figure 14.8.2). None of the remaining 590 ha would be subject to noise levels above 25 ANEF under worst case conditions.

Effects at site acquisition stage

The immediate effect on land use of acquiring the site at Wilton would emerge as a need to limit, as far as practicable, further airport-sensitive development. At the time of



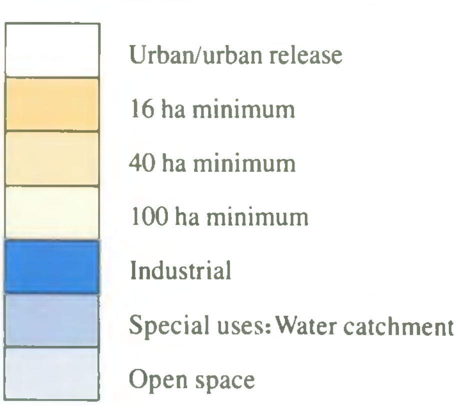


Figure 14.8.2
CURRENT LAND USE ZONING NEAR WILTON (Simplified)

public release of the Draft Environmental Impact Statement, the Department of Environment and Planning proposes to put in place interim planning measures in order to control development in potential noise-affected areas, and to protect the airport site.

The question of what development restrictions should be imposed on land potentially subject to noise levels of above 20-25 ANEF under the worst case assumptions is a matter for judgement by the land-use authorities; however, the advice of the Department of Aviation is that some people may find land subject to such a level of noise exposure is not suitable for residential use and that incorporation of noise control features in residences is appropriate. The Department also advises that schools, hospitals, and other highly sensitive uses are inappropriate on land subject to 20-25 ANEF.

While the content of these interim planning measures is not known at the time of writing, they will not in any sense 'sterilize' land, since many of the land uses at present permitted by the relevant planning schemes are compatible with the worst case noise levels (Section 14.2). None of the potentially noise-affected land is zoned exclusively for residential or other use that is particularly sensitive to noise.

Effects at aircraft operations stage

If planning measures are taken at the site acquisition stage, there would not be further restrictive effects should aircraft operations commence and build up to the worst case level.

CHAPTER 15

The Physical Environment and Effects of the Proposal

Introduction

This chapter describes the physical environment of the proposed site, and the likely effects of site acquisition and airport development; and outlines proposals for environmental safeguards and monitoring programmes.

The chapter commences with a description of the geology, soils and physiography of the proposed site in terms of its suitability for airport development (Section 15.1). The effects of airport development and operation on water and air quality are then described (Sections 15.2 and 15.3). In Section 15.4, proposals for road and rail access are described. This section deals with the means by which access could be provided, and with the impact of traffic generated by the airport on the existing road and rail systems. A comparison of the relative accessibility of the Badgerys Creek and Wilton sites is made in Chapter 17. The discussion on access is followed by a description of proposals for relocation of existing infrastructure and for provision of new infrastructure (Section 15.5). The chapter concludes with an assessment of the landscape character and relative scenic quality of the proposed site, and the likely impact of airport development (Section 15.6).

15.1 GEOLOGY, SOILS AND PHYSIOGRAPHY

15.1.1 Geology

This section describes the geology of the proposed airport site at Wilton, including its seismic stability, mineralization, and materials that could be used for airport construction or which could become sterilized by airport development at the site. Information for this section has been obtained from the Department of Mineral Resources, which is currently undertaking the compilation of detailed geological information for the Wollongong—Port Hacking 1:100,000 sheet (Chesnut 1981b; Sherwin and Holmes in press), which covers the site area.

Regional geology and stratigraphy

The geology of the area is dominated by the Mid-Triassic Hawkesbury Sandstone which occupies most of the plateau feature, while the overlying Mid-Triassic Wianamatta

Group dominates the north-western section of the sheet from Picton through to Cobbitty. The Late Permian Illawarra Coal Measures are exposed in parts of the south-eastern section of the sheet along the escarpment between Port Kembla and Coledale. The coastal margin contains recent (Holocene) and other Quaternary deposits.

The proposed site is near the edge of the structural centre of the Permo-Triassic Sydney Basin. As a result of this and the general structure of the basin, the Mid-Triassic rocks are exposed in this location. The Sydney Basin evolved as a north-westerly elongated crustal depression on the eastern margin of the Lachlan Fold Belt. During the Early Permian, sediments from the Lachlan Fold Belt were deposited in marine environments within the Sydney Basin. However, during the Late Permian to Mid-Triassic, orogenesis in the New England Fold Belt provided the impetus for vigorous erosion and transport of detritus from that region into a dominantly alluvial and deltaic Sydney Basin.

The structural centre of Triassic rocks in the Sydney Basin is located within the Penrith Basin, a structural sub-basin probably of Tertiary age. Further south towards Wilton, considerable erosion of the Woronora Plateau has occurred down to the middle portion of the Hawkesbury Sandstone, extending to the Illawarra Coal Measures below the Illawarra escarpment.

Sedimentary rocks exposed in the Wollongong—Port Hacking 1:100,000 sheet area comprise the Hawkesbury Sandstone, the Mittagong Formation and the Wianamatta Group. The rocks range in age from Early to Mid Triassic. No Late Triassic sediments are known to have been deposited in the Sydney Basin. However, it is deduced that Early Jurassic sediments were deposited, but are preserved only where they collapsed into volcanic breccia necks (Crawford et al. 1980).

Geology of the proposed site

Triassic rocks of the Wianamatta Group (Ashfield Shale), Mittagong Formation and Hawkesbury Sandstone crop out over most of the proposed airport site at Wilton (Stroud et al. in preparation). These are discussed below and their location shown in Figure 15.1.1.

Ashfield Shale

This unit forms the basal unit of the Wianamatta Group and coincides with the cleared area between Allens Creek and Cascade Creek. The unit consists of dark grey to blue-black siltstone with interbedded siltstone—fine sandstone laminite beds. The bedding is generally uniform and the sandstone content of the unit increases towards the top. The thickness of this unit varies from about 40-60 m.

Mittagong Formation

This unit lies between the Wianamatta Group and the overlying Hawkesbury Sandstone. It consists of fine-grained quartzose sandstone interbedded with dark grey sandstone and laminite in beds to about 1 m thick. The Mittagong Formation is generally fairly thin: it ranges in thickness up to a maximum of about 6 m, but has an average thickness of about 2 m. It occurs in two locations which coincide with two of the highest parts on the ridge feature which crosses the proposed site from east to west.

Hawkesbury Sandstone

The Hawkesbury Sandstone covers the remainder of the proposed site (about 95%). The sandstone varies from very fine to coarse-grained, with the major part of it being medium-grained. Interbeds of laminite, siltstone and claystone are common as lenses (referred to as 'shale lenses') within the sandstone. These shale lenses can vary in thickness from a few millimetres to more than 10 m, and in places they may extend laterally for more than 1 km although most are much smaller. These Hawkesbury Sandstone shale lenses have been valued in the past as sources of light-firing shale for specialized brick manufacture.

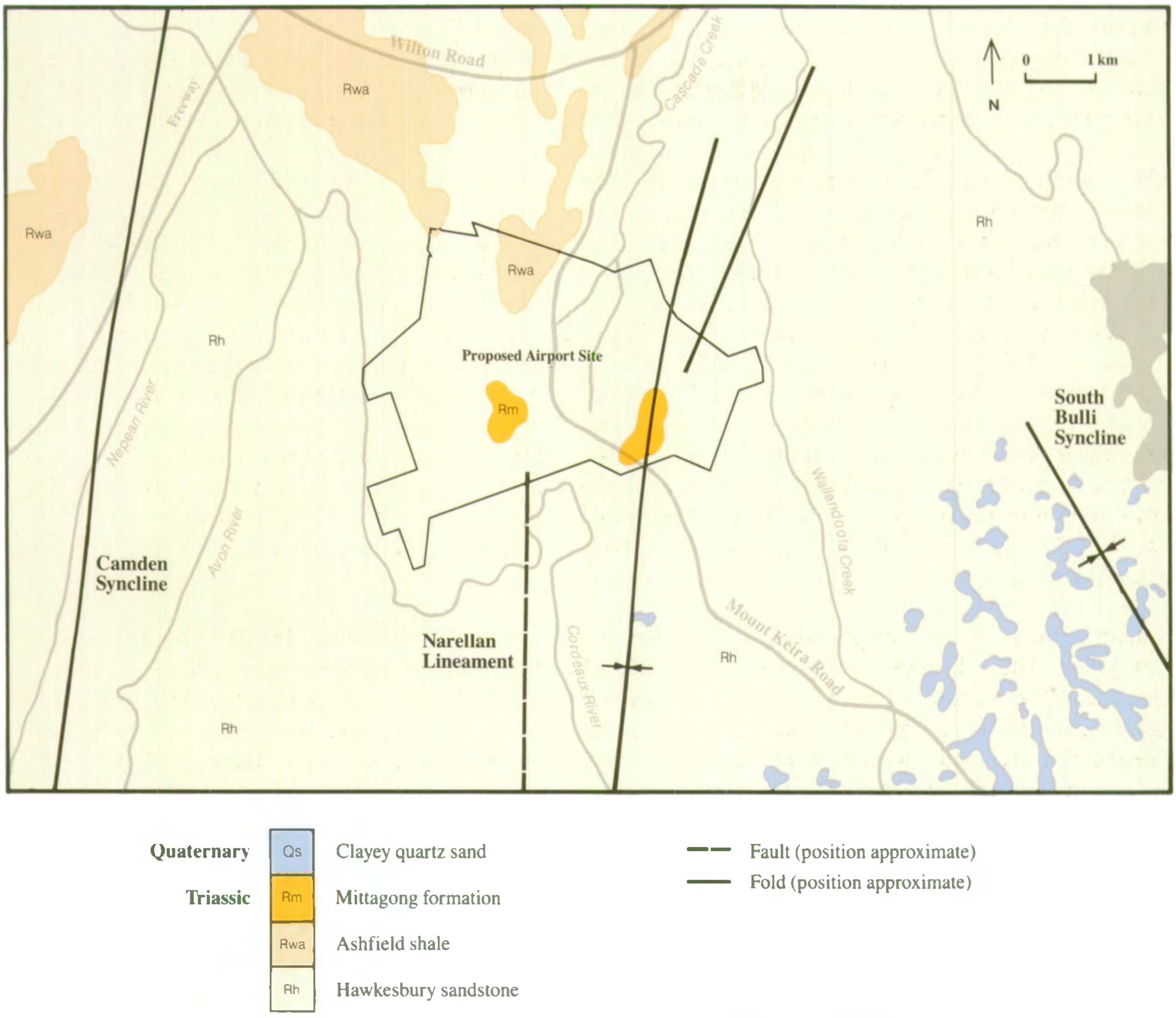


Figure 15.1.1
GEOLOGY

There appears to be a relationship between the abundance of these shale lenses and their stratigraphic position within the unit. Various researchers (Bowman 1974; Stroud 1974) note that they appear to be more abundant in the top quarter of the Hawkesbury Sandstone, while a crude statistical treatment of drill core data indicates that they are more abundant in the top half of the unit (Stroud 1974). The shale lenses seem to be more abundant and much larger in the eastern part of the map area. This distribution is comparable to that in the underlying Narrabeen Group, in which the silty or fine-grained units also do not persist to the west — to the extent that the group becomes a sandstone unit that is difficult to distinguish from the overlying Hawkesbury Sandstone.

Structural features

The major structural features that are likely to affect the proposed site are the Narellan Lineament and an unnamed syncline west of Lake Cordeaux.

Narellan Lineament

This lineament (Figure 15.1.1) has been defined from satellite imagery. Analysis of the orientation of the lineament suggests it is similar to that of faults in the area, and it is thus likely that these lineaments are related to the tension directions in the region. The Narellan Lineament is a relatively prominent feature, and is considered to be a monocline uplifted to the east.

Synclinal folds
Previous researchers (Cramsie 1964; Bunny 1972; Bowman 1974) examined the folds that had an east-south-easterly axis and reported that they were probably active during the Late Permian sedimentation. Their development was probably associated with that of the deepest part of the Sydney Basin in the Sydney Region.

Coal resources

The proposed site is located in the Southern Coalfield, which is predominantly a producer of low-ash hard coking coal for the domestic steel industry as well as for the export market. This type of coal is not produced by any other region in the State and is of considerable importance to the Port Kembla steelworks. The Appin and Tower collieries lie to the north of the proposed site, to the east is the South Bulli Colliery, while to the west are the Bargo and Tahmoor collieries. (Figure 15.1.2 shows the existing mining tenure in the region.)

The proposed site would appear to affect:

- Coal Development Area No. 3
- South Bulli Colliery.

At present the proposed site is not affected by any underground workings.

The Bulli seam is the major economic seam in the Wilton area and is currently being mined in the surrounding collieries. The seam is classified as a hard coking coal, although there is some evidence to suggest that coking properties deteriorate in the area of the proposed airport site, owing to the intrusion of igneous rock into the coal measures. This seam varies in thickness from less than 1 m to over 2 m, with the depth of cover above this seam ranging from 420 m in the south to 450 m in the north.

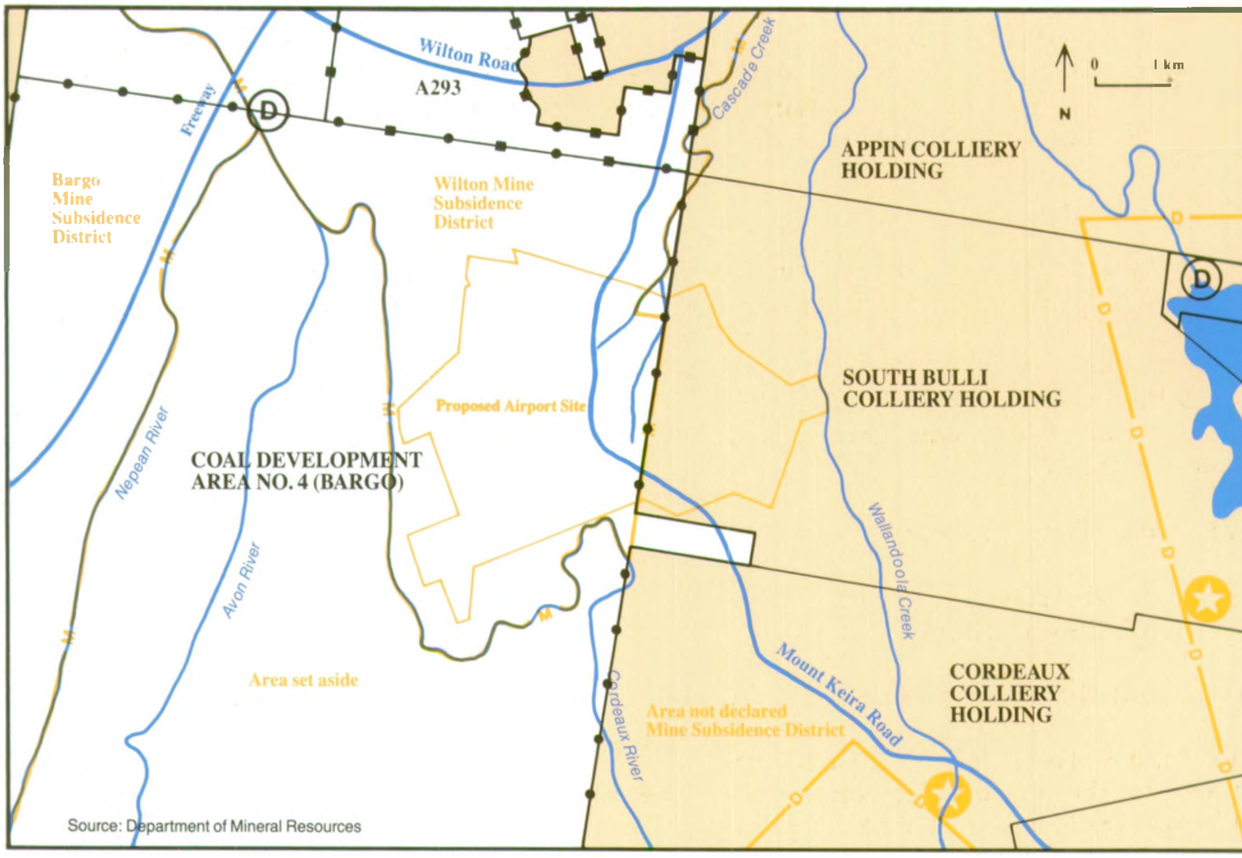
Another seam in the area, the Wongawilli seam, may have a potential use as either a steaming coal or as a component in a coking coal blend. In the area of the proposed site the significant section of this seam varies from 2-2.5 m. The Wongawilli seam occurs at depths of between 450 m and 500 m. A third seam, the Balgownie seam, lies between the Bulli and Wongawilli seams. This seam is considered to be uneconomic for mining purposes within the proposed site.

Table 15.1.1 shows the potential coal resources that could possibly be sterilized by future airport development.

Table 15.1.1 In situ coal resources at the proposed airport site

Seam	Thickness (m)	Coal resources (Mt)
Bulli	1.5 - 2.0	10.0
Wongawilli	2.0 - 2.5	40.0

There are proposals for some of the coal resource underlying the proposed site to be mined, although not for about twenty years. While future airport development would be in conflict with the concurrent extraction of the total economic coal resource from beneath the site, it would be possible to design a mine plan that avoided affecting structures sensitive to subsidence and thus allow some coal extraction to occur.



Coal prospecting areas (Including exploration permit tender areas and coal development areas)

Proposed coal mining areas (Including coal lease tender areas)

Colliery holdings

Mine Subsidence Districts (Mine Subsidence Compensation Act, 1961)

Dam Notification Areas (Section 17A Coal Mining Act, 1973)

Underground coal mine pit top site

Prescribed dam (Dams Safety Act, 1978)

Figure 15.1.2
COLLIERY HOLDINGS AND MINE SUBSISTENCE DISTRICTS

Extractive resources

The Department of Mineral Resources (1984) indicates that there are no regionally significant identified or potential extractive resources within the proposed airport site at Wilton. There would therefore be no objections on these grounds to development of the site as an airport.

Table 15.1.2 shows the quantities of materials estimated to be required for the purpose of constructing runway and taxiway pavements, car parks and terminal buildings commensurate with the scale of development implied by the preliminary master plan shown in Chapter 13.

Figure 15.1.3 shows the existing and potential sources from which the required materials could be drawn. Most of these materials, which are discussed below, would either be available from existing sources or could be obtained from the site as part of the cut-and-fill required for runway preparation.

- **Sub-base:** Depending on the different qualitites of material and engineering specifications for the sub-base, most requirements should be able to be obtained on site — from crushed Hawkesbury Sandstone, Mittagong Formation (shale and sandstone), and Ashfield Shale.

- **Base-course:** As with the sub-base requirements, most base-course material (depending on the material quality and engineering specifications) should be obtainable on site. These materials may need to be augmented by high quality base-course from commercial sources, such as crushed sandstone from Menangle (Cleary Bros) or from Mount Hunter (Readymix Farley).

- **Coarse aggregate (for concrete and bituminous concrete):** High-grade coarse aggregate for concrete and bituminous concrete is available from hard rock sources in the Albion Park—Kiama area (Readymix Farley, Boral, Pioneer Concrete and Cleary Bros). Although blast furnace slag from Port Kembla has been widely used in the past as concrete aggregate and prepared road-base, recent changes in steelmaking technology have affected its suitability for these applications.

- **Fine aggregate (for concrete and bituminous concrete):** Fine to medium-grained construction sand for concrete and bituminous concrete is available from a large deposit at Elderslie (Readymix Farley, and Spring Sand and Soil Supplies) and from Kurnell Peninsula (Hooker Industrial Sands and Minerals, and Metropolitan Sand Co.). There is also a small undeveloped deposit of similar fine to medium-grained sand at Menangle Park on land owned by the Macarthur Development Board. This sand may need to be blended with coarser sand from the Nepean River or Penrith Lakes (which could be supplied by Readymix Farley, Pioneer Concrete and Boral).

Table 15.1.2 Estimate of construction materials required for airport development

Facility	Construction material	Quantity (000 m^3)
Runways, taxiways, roads and car parks	Sub-base 1	1,200
	Sub-base 2	400
	Sub-base 3	600
	Base-course	300
	Concrete	375
	Bituminous concrete	40
Terminal building	Concrete	60

Source: Department of Aviation.

Environmental engineering and geological hazards

The following geological features and processes are recognized as possibly affecting land use within the proposed site:

- natural geological hazards, comprising:
  - land instability (soil creep, landslip, rock falls, rock slides and cliff recession)
  - seismicity;
- man-induced (pseudo-geological) hazards, comprising:
  - subsidence after mining
  - settlement of filling or of reclaimed lands

These are discussed briefly below:

Land instability
The sandstone escarpment features which occur along parts of the proposed airport site boundary are subject to wedge and toppling failures. These are either generated by

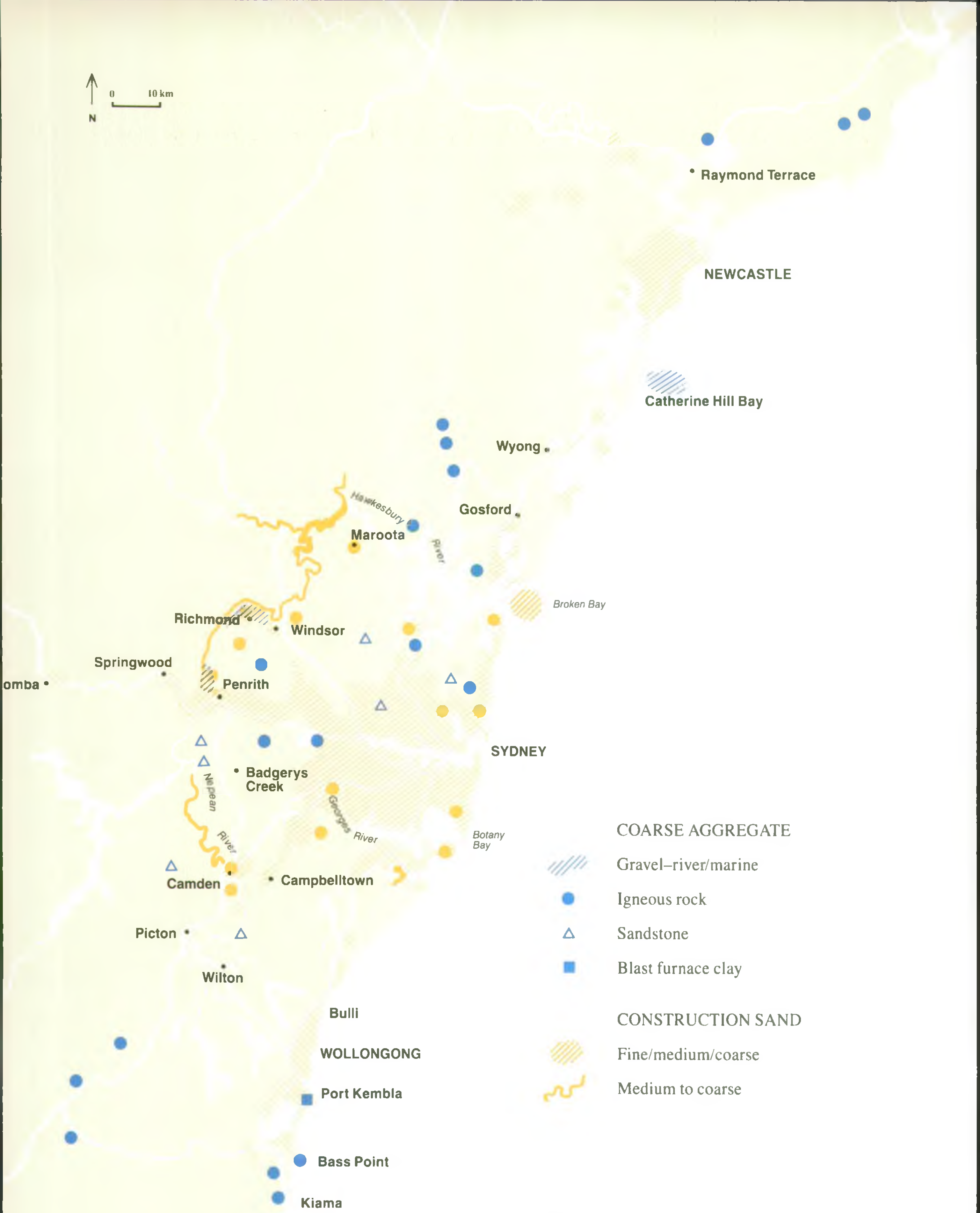


Figure 15.1.3
POTENTIAL SOURCES OF CONSTRUCTION MATERIAL FOR THE SYDNEY REGION

weathering and separation processes along bedding planes and joints (wedge failure) or are the result of undercutting caused by the weathering of an underlying shale lens (toppling failure). In some places, more friable sandstone may be readily eroded by wind or water, undercutting the overlying sandstone which may eventually collapse.

Seismicity
A system of seismograph stations was established in the Sydney Region during 1958-59. Data collected to date indicate that this area has a relatively low seismicity, with most earthquakes occurring on the boundary of the Sydney Basin (Drake 1974).

During the time in which seismic activity has been recorded, none of the earth tremors or earthquakes originating in the region of the proposed site has caused surface damage or underground damage to coal mines, although there were reported instances of structural damage to old buildings. The area has been affected by two recent earthquakes:

- the Robertson-Bowral earthquake (21 May 1961)
- the Picton earthquake (20 March 1973).

Mills and Fitch (1977) report that the Picton earthquake did not occur within a mapped fault zone although it is probable that it occurred in a zone of weakness. Doyle et al. (1968) and Denham et al. (1975) give reports on these earthquakes. The Robertson-Bowral earthquake had a magnitude of 5.6 on the Richter scale and the Picton earthquake had a magnitude of 5.5 on the Richter scale. The two earthquakes recorded in 1961 and 1973 are the largest earthquakes to have been recorded within the Sydney Basin. Denham (1980) concludes that both earthquakes resulted from movement on high angle thrust faults at depth due to north-east/south-west compressions.

The Modified Mercallie Scale (MM) is used to measure the ground-shaking effects (intensity) of an earthquake. This scale uses twelve levels of intensity (each designated by a Roman numeral), and for each level there are certain criteria that can be readily observed by people experiencing the earthquake. For example, at an intensity level of IV, hanging objects swing, a vibration like that of a passing truck is felt, stationary cars rock, and windows and dishes rattle. Degrees of damage to various classes of masonry structures serve as criteria for identifying higher intensity levels.

Figure 15.1.4 shows values of Modified Mercallie intensities which are expected to be exceeded on average once every 100 years in the Illawarra Region. The interpretation from this map is that a ground-shaking event equivalent to intensity level V on the Modified Mercallie scale would be expected to be exceeded during a 100-year interval at Wilton. At this intensity level the disturbance is felt outdoors, its direction can be estimated, people sleeping are awakened, liquids are disturbed and in some cases spilt, small unstable objects are displaced or upset, doors swing closed or open, shutters and pictures move, and the pendulum movement of clocks is affected.

It is estimated from Australian accelerograms that the peak ground motion at intensity MMV is likely to be in the range 2.0 ± 1.0 m/s^2 at a period of about 0.05 s. Perceptible motion is likely to persist for a few seconds. This is equivalent to a peak ground velocity of about 1.6×10^{-2} m/s (Gaull 1984).

The Standards Association of Australia's earthquake hazard classification map indicates that Wilton might be within Zone 1. The Earthquake Code AS 2121 for Zone 1 requires the design of ductile structures (structures, often reinforced, that are capable of absorbing large amounts of deformation) to make provision for additional lateral loads likely to be produced by earthquakes and also to incorporate certain ductility requirements. For the design of non-ductile structures, significant load penalties must be taken into account.

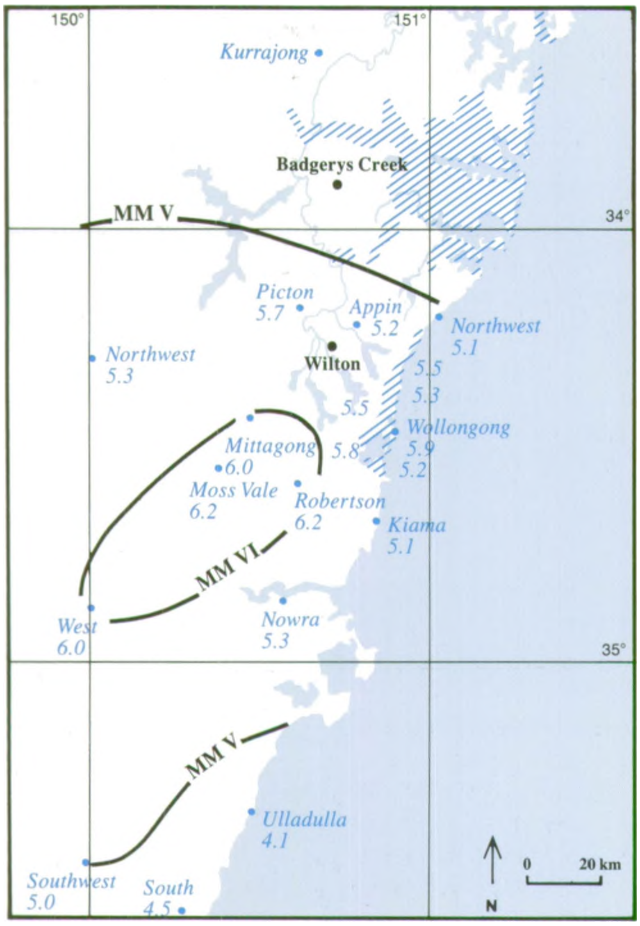


Figure 15.1.4
MODIFIED MERCALLIE GROUND INTENSITIES EXPECTED TO BE EXCEEDED ON AVERAGE ONCE IN EVERY 100 YEARS

Northwest 5.3 Control point used to estimate the MM V and MM VI contour lines

NOTE: This information has been prepared using earthquake data from the last 100 years of seismicity and using the 'extreme value' method to estimate the Modified Mercallie scale contour lines

Source: After B. Gaull 'Seismic Risk in the Illawarra Region'

Mining subsidence

Table 15.1.3 shows the expected maximum subsidence assuming that the total depth of coal from both the Bulli seam (which would be extracted first) and the Wongawilli seam were mined. Residual subsidence could occur up to two years after mining and would be about 150 mm in total, or about 5% of the maximum subsidence shown in Table 15.1.3.

Table 15.1.3 Expected ground subsidence and strain parameters assuming total extraction of coal beneath the site

Seam	Max. subsidence (m)	Max. tensile strain (mm/m)	Max. compressive strain (mm/m)
Bulli	0.850	1.27	1.00
Wongawilli	1.925	2.63	2.07
Total	2.775	3.90	3.07

Land settlement

Currently, the only area of known man-made fill on the site is the Mount Keira Road formation. Airport development would necessitate large areas of the proposed site being subjected to cut-and-fill to create the required land surface areas. Special compaction methods would need be used and attention given to the grain size of fill material and to drainage in order to minimize the potential effects of differential settlement.

Assessment of effects and safeguards

A decision to acquire the proposed Wilton site could potentially sterilize important coal resources beneath and adjacent to the site. However, one of the reasons that this site was the preferred choice over all other possible sites in the Wilton area was because it overlies an area of poor quality coal and therefore minimizes the potential for coal resource sterilization.

Part of the proposed site is within the Wilton Mine Subsidence District (Figure 15.1.2). This is a declared area under the Mine Subsidence Compensation (Amendment) Act, 1983, and the Mine Subsidence Compensation Act, 1961. These Acts require all surface development to be constructed in accordance with special design criteria approved by the Mine Subsidence Board. It would take about fifteen years to extract the coal from beneath the proposed site. If airport construction commenced within two years of mining being completed, the effects on surface developments would be limited to residual subsidence, which could be taken into account in their design. If, on the other hand, airport construction commenced prior to mining, the mine plan would have to be designed to avoid subsidence-sensitive structures such as runways and taxiways. Mining could be undertaken beneath buildings and other facilities provided that these had been designed to the tensile and compressive strain parameters set out in Table 15.1.3. The mine plan would also need to be designed to avoid disturbance to drainage flows.

The acquisition of land owned by the Bellambi Coal Company Pty Limited for the proposed airport site would preclude that company from proceeding with its current proposals to develop a new mine surface complex on this land. The company may have difficulty in finding a suitable alternative site for these facilities in view of the limited availability of land that is outside the Metropolitan Water Sewerage and Drainage Board's catchment area but still relatively close to the South Bulli mining operations. An alternative site for the complex would also probably result in a less efficient operation than that now planned.

If the Wilton site were selected, the Department of Aviation would inform the Department of Mineral Resources and the Joint Coal Board of the decision in order to allow further consideration to be given to the question of whether to extract the underlying coal. The Department of Aviation would also open negotiations with the Bellambi Coal Company Pty Limited to discuss the effects of the acquisition of the company's land.

In terms of construction materials required for airport development, the Department of Mineral Resources (1984) indicates that these materials would either be available from existing sources or could be obtained from the site. The supply of material from existing sources would to some extent depend on the timing and phasing of airport construction. However, it is anticipated that the size of the Sydney market will ensure that there are always suitable existing sources of supply of construction materials and that there would be no need to develop special sources of material solely for airport development.

A number of geological features have been identified that would require consideration in the engineering design of an airport at the proposed site, but none of these is sufficiently significant to preclude airport development.

15.1.2 Soils

This section broadly describes the soils of the proposed site and the potential erosion hazard associated with the earthworks required for airport development. Information for this section was obtained from survey work undertaken by the NSW Soil Conservation Service.

Soil types and characteristics

The proposed site contains soils derived from the Wianamatta Group and the Hawkesbury Sandstone. Three broad soil types occur within the site:

- hard setting red-brown duplex soils
- yellow earths and hard setting yellow duplexes
- discontinuous shallow stony sands.

Figure 15.1.5 shows the approximate distribution of these three main soil types in relation to the proposed site.

- **Hard setting red-brown duplex soils:** Those soils occur in small portions of the site on hillcrests and ridges in association with shale caps on the Woronora Plateau. They comprise the following:

  - lithosols, which are located on the crests of ridges with a topsoil of about 10-20 cm deep overlying either bedrock or reddish-brown clay subsoil;

  - red-brown podzolic soils, which are found on the slopes. The depth of these soils can range from between about 0.5-2 m, with the deepest profile occurring where the ground slope changes from being convex to concave. These soils are commonly hard setting but can be pliable, and generally overlie clay subsoil and highly weathered bedrock;

  - red-yellow podzolic soils, which are found along the drainage depressions or other areas of poor drainage. The topsoil is usually 10-20 cm deep and overlies a brownish-yellow subsoil. These soils are up to 2 m deep and can become waterlogged. They are often saline.

- **Yellow earths and hard setting yellow duplexes:** These soils occur over the major portion of the site in association with the Hawkesbury Sandstone and with minor shale and laminite lenses on the plateau surfaces. They comprise the following:

  - yellow podzolic soils, which are located on the crests of ridges and adjacent slopes with a topsoil about 10-20 cm deep overlying a yellow pedal clay which extends to a depth of about 1 m;

  - lateritic podzolic soils, which are similar to the yellow podzolic soils but contain ironstone fragments;

  - yellow earths, which are also located on the crests of ridges but are usually 20-150 cm deep;

  - earthy sands, which are generally found at the bottom of drainage depressions and have a 1-2 m deep profile.

- **Discontinuous shallow stony sands:** These soils occur in a very small portion of the site in association with the Hawkesbury Sandstone and minor shale and laminite lenses below the surface of the plateau in the gorge areas. These areas of the site are likely to contain the following soils:

  - lithosols, which are likely to occur on the crests of the escarpments and on hillslopes in discontinuous sections between rock boulders and outcrops. They consist of up to about 20 cm of loose or weakly coherent sand topsoil and directly overlie the bedrock. Where high rates of erosion occur, bare bedrock is likely to prevail;

- yellow earths, which are likely to occur in areas set back from the crest edges of the escarpments where the erosion rate is low. The topsoil is likely to be only a few centimetres deep, overlying up to about 30 cm of clayey subsoil. This soil is also likely to be present in discontinuous sections on the escarpment slopes;

- yellow podzolic soils, which generally occur on the escarpment slopes on narrow benches in discontinuous sections between rock boulders and outcrops. The soil profile is about 50-70 cm deep, is loose or weakly coherent, and overlies a yellow clayey subsoil where the bedrock is weaker and fragmented;

- red and yellow podzolic soils, which occur in association with the shale and laminite lenses that form wide benches on the escarpments. The topsoil is sandy and loose or weakly coherent, overlying medium to heavy clay. Where the area is well drained, the soils are red and yellow, but they are mottled in poorly drained situations;

- siliceous sands, which are depositional sands and can be over 1 m deep. They generally occur at the bottom of gorges or incised drainage channels, can often be swampy, and have a high organic content.

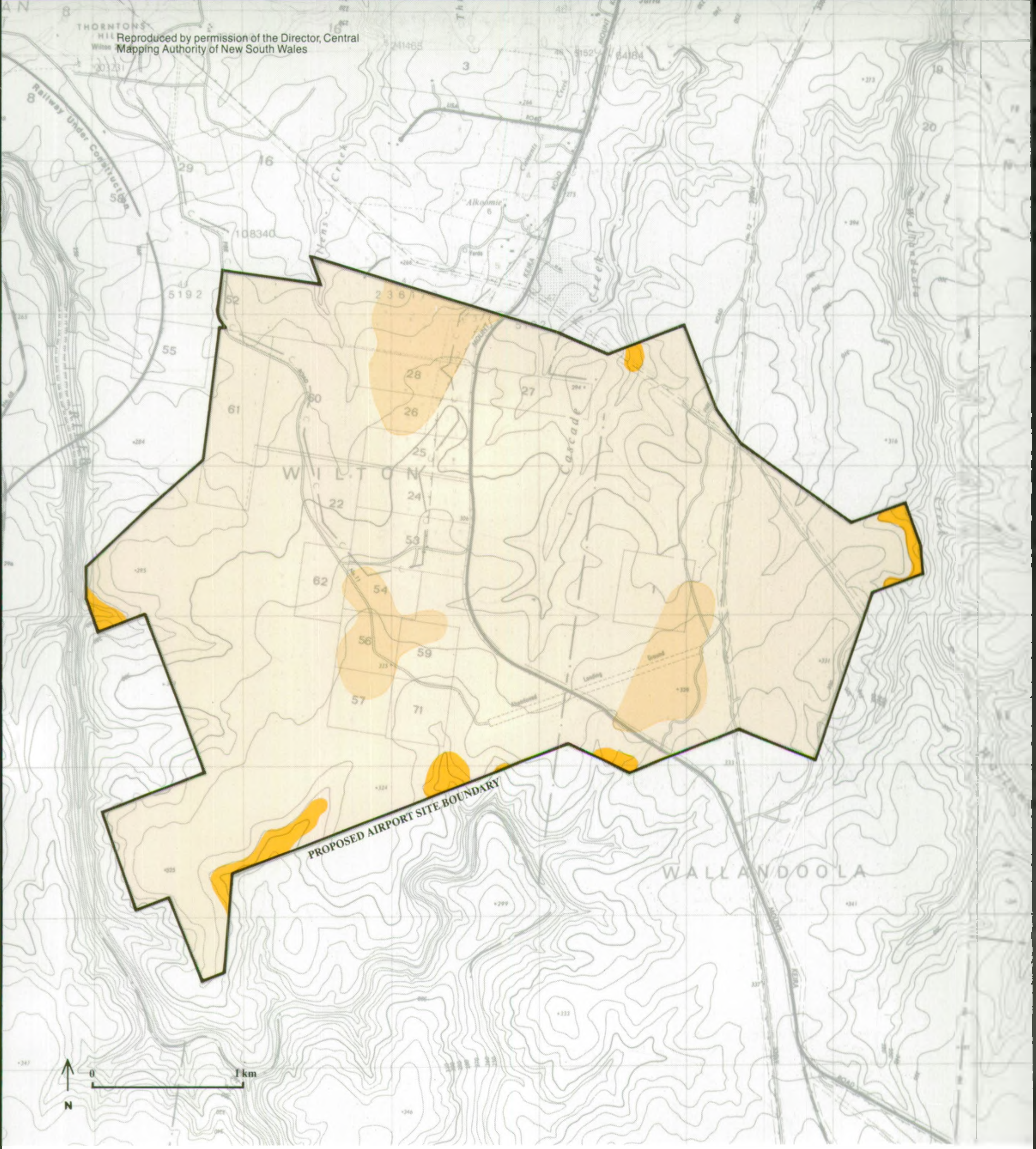
Soil characteristics for the types described above are presented in Table 15.1.4. The main characteristic of concern relating to the proposed site development would be the erodibility of the soil and the potential for sediments to move into the downstream areas during construction activities. The degree of soil erosion depends on the soil profile morphology and the physical properties of the soil unit. Five classes of erodibility have been used to characterize soil erosion potential and are classified as to the type of erosive action (Soil Conservation Service 1978). Other characteristics relating to the soils on the site are also presented in this table.

Table 15.1.4 Soil characteristics

Type	Geology	Dominant materials	Occurrence	Intrinsic fertility	Erosion hazard		Drainage	Other
					Type	Degree		
Hard setting red-brown duplex soils	Wianamatta Group: Ashfield/ Bringelly Shales	Sandy to silty clay loam topsoil; light to medium clay subsoil	Elevated hill crests and ridges	Moderate	Sheet: Gully: Note: subsoil has moderate to high erodibility	moderate moderate	Poor	Moderate shrink/swell, generally acid, and salinity can be a problem in drainage depressions
Yellow earths and hard setting yellow duplex soils	Hawkesbury Sandstone interbedded shale lenses	Sandy clay loam with some sandstone fragments, ferruginous nodules and pisolithic fragments	Crests and slopes of plateau surface	Low	Gully: Sheet: Note: Soils are moderately to highly erodible but slope angles are generally low	moderate moderate	Permeable, drainage impeded by bedrock	Possible shrink/swell problem in clays
Discontinuous shallow stony sands	Hawkesbury Sandstone and shale lenses	Quartzose sand usually as topsoil, and coarse sandy clay/loam often as a subsoil	Steep hill slopes, escarpments	Poor	Sheet: Gully: Rock fall:	extreme moderate high	Highly permeable, drainage impeded by bedrock, soil has poor water retention qualities	Low shear strength; generally acid; shallow and stony

Assessment of effects and safeguards

The site comprises soils which are potentially highly erodible. Consequently, special measures would be adopted during construction in order to minimize problems of erosion



Yellow earths and hard setting yellow duplexs

Hard setting red/brown duplex soils

Discontinuous shallow stoney sands

Figure 15.1.5
SOIL TYPES

Source: Soil Conservation Service
(Preliminary 1:100,000)

and sedimentation which would otherwise affect the water catchment, and thus in turn adversely affect part of the Sydney water supply system. In order to minimize such problems, the Department of Aviation would enter into an agreement with the Metropolitan Water Sewerage and Drainage Board (Appendix H) under which the construction and operation of an airport at the site would be undertaken in accordance with special conditions established to protect the water supply system. As part of these conditions the Department of Aviation would be required, prior to any other earthworks being undertaken, to construct, stabilize and maintain in a fully functional condition a special drainage system around the perimeter of the proposed site as discussed in Section 15.2.

This sediment control and drainage system would be designed for the probable maximum precipitation event, to ensure against any likelihood of run-off or sediments from the site affecting either the Pheasants Nest or Broughtons Pass weirs, which are part of the Sydney water supply system. Run-off from developed areas of the site would be diverted through detention ponds to the Allens Creek catchment, which does not drain into the water supply system. Interim sediment control basins would be provided to trap sediments during construction work.

In addition, other specialized erosion and sediment control measures appropriate to the site would be determined in consultation with the NSW Soil Conservation Service, and implemented during site development. These measures would include:

- ensuring that the site was only partially cleared and that, during construction, progressive rehabilitation of disturbed areas were undertaken through revegetation and landscaping;

- special measures for the removal and stockpiling of topsoil, including the progressive use of topsoil for rehabilitation (any stockpiles not likely to be used would be stabilized with vegetation);

- land reshaping and contouring to avoid excessive concentration of drainage and, where possible, the locating of slopes away from areas yielding excessive run-off;

- ensuring that contour drains were constructed at as low an angle as possible over the entire lengths of slopes;

- where necessary, creation of diversion banks to disperse run-off and protect rehabilitated work.

15.1.3 Physiography

This section describes the landform and topography of the proposed site and assesses its suitability for airport development. Information for this section has been obtained from topographic maps of the Sydney Region published by the NSW Central Mapping Authority and the Commonwealth Division of National Mapping.

Landform and topography are important factors in the siting and design of an airport because relatively flat grades are required for airport runways and aircraft movement areas (taxiways, airport aprons and aircraft maintenance areas), and because extensive obstruction-free approach surfaces with shallow gradients are essential. The selection of the proposed site and preparation of a master plan for airport development at that site therefore have to take into account any significant physiographical features such as sloping terrain, gorges, and creek or river courses which incise the area.

Regional physiographic units

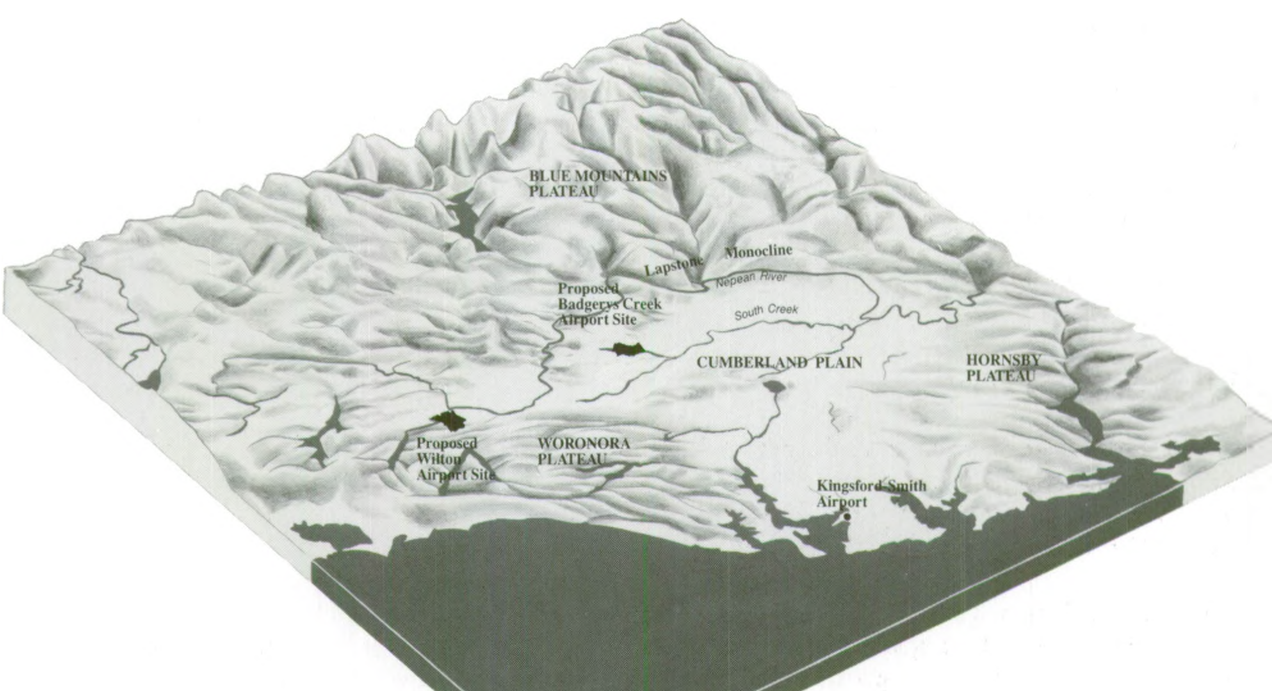
The proposed airport site is located within the Woronora Plateau physiographic sub-region of the Sydney Basin. The Sydney Basin is a simple asymmetrical structural basin which extends along the coastline from Port Stephens in the north to Batemans Bay in the south and inland to Rylstone and Muswellbrook.

The Woronora Plateau (Figure 15.1.6) forms the southern extension of the Cumberland Plain and is one of a number of plateau features adjoining this plain. To the west and adjacent to the Woronora Plateau is the Blue Mountains Plateau, which in turn is joined to the Hornsby Plateau which extends northwards from the northern suburbs of Sydney. The transition between the Cumberland Plain and the surrounding plateau feature is strongly pronounced to the west (the Lapstone Monocline) but is less pronounced to the north. Southwards, the Cumberland Plain slopes gently upwards, making the transition between the plain and the Woronora Plateau less distinct; further to the south the Woronora Plateau merges into the Southern Tablelands.

Landform

The proposed airport site is located in the central part of the gently sloping Woronora Plateau. This plateau extends from the Illawarra escarpment in the east, from Campbelltown—Appin in the north, and from Picton—Bargo in the west, and southwards to Robertson—Mittagong where it joins the Southern Tablelands region.

The plateau is deeply incised by numerous drainage systems which form an important part of Sydney's water supply system. The top elevation of the plateau ranges from about 200 m above sea level in the north to about 750 m in the south, a distance of about 30 km. There is a general dip across the plateau to the north-north-west. The elevation of gorges within the plateau region ranges from about 65 m in the lower northern part to about 300 m in the higher southern part.



Source: Hyde, Heggie, Malfroy and Hawke 'Nocturnal wind flows across the Sydney Basin' (1980)

Figure 15.1.6
REGIONAL PHYSIOGRAPHY

The area of plateau on which the proposed site is located is bounded by the Cordeaux River gorge to the west and south, and by the Wallandoola Creek gorge to the east. The Cordeaux River gorge is about 100 m deep, with precipitous sides; the less precipitous Wallandoola Creek gorge is 50-70 m deep. The northern boundary of the proposed site is incised by a number of small creek channels which run approximately north—south. These creek channels are relatively broad and are not as deeply incised as the other gorges.

The proposed site can be described in terms of the following landform features:

- ridges
- plateau
- slopes
- escarpment/gorge
- stream dissection.

Figure 15.1.7 and Table 15.1.5 show the distribution and types of these landforms within the proposed site.

Table 15.1.5 Landform units

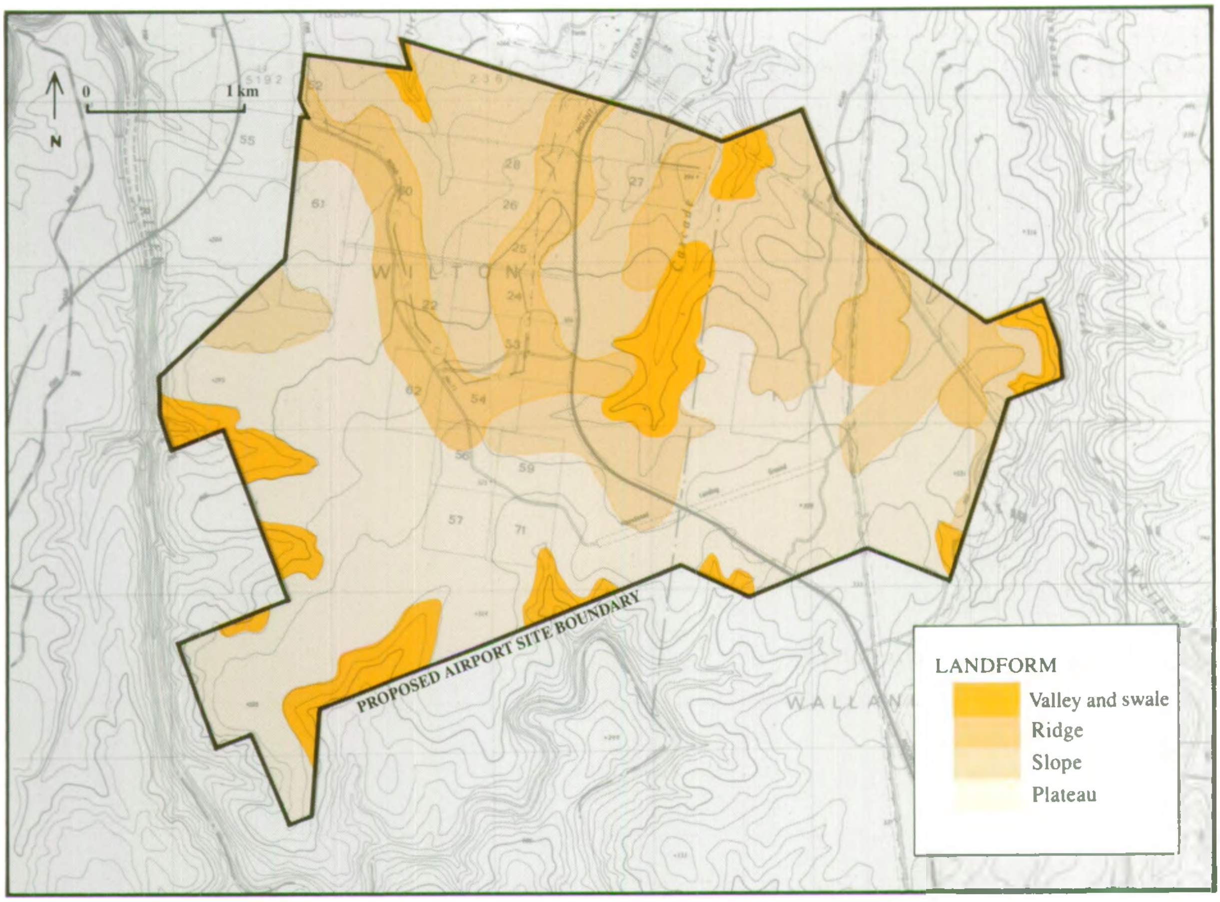
Type	Distribution	Area	Elevation range (m)+
Ridges	Predominantly north-west portion of site	240 ha (17%)	280-320
Plateau	Ranges over entire site	580 ha (40%)	280-333
Slopes	North-central portion of site	450 ha (31%)	320
Valleys and swales	Minor areas along boundary of site and Cascade Creek	170 ha (12%)	250-320* 260-310**
Stream dissection	Central and northern sections of site	12 km	245-310

* Sections along site boundary.
** Cascade Creek.
\+ Metres above sea-level.

Topography

The elevation of the proposed site ranges from about 245 m at its lowest point, where Allens Creek drains from the site, to 333 m above sea-level at the highest point, near the south-eastern corner of the site. From this point, there is a gentle slope towards the township of Wilton in a northerly direction, dropping about 20 m over a distance of about 2 km in the eastern portion of the site and about 45 m over a distance of about 3 km in the western section.

The site contains a relatively large proportion of flat land, with about 75% having a slope of less than 5%. The steeper terrain is associated with the incised creeks that drain the site and with the escarpment area fringing the boundary of the site. The maximum slope gradient ranges between 10% and 20%: this occurs around the site perimeter, in a small



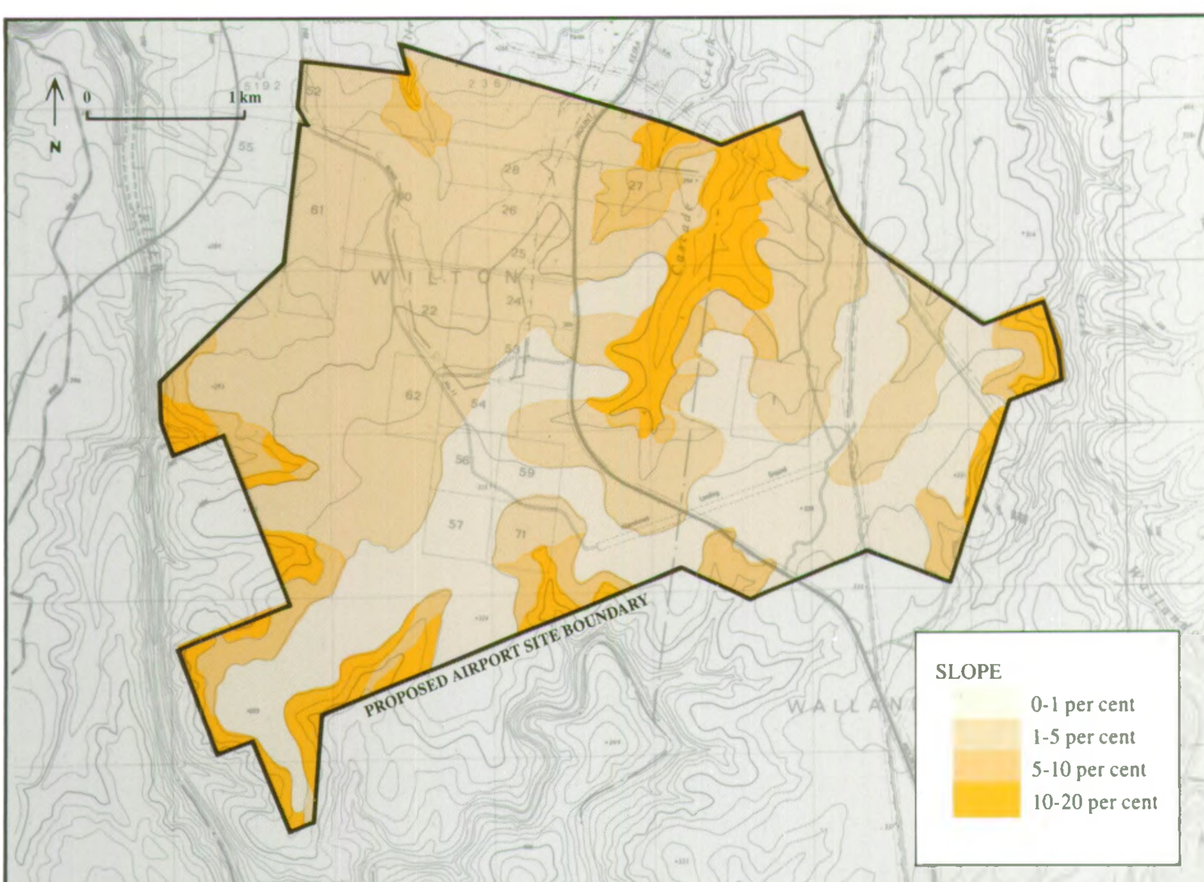


Figure 15.1.7
SITE PHYSIOGRAPHY

section adjacent to Allens Creek near the north-western boundary, and in the Cascade Creek gorge which drains from the central portion of the site.

Figure 15.1.7 and Table 15.1.6 show the site topography categorized into the following four classes of slope gradient:

- flat terrain: 0-1% slope
- gently sloping terrain: 1-5% slope
- undulating terrain: 5-10% slope
- rolling terrain: 10-20% slope.

Table 15.1.6 Site topography

Slope %	Distribution	Area	Elevation range (m)*
0-1	Southern and eastern portion of site on high ground	410 ha (28.5%)	300-333
1-5	Ranges over the whole site	665 ha (46.0%)	250
5-10	Fringe areas adjacent to escarpment along boundary and adjacent to creeks along boundary	160 ha (11.0%)	265-320
10-20	Fringe areas coinciding with areas along the site boundary and incised creek lines in central portion of site	205 ha (14.5%)	245-320

* Metres above sea-level.

Topography surrounding the proposed site is basically a continuation of the dissected plateau formation. Eastwards towards the coast the terrain rises to about 400 m at the top of the Illawarra escarpment before dropping steeply to the coastal plain.

There are a number of moderately high peaks in this region which rise about 60-80 m above the surrounding areas, with the highest peaks reaching an elevation of about 450 m above sea-level. North of the proposed site, the plateau slopes downwards towards Campbelltown and Narellan and merges with the Cumberland Plain. At this point the elevation is about 150-160 m. However, this gradual slope towards the north is interrupted by the Razorback Range and is incised by a number of drainage gorges. The Razorback Range rises to 330 m (or about 180 m above the surrounding area). To the west, the Razorback Range merges into the hilly rugged terrain east of the Burragorang Valley. Immediately to the west of the proposed site is the township of Bargo, a distance of about 10 km. The terrain is still relatively flat in this location, and is at about the same elevation as that of the site. However, further west of Bargo the terrain begins to rise, and here it ranges in elevation from about 400 m around Buxton (which is about 15 km from the site) to over 800 m at a distance of about 30 km.

Location of airport facilities in relation to terrain

Table 15.1.7 and Figure 15.1.8 show the expected position of the major airport facilities (runways and taxiways, airport terminal area, and aircraft cargo and maintenance areas) in relation to the various landform and topographic features within the proposed site.

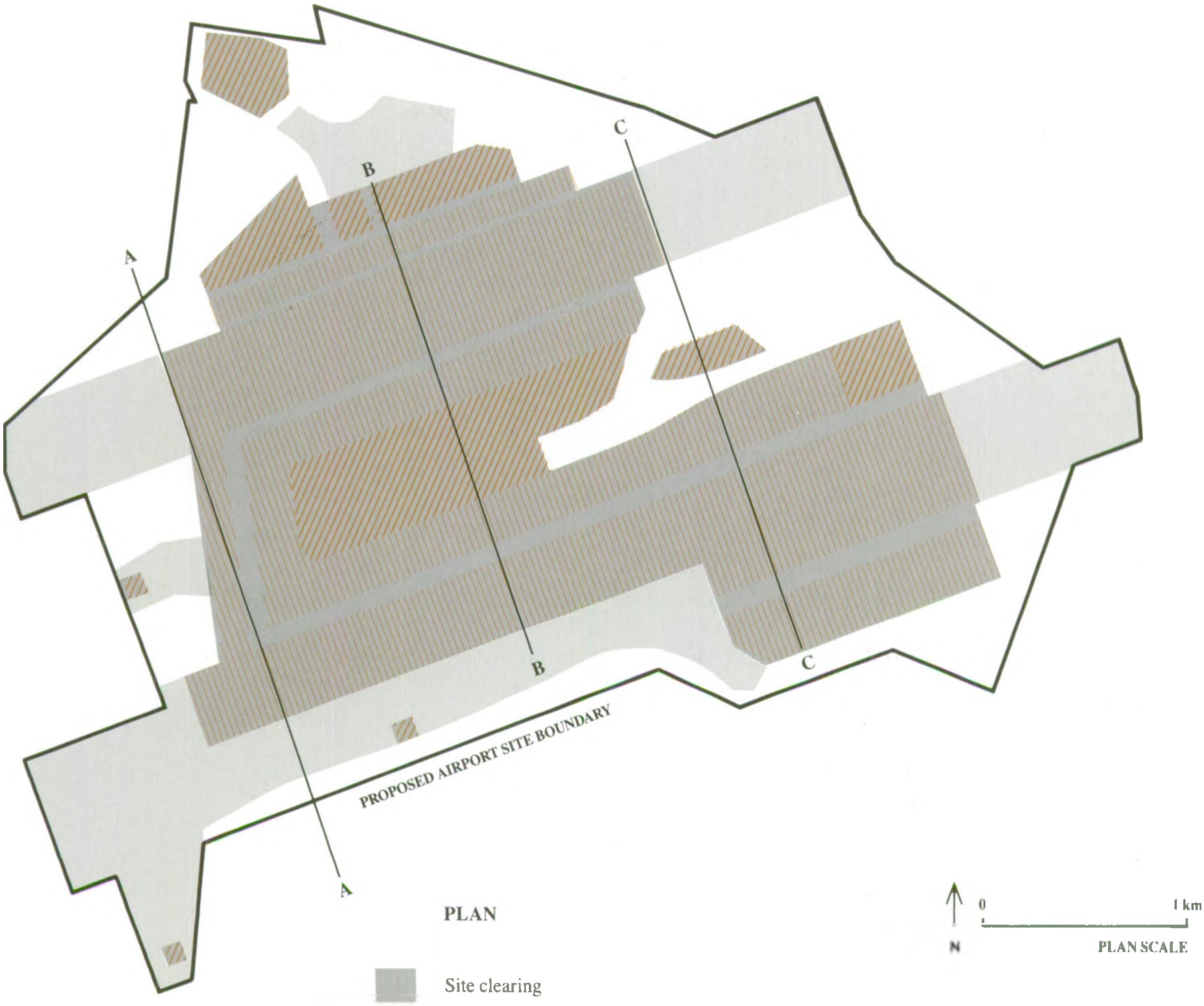


Figure 15.1.8
SITE CLEARING AND GROUND LEVELLING

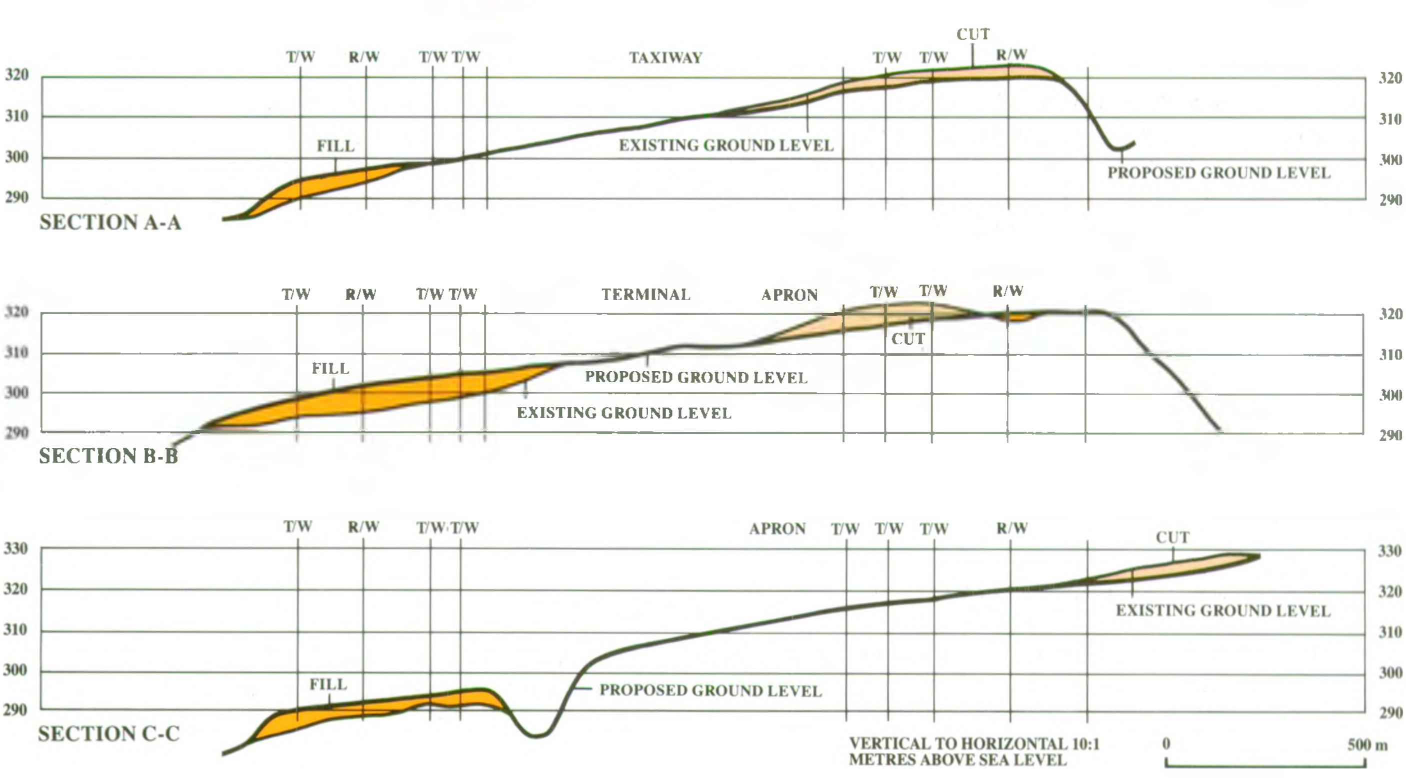


Table 15.1.7 Airport facilities in relation to landform and topographic features

Airport facility	Predominant landform feature	Topographic features						
		Elevation*			Slope category (%)			
		Max. (m)	Min. (m)	Av. (m)	(0-1%)	(1-5%)	(5-10%)	(10-20%)
Runway/taxiway								
- Short	Plateau, ridge, slope	305	285	295	-	90	10	-
- Long	Plateau, slope, escarpment	325	290	320	30	60	5	5
Connecting taxiway	Plateau	325	295	315	-	100	-	-
Airport terminal area	Plateau, ridge, slope	325	305	315	30	70	-	-
Aircraft cargo area	Plateau, ridge, slope	330	315	320	20	70	-	10
Aircraft maintenance area	Plateau	330	325	330	70	25	5	-
- Commercial	Plateau	330	325	330	70	25	5	-
- General aviation	Plateau, ridge, slope	305	280	295	-	95	5	-

* Metres above sea-level.

Land shaping

Land shaping of the ground surface by excavating and filling would be required to obtain the necessary grades for airport development. Where possible, development design would utilize existing topography and natural land features to avoid extreme land modifications. However, because of the nature of the future development and the requirement to achieve relatively flat grades, much of the airport site would be cleared and levelled for the construction of runways, taxiways and aircraft terminal facilities as well as for a number of other aircraft and non-aircraft related facilities (such as maintenance and cargo handling areas).

Most of the airport development (as shown in Figure 15.1.8) has been designed to avoid the incised creeks, and advantage has been taken of the site slope and drainage features to divert all site run-off away from the water supply catchment. It has been possible to align the runways roughly parallel to the contours to avoid the necessity of deep cut-and-fill, although some sections of the runways which cross creek dissections would require filling. The location of the airport terminal building has also been chosen to ensure amongst other things that effective drainage can be provided.

The estimated amount of cut-and-fill required for future airport construction is shown in Table 15.1.8. These calculations are based on nearly level runways and taxiways and would involve up to about 20 m of fill in some locations (mainly to fill in the creek beds). Up to about 10 m of cut would be required under existing ridge lines across the runway.

Table 15.1.8 Estimate of earthworks for future airport construction (000 m^3)

Facility	Cut	Fill	Balance*
Long runway and associated taxiways	2,180	2,755	575 (F)
Short runway and associated taxiways	288	1,293	1,005 (F)
Connecting taxiway	139	37	102 (C)
Terminal and cargo areas	11,556	9,950	1,606 (C)
Total	14,163	14,035	128 (C)

* F = fill, C = cut.

The balance of material would be used in roadworks and other construction activities on the site, and there would thus be no need to dispose of any material off site.

Assessment of effects and safeguards

The gorges which surround the proposed site to the east, south and west preclude any flexibility in terms of relocating the site in those directions. To the north, the topographic features do not necessarily preclude some adjustment of site location in this direction but would necessitate a greater amount of earthworks to provide a relatively flat site for runway development. This is because the two main creeks that have their origins within the proposed site are more deeply incised into the landscape further to the north.

A range of measures would be developed during airport construction to minimize the amount of earthworks and to ensure that appropriate procedues for erosion and sediment controls were implemented. Where possible, detailed design and layout of future airport facilities would utilize existing topography and natural features. Land shaping would only be carried out on areas under construction as opposed to shaping the entire site. Soil erosion control measures as described in Section 15.1.2 would be implemented.

15.2 DRAINAGE AND WATER QUALITY

The purpose of this section is to describe, in general terms, the existing surface water and groundwater systems and the potential for flooding of the proposed site; to assess the potential effects of airport development on drainage and water quality within the site and surrounding area; and to describe the drainage and run-off control scheme that would be adopted to manage water flow and preserve water quality, in order to minimize any adverse environmental effects arising from the changed drainage pattern.

Information for this section has been obtained from the Water Resources Commission, the Metropolitan Water Sewerage and Drainage Board and the State Pollution Control Commission, and from topographic maps of the area. Also, preliminary estimates of site run-off before and after development were made in order to determine the requirements for stormwater run-off control.

15.2.1 Description of existing conditions at the proposed site

Relationship to Sydney water supply system

Figure 15.2.1 illustrates the water supply system in the vicinity of the proposed site. There are four water storages: the Nepean, Avon, Cordeaux and Cataract reservoirs. Water from three of these storages flows through the Nepean, Avon and Cordeaux Rivers, which have their confluence at Pheasants Nest Weir. At this point, water is diverted to the Cataract River via the Nepean Tunnel, which enters the Cataract River upstream of Broughtons Pass Weir. Here, water from these four rivers is diverted into the Cataract Tunnel, and thence into the Sydney Water Supply Upper Canal which flows north to Prospect Reservoir.

Most of the run-off from the proposed site now enters Sydney's water supply system via the Cascade and Wallandoola Creeks (which drain into the Cataract River) and the Cordeaux River. Run-off from the site flowing into Allens Creek does not enter the Sydney water supply system, but flows into the Nepean River.

Drainage basins

The proposed site contains parts of four drainage basins (Figure 15.2.2):

- the Allens Creek drainage basin
- the Cascade Creek drainage basin
- the Wallandoola Creek drainage basin
- numerous small drainage tributaries of the Cordeaux River.

The Allens Creek drainage basin, with a relatively small area of 31 km^2, drains into the Nepean River about 2 km west and upstream of Douglas Park, and about 10.5 km from the proposed site. As this junction is downstream of Pheasants Nest Weir, water from the Allens Creek drainage basin does not enter the Sydney water supply system.

The Cascade Creek drainage basin, of about 9 km^2, drains into the Cataract River a few hundred metres upstream of the Broughtons Pass Weir, where water is diverted to Sydney's water supply. The Cataract River then flows into the Nepean River about 3 km downstream from the junction of Allens Creek.

The Wallandoola Creek drainage basin also drains into the Cataract River, about 1 km upstream from its junction with Cascade Creek. This basin is about 32.5 km^2 in area.

About seven small tributary drainage sub-basins within the proposed site also drain directly into the Cordeaux River. The Cordeaux River drainage basin is approximately 165 km^2 in area.

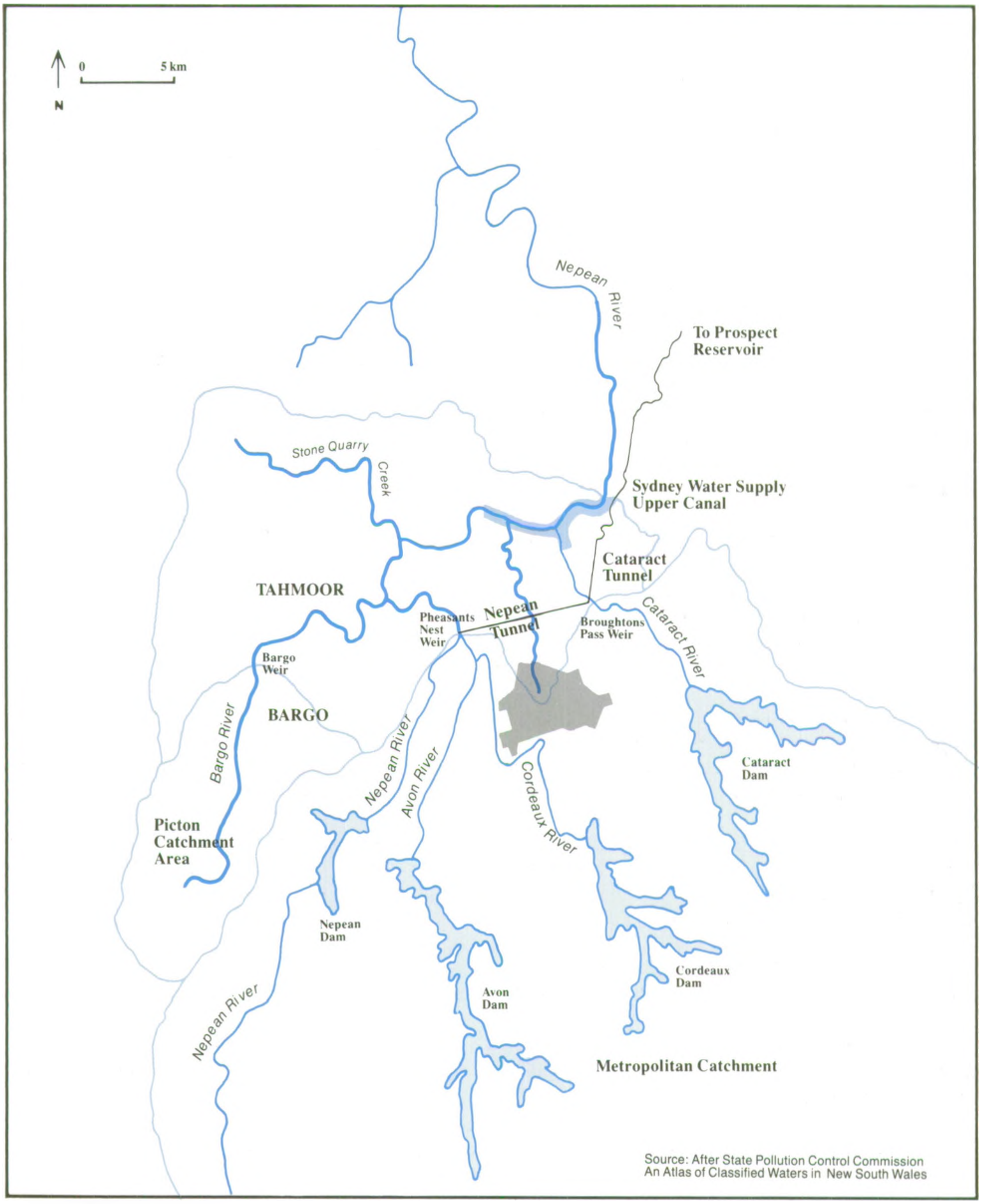
The headwaters of Allens and Cascade creeks originate within the proposed site as do tributary creeks draining into the Cordeaux River. The headwaters of the Wallandoola drainage basin occur about 9 km to the south-east of the site.

Table 15.2.1 shows the relative proportion of each basin within the proposed site.

Surface water features

The principal surface water features of the proposed site consist mainly of intermittent watercourses and a small number of artificial dams (Figure 15.2.2); Cascade Creek is the dominant watercourse. About 14 km of drainage channels flow through the site and over 80% of the total length of these is made up of minor channels.

The proposed site is mainly composed of native forest vegetation, with only a small portion cleared and grassed, and at present run-off occurs mainly as a natural process. A number of roads and tracks pass through the site.



Proposed airport site

Metropolitan Catchment
(Section 55, MWS & DB Act, 1924)

Devines Weir Inner Catchment area
(Section 55, MWS & DB Act, 1924)

Class S – Specially protected waters

Class P – Protected waters

Figure 15.2.1
UPPER NEPEAN RIVER SCHEME – PART OF SYDNEY'S WATER SUPPLY SYSTEM

Table 15.2.1 Features of the drainage basins within the proposed site

Drainage basin	Approximate total area of basin (km²)	Approximate area of basin within the proposed site (ha)	Area of basin within the proposed site (%)	Proportion of total basin area that is within the proposed site (%)
Allens Creek	31	200	14	6.5
Cascade Creek and tributaries	9	480	33	53.3
Tributaries of Wallandoola Creek	32.5	175	12	5.4
Tributaries of the Cordeaux River	165	585	41	3.5

Flooding

There are no developed floodplains within the proposed site; in most circumstances, rainfall drains rapidly away. Creeks like Allens, Cascade and Wallandoola, however, are subject to flash flooding during major storm events as a result of the naturally high rate of run-off in their catchments.

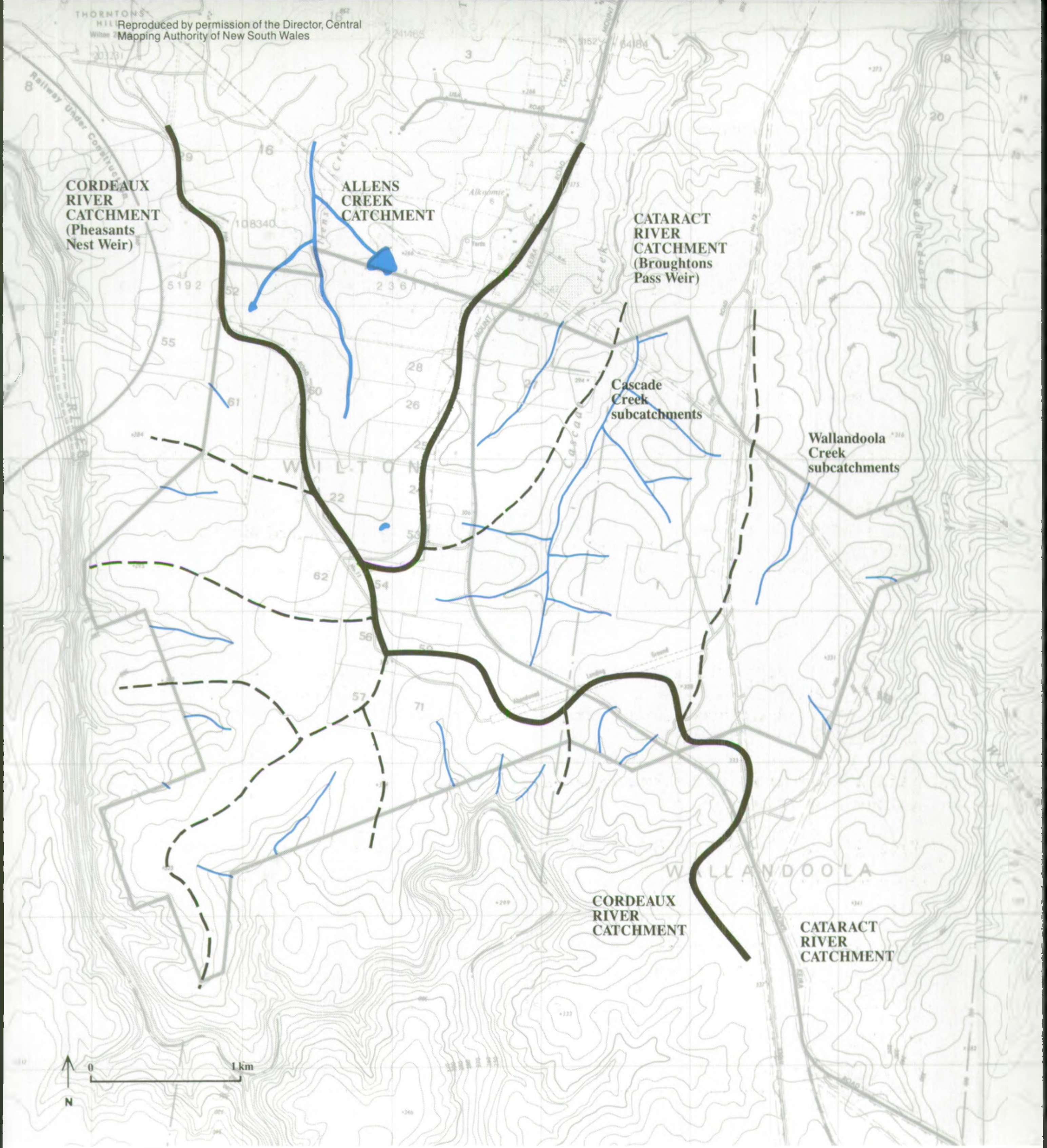
Table 15.2.2 shows the probable run-off co-efficient values for the various types of existing terrain within the site.

Table 15.2.2 Run-off co-efficients for the proposed site before airport development

Condition of site	Area (ha)	Run-off co-efficient for storm intensity of 100 mm/h
Natural forest, sandstone outcrop	1,305	0.7
Cleared, grassed areas	60	0.6
Grazing land	65	0.4
Roads and tracks	10	0.8

15.2.2 Groundwater

The proposed site is located within the Hawkesbury River Basin (Figure 15.2.2) in an area expected to give low salinity—low yield groundwater. Apart from sections along the Nepean River between Penrith and Windsor, groundwater resources in the basin have not been developed. The Hawkesbury Sandstone — which extends over all the proposed site save for some small areas of Mittagong Formation consisting of interbedded shale laminite and medium-grained quartz sandstone — is the most favourable of the porous rocks in the Sydney Basin for obtaining groundwater. The groundwater, which occurs mainly in fracture systems and bedding plane partings within the sandstone, is usually of low salinity but may have some iron content. In general, bore yields of 0.1-2.0 L/s are about the same as or slightly above yields encountered in the Wianamatta Group. The low yields and iron content limit its possible uses.



Drainage catchment

Major subcatchment

Dam

Creek and drainage swale

– Class S – Specially protected waters

– Class P – Protected waters

(Source: Government Gazette No. 21 February 1976 and No. 97 July 1976)

NOTE: Low salinity low yield groundwater underlies the whole of the prospsed site

Figure 15.2.2 SURFACE WATER FEATURES

15.2.3 Water quality

Figure 15.2.1 shows the classification made by the State Pollution Control Commission of surface waters within the Metropolitan Catchment and adjacent areas.

It will be seen that surface water run-off from the proposed site presently flows into Class P or Class S waters, classified under Part III of the Clean Waters Act, 1970, as protected or specially protected waters into which no discharges may be made without a licence. The criteria for Class S waters are intended to ensure a high level of protection for impounded waters to be used for public water supplies, for waters in the vicinity of an intake point for potable supplies, and for waterways originating wholly within nature reserves, national parks and places of particular scientific interest. All waters flowing into Class S waters are classified as Class P, or protected waters. No effluents may be discharged into Class S waters, and discharges of effluents into Class P waters must be of a quality similar to that required as a raw source of potable water. Water quality criteria have been established by the State Pollution Control Commission for Class S and Class P waters. These criteria are set out in Appendix J.

15.2.4 Possible contaminants and methods of treatment

Table 15.2.3 lists possible sources of contaminants of site run-off and effluent from operations which may be conducted on the site. The list has been developed from inventories conducted at Kingsford-Smith Airport and other aerodromes in the Sydney Region. All of the sources listed in Table 15.2.3 could be expected to be present at the second airport should development reach the maximum level indicated by the preliminary master plan.

For treatment purposes, these contaminants would be grouped as follows:

- chemical or process effluent arising from operations such as aircraft maintenance;
- domestic sewage from toilets and kitchens;
- 'contaminated' stormwater from heavily used open areas, such as aprons, washdown areas and carparks;
- 'clean' stormwater from cleared and grassed areas and intermittently used pavements.

Because of the uncertainty associated with the nature and scale of operations at the second airport it is only possible to establish proposed waste treatment methods in general terms. However, the Department of Aviation would comply with the requirements of the Clean Waters Act, 1970, in regard to all specific discharges that may issue from the site during the the course of airport construction and operation. The principles for segregating and treating wastewaters are described below.

Chemical or process effluent

Chemical or process effluent would be treated to standards established in consultation with the Metropolitan Water Sewerage and Drainage Board and to the satisfaction of the State Pollution Control Commission. Depending on the nature of the effluents, the process could comprise pre-treatment on-site prior to discharge to a Metropolitan Water Sewerage and Drainage Board sewer, or complete treatment on-site.

Domestic sewage

No sewerage facilities are at present located within or adjacent to the proposed site and no sewage treatment schemes are scheduled for this area in the short to medium-term.

Table 15.2.3 Potential sources of contaminants during airport construction and operation

Contaminant	Source
Sediments	Natural erosion, site earthworks
Nutrients	Soil sediments, fertilizers, sewage effluent
Contaminated food/water	Kitchen waste from international flights
Sulphuric acid	Wet oil batteries used for standby power supplies, and installed in come airport facilities, e.g. control tower
Emulsified oil, grease, decarbonizing solvent cleaners	Workshops for conventional engine maintenance
Detergents	Aircraft washdown areas, vehicle service and maintenance areas
Paint strippers	Aircraft/vehicle maintenance
Acid, fluorocarbon and hydrocarbon solvents	Fire-fighting equipment
Trade wastes	Kitchens
Aircraft fuel	Fuel storage, aircraft refuelling
Rubber detritus	Aircraft touchdown
Pesticides/herbicides	Ground maintenance

The Department of Aviation could either treat domestic sewage in a dedicated plant located on the airport site, or could discharge to a future Metropolitan Water Sewerage and Drainage Board sewer for treatment in a water pollution control plant located off-site and designed to serve not only the airport, but development in surrounding areas (an estimate of the required capacity of such a combined facility is given in Section 15.5).

In either case, it is assumed that the water pollution control plant would discharge effluent into the Hawkesbury—Nepean river system and therefore a high degree of treatment would be needed, including removal of nutrient. It is further assumed that the treatment process used would be of advanced design and would include methods for removal of nitrogen and phosphorus.

If the treatment were to be carried out in a dedicated plant located on the airport site, the Department would investigate the possibility of on-site disposal of treated effluent through irrigation.

Stormwater

Stormwater would be considered in two categories:

- run-off from contaminated areas where there is a possibility of stormwater containing significant quantities of oil or particulate material;
- run-off from clean areas (for example, taxiways).

The areas designated 'contaminated' would be separated from areas designated 'clean' by suitable grading to direct run-offs into the appropriate system.

Contaminated stormwater

Contaminated stormwater would discharge into a holding area where it would be treated prior to disposal by means to be established in consultation with the Metropolitan Water Sewage and Drainage Board and to the satisfaction of the State Pollution Control Commission. The process could comprise pre-treatment on-site and discharge to a water pollution control plant operated off-site by the Board, or full treatment on site. For run-off from some contaminated areas it might be possible to divert only the first flush to the holding area for treatment, and subsequent run-off to the clean stormwater system.

The Department of Aviation would ensure that the design of fuel storage facilities would comply with the relevant requirements of the Dangerous Goods Act, 1975 and bunding would be designed to ensure that spillage resulting from failure of the facility was fully contained and could not enter the stormwater system.

Clean stormwater

Areas from which stormwater run-off would probably be designated as clean include most areas of the site where there are no operations that could give rise to process or domestic wastewaters, or carry the risk of contamination of run-off through accidental spills of chemicals, fuel, oil or detergents. Such clean areas would probably include, for example, visitor car parks, access roads within the site, roofs of buildings, taxiways and runways, and cleared or landscaped areas. These areas would make up the major part of the total site area.

Stormwater run-off from these areas would be diverted into a number of retention basins, which together would be adequate to retain the whole of the first flush of stormwater. Water from these retention basins would then be discharged into a retarding basin located on Allens Creek. Thus, all clean stormwater run-off from the proposed site would be diverted from the catchments of the Cascade and Wallandoola Creeks and the Cordeaux River and would therefore be prevented from entering the Sydney water supply system. In this way the integrity of the Sydney water supply system would be protected from the small quantities of contaminants that might be present in clean storm-water.

The layout of the proposed run-off control system is shown in Figure 15.2.3. The perimeter canal would encompass about 980 ha or 68% of the area of the proposed site. Of this, about 875 ha is presently located in the catchments of the Cascade and Wallandoola Creeks, and the Cordeaux River. The balance, 105 ha, drains into Allens Creek. The area of the Allens Creek drainage basin would be increased by 28%.

To prepare a preliminary scheme for run-off control, reference has been made to the probable maximum precipitation estimates used by the Metropolitan Water, Sewerage and Drainage Board for the Cordeaux catchment for the purposes of dam spillway design. These estimates are set out in Table 15.2.4 and are compared to the precipitation measured in the storm of February 1898 which lasted 72 hours, and had its centre over the Cordeaux catchment.

For design of the perimeter canal system, rainfall intensity in the order of 230 mm/h was used for the preliminary estimates of capacity. The canal shown in Figure 15.2.3 would vary in width from about 15 m wide at the top of the catchment to about 100 m wide at the lower end of the proposed site, and would be designed to retain the probable maximum precipitation that would result in a peak canal flow of some 250 m^3/s. The canal would be partly lined and appropriate landscaping treatments would be used. In order to retain the peak flow from a storm event of probable maximum precipitation, a retarding basin would be constructed near the site boundary on Allens Creek.

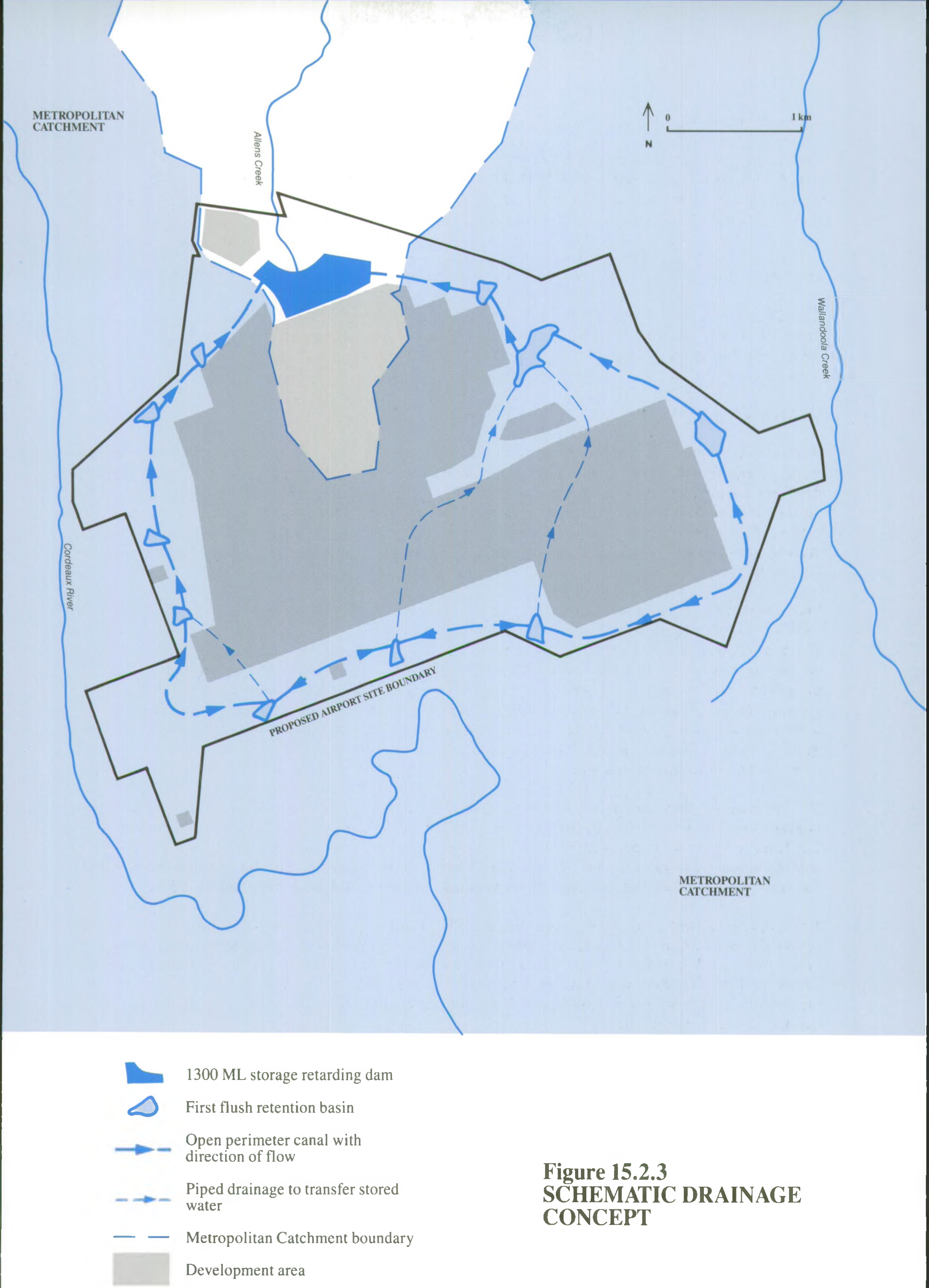


Figure 15.2.3
SCHEMATIC DRAINAGE CONCEPT

Table 15.2.4 Maximum precipitation values at Cordeaux catchment

Storm event	Duration (hours)					
	1	3	6	24	48	72
12-15 February 1898 precipitation (mm)	-	-	15	430	870	900
12-15 February 1898 rainfall intensities (mm/hour)	-	-	2.5	18	18	13
Estimated probable maximum precipitation (mm)	230	360	470	1,020	1,220	1,320
Estimated probable rainfall intensities (mm/hour)	230	120	78	43	25	18

Source: Bureau of Meteorology (1982).

The stormwater retention ponds would be designed to contain the first flush from a one-in-ten-year storm having a duration equal to the time of concentration of the particular sub-catchment, plus an additional fifteen minutes to allow the drainage area to flush clean. About 250 m^3/ha storage capacity would be required to store the initial flush. This would mean that the total storage capacity for the stormwater retention system would be between 200,000 and 300,000 m^3. The capacity of basin sizes would vary from about 20,000-30,000 m^3 serving the smaller sub-catchments up to 90,000 m^3 for the larger sub-catchments within the proposed site.

Once the first flush retention basins were filled, the water would be allowed to stand, to enable suspended material to settle. Additional clean stormwater run-off would by-pass these basins and flow into the retarding basin at Allens Creek. This basin would be designed to control the rate of discharge of stormwater into Allens Creek such that the present rate of flow for a 1:100 year storm event would not be exceeded. Preliminary estimates indicate that a retarding basin of approximately 1300 ML capacity would be required.

The scheme described above would ensure that all clean stormwater run-off from developed areas of the site would be collected at one point before discharge from the proposed site. This would have two benefits:

- if necessary, clean stormwater run-off could be further treated prior to discharge;
- since the discharge would be at a point source, its quality would be readily subject to control by the State Pollution Control Commission.

Treatment of clean stormwater prior to discharge to Allens Creek would include settlement and screening to remove solids.

15.2.5 Assessment of effects and safeguards

The above assessment of effects is confined to the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further investigation once the locations for these facilities were determined. The authority responsible for constructing new access routes would also be responsible for ensuring that adequate safeguards were adopted during construction to contain run-off and sedimentation, and that adequate provisions were made for drainage and water quality control once construction had been completed.

No adverse effects on drainage or water quality would result from acquisition of the proposed site at Wilton; until construction commenced, the Department of Aviation would endeavour to maintain the present management practices of the Metropolitan Water, Sewerage and Drainage Board.

Possible effects during construction and operation of the proposed airport have been considered under the following categories:

- risk of contamination of Sydney's water supply
- loss of an area of water supply catchment
- increased potential for flooding in Allens Creek
- effects on groundwater
- effects on water quality during construction
- effects on water quality during operation.

In addition, the relationship of the proposed run-off control system to hazards to aircraft from bird strikes is discussed.

Contamination of Sydney's water supply

The undertaking by the Department of Aviation to divert to Allens Creek, run-off from those parts of the site that would be used for airport operations and that now drain into the Sydney water supply system, would ensure that no contaminated water from the site entered the supply system.

The risk of contamination of the water supply system through emergency dumping of fuel would probably be slight. Such incidents occur infrequently, and except where there is immediate danger to the aircraft or its occupants, the procedure is carried out in an area and at an altitude that would not give rise to adverse effects on the ground.

The risk of contamination of the water supply system by exhaust emissions from aircraft and ground vehicles would be considered slight, and insignificant in the context of the total of such emissions in the region (Section 15.3).

Loss of catchment area

The 875 ha of the proposed site that would be excised from the catchments of the Cascade and Wallandoola Creeks and the Cordeaux River as a result of the proposed run-off control system would be located downstream of the water storages (Figure 15.2.1). However, this area forms part of the overall water supply catchment and, in the event of development of the site as an airport, it would be lost to the catchment.

The Metropolitan Water Sewerage and Drainage Board has estimated the cost of the water lost at $23,600 per annum (Appendix H).

Flooding in Allens Creek

About 55% of the site (some 790 ha) would become an impervious surface, from which the run-off water would be directed into semi-natural and lined channels, thus increasing the flow rate and volume of water passing a given place at a given time. It is estimated that run-off from the proposed site would be increased by some 12% as a result of paving and of building development. Table 15.2.5 shows the probable new run-off co-efficient values.

Table 15.2.5 Run-off co-efficients for the proposed site after airport development

Condition of site	Area (ha)	Run-off co-efficient for storm intensity of 100 mm/h
Paved areas and buildings	790	0.9
Partially developed grassed areas	650	0.4

Because most of the run-off from the proposed site would be directed into Allens Creek, the creek's drainage characteristics would be changed. Table 15.2.6 shows the relative change in drainage area that would be occasioned by airport development.

Table 15.2.6 Changes to Allens Creek drainage basin

	Drainage basin area (ha)	Above Wilton (ha)	At site boundary (ha)
Before development	3,130	885	200
After development	4,005	1,760	1,075
Increase factor	1.28	1.99	5.37

The effects of this increase in drainage area would be most marked at the site boundary. The drainage retarding basin constructed at the boundary would be used to ensure that the peak flows for any storm up to a 1:100 year storm event were not exceeded in Allens Creek where it passes under Wilton Road.

The hazards associated with increased run-off and greater potential for flooding along Allens Creek, as a result of the development, would be minimized by the construction of the proposed retarding dam. This would ensure that peak flows along the creek downstream of the site would be similar to those experienced at present, and would also ensure that any potential effects on downstream riparian vegetation would be minimized.

The rate and magnitude of flooding along Wallandoola and Cascade creeks would be lowered, as about 5% of the run-off to Wallandoola Creek and about 40% of the run-off to Cascade Creek would be diverted into Allens Creek.

Groundwater

Because of the nature of the rocks underlying the proposed site, downward movement of water is generally retarded and the main flow is parallel to the prevailing direction of the rock strata. Groundwater tends to settle at a number of levels separated by relatively impermeable layers of rock. Drainage from the site could find its way into the groundwater only at points where a fracture joint or bedding plane parting gave access, and only if a favourable hydraulic gradient existed. Even then, the drainage would most likely reach only the groundwater lying at the topmost level and would be unlikely to seep down through further strata of rock.

Water quality during construction

During airport construction there would be some risk of sediments being released from the construction site and finding their way into the creeks draining the site. In order to reduce the potential risk of sedimentation and pollution of the water supply system, the perimeter canal would be built before any other site earthworks were started.

Temporary silt traps would be constructed where required to collect run-off from disturbed areas during the initial stages of construction. To help reduce sedimentation even further, progressive revegetation of disturbed areas would be co-ordinated with the construction work. Also, the proposed drainage system — consisting of retention basins to contain the first flush of stormwater and retarding basins to control the rate of flow of run-off (Figure 15.2.3) — would be progressively installed during the construction phase to suit the development programme and the requirements for run-off control.

During the initial development of the site, water quality in Allens Creek might be temporarily affected by increased nutrient loads, since total nitrogen and phosphorus entering the system from run-off would be expected to increase. However, once development was finished, the contribution of total nitrogen and total phosphorus to the system from run-off would be expected to decrease significantly (Smalls 1983).

Water quality during operation

Section 15.2.4 described a scheme for separating and treating wastewater streams and run-off from the proposed site. The Department of Aviation would comply with the requirements of the Metropolitan Water Sewerage and Drainage Board and the State Pollution Control Commission with regard to standards for discharges from the proposed site.

Stormwater run-off from the proposed site and discharges from the water pollution control plant — which could be located either on-site, or off-site as a joint-use facility — would enter Allens Creek, and thence would flow into the Hawkesbury—Nepean River system and into the ocean at Broken Bay.

The total catchment area of the Hawkesbury and Nepean Rivers and their tributaries is approximately 21,700 km^2 and includes the western and south-western areas of Sydney — areas that would be expected to accommodate a major part of the population increases forecast in Chapter 1. Changes in land use patterns within the catchment of the Hawkesbury and Nepean Rivers would continue to have important consequences for the quantity and quality of water in these rivers.

There has been significant development of the water resources of the upper catchment in response to urban water demands in the Sydney metropolitan area; each year, large volumes of water are diverted from the upper catchment to the metropolitan water supply networks, with the consequence that streamflows in the lower catchment are accordingly reduced. This reduction is important during drought and during moderately dry periods, as it is at these times that downstream water quality is most influenced by river flows. In addition, streams in the lower catchment are used as drains for urban areas within the basin, with stormwater and treated sewage effluent being directed into them for eventual discharge to the ocean.

These two consequences of urban development have affected the water quality of both the Nepean and Hawkesbury rivers. The reduction in diluting flows from the upper catchment, coupled with the increasing volume of waste discharges, has caused the natural assimilative capacity in some sections of the Nepean River to be exceeded, thus at times causing the waters to become eutrophic.

The State Pollution Control Commission has produced estimates of projected nutrient loads (nitrogen and phosphorous) in the Camden assimilation zone (Camden to Wallacia) of the Nepean River (SPCC 1983). These predictions indicate that, in comparison with 1979-80 loads at low streamflows, by the year 2000 nutrient loads and concentrations may increase by up to ten times, depending on location, unless nutrient removal facilities are installed at water pollution control plants. If nutrient removal facilities were installed at the Camden plant, nutrient loads would still increase in the Nepean below Camden, but to a lesser extent.

The State Pollution Control Commission, in discussing these predictions, also notes that:

> By the year 2000, new sewage treatment works, possibly without nutrient-removal facilities, will be operating at Menangle and Picton. If these new treatment works were to discharge their effluents to the river rather than dispose of them by land application, their phosphorus loads might be assimilated before reaching the Camden zone, despite the short river distances between these works and especially if phosphorus were removed from the effluent, but their nitrogen loads might not be completely assimilated. The nitrogen loads in the Camden zone would thus be increased and, assuming both nitrogen and phosphorus removal at the Camden sewage treatment works, plant growth in the upstream (nitrogen-limited) river sections of the Camden zone might be encouraged.

The contribution of nutrients from the second Sydney airport site, developed to the maximum level shown in the preliminary master plan, has been calculated using the following assumptions:

- domestic sewage for 20,000 population equivalents associated with airport activities would be treated at a new water pollution control plant located off-site and also serving other development, and would produce daily effluent flows of 0.27 m^3 per day per population equivalent, with total nitrogen of 5 g/m^3 and total phosphorous of 1 g/m^3;

- nutrients in site run-off would be equivalent to that for a fully developed urban area, and would be estimated at 7 kg/ha per annum for nitrogen and 1 kg/ha per annum for phosphorous.

The resulting estimated total nutrient load in Allens Creek as a result of airport development under the worst case is shown in Table 15.2.7.

Table 15.2.7 Estimated nutrient loads in Allens Creek as a result of airport development

Source	Nutrient (kg/day)	
	Nitrogen	Phosphorous
Water pollution control plant (airport related flows)	27	5.4
Site run-off into Allens Creek (980ha)	19	2.7
Totals	46	8.1

These loads would be assimilated to some extent before reaching Camden. There are no forecasts of nutrient loads in the Nepean upstream of Camden and the contribution that the airport generated nutrient loads would make is therefore difficult to estimate. However, there are forecasts for nutrient loads in the Camden assimilation zone of the Nepean River for the year 2000 (SPCC 1983) and these can be used as a guide to the order of magnitude of the loads contributed by airport development.

If it were assumed that the second airport were developed to 50% of its maximum by the year 2000, and that half the nutrient load generated by the airport reached the Camden assimilation zone, then the airport would contribute about 2.2% of the forecast nitrogen load and 1.9% of the forecast phosphorous load in this zone.

Precautions against birds

In addition to the safeguards adopted to minimize water pollution, the Department of Aviation would implement measures to reduce the attractiveness of the drainage system to birds. These would include design provisions such as constructing the basins with vertical walls to discourage plant growth, and operational measures such as ensuring that these basins were empty except during rainfall events.

15.3 AIR QUALITY

This section describes the existing air pollution levels in Sydney, the factors giving rise to them, and the emission sources of airport related air pollutants. On the basis of this data, an assessment is made of airport emissions under worst case assumptions and of the likely contribution to Sydney's future total emissions.

Like motor vehicles, aircraft convert hydrocarbon fuel to propulsive energy and, in the conversion, air pollutants are emitted. For the purposes of assessing effects on air quality the worst case was defined in terms of an assumed 275,000 aircraft movements per year, with an assumed division by aircraft type as follows:

- B747: 37,500 movements
- A300: 87,500 movements
- F27: 60,000 movements
- general aviation aircraft: 90,000 movements.

However, a level of aircraft operations of 275,000 movements per year is unlikely to be reached for many years, if ever. The reasons are discussed in Section 1.2.

15.3.1 Existing pollution levels

Air quality criteria for urban air pollutants have not been defined in New South Wales. However, the State Pollution Control Commission uses as its objectives the Guidelines of the National Health and Medical Research Council, supplemented by the Long-Term Goals set out by the World Health Organization and the Air Quality Standards of the US Environmental Protection Agency. These criteria for air quality have been determined in the light of international findings on the adverse effects of air pollutants on health; they do not take into account deleterious effects on plants and materials or any reduction to visibility.

Present levels of the major pollutants affecting air quality in the Sydney Region are set out in Table 15.3.1 and discussed below:

- **Ozone:** This is the major constituent of photochemical smog. It is the principal reaction product generated when reactive organic substances (mainly hydrocarbons) and nitrogen oxides are exposed to sunlight in high concentrations. The small number of days per year on which the National Health and Medical Research Council Guidelines are presently exceeded represents a fall from the levels of ten years ago, but it is not known whether this is because of different meteorological conditions or reductions in hydrocarbon emissions.

- **Hydrocarbons:** Hydrocarbons constitute the major portion of the reactive organic substances that eventually cause photochemical smog. They are primarily associated with the processing and use of petroleum products, and are thus present in emissions from aircraft and automobile engines, which consist of products formed during combustion as well as unburnt fuel components. Hydrocarbons in the air also produce the distinctive odour associated with petrol or kerosene products. This odour does not indicate the presence of injurious levels of air pollutants, but it can be objectionable and can lead to complaints from residents near airports.

Table 15.3.1 **Maximum pollutant concentrations measured during 1982, compared with accepted standards**

Pollutant	Standard, goal or guideline	Sampling period (average)	Reference organization	Network maximum 1982	Number of days/sites at which standard exceeded
Ozone	12 phm	1 hour	NHMRC	18 phm	8 days/3 sites
Hydrocarbons*	0.24 phm	2 hours	USEPA	n.a.	n.a.
Acid gases	60 μg/m³	1 year	WHO	51 μg/m³	Not exceeded
	200 μg/m³	24 hours	WHO	130 μg/m³	Not exceeded
Nitrogen dioxide	17 phm	1 hour	NHMRC	21 phm	2 days/1 site
	5 phm	1 year	USEPA	1.6 phm	Not exceeded
Sulphur dioxide	14 phm	24 hours	USEPA	2.6 phm	Not exceeded
	2 phm	1 year	NHMRC	0.4 phm	Not exceeded
Suspended matter	40 μg/m³	1 year	WHO	27 μg/m³	Not exceeded
	120 μg/m³	24 hours	WHO	103 μg/m³	Not exceeded
Total suspended particulates	90 μg/m³	1 year	NHMRC	122 μg/m³	6 sites**
	260 μg/m³	24 hours	USEPA	411 μg/m³	10 days/5 sites**
Lead	1.5 μg/m³	90 days	NHMRC/USEPA	7.0 μg/m³	71 (90-day periods)**
Carbon monoxide	35 pm	1 hour	USEPA/WHO	29 pm	Not exceeded
	9 pm	8 hours	USEPA/WHO	n.a.	53 days**

* Non-methane hydrocarbons.
** Includes Newcastle and Wollongong monitoring stations.

Notes:
NHMRC- National Health and Medical Research Council (Guidelines)
USEPA- United States Environmental Protection Agency (Standards)
WHO - World Health Organisation (Long-Term Goals)
n.a. - Not available

Source: State Pollution Control Commission (1984).

- **Acid gases:** The major acid gases are sulphur dioxide and oxides of nitrogen. Levels of acid gases in Sydney are not high compared with the levels in large cities overseas because domestic fuels are relatively low in sulphur. Acid gas levels in Sydney peaked in the early 1970s, then decreased, and have now levelled out. They seldom exceed the World Health Organization's Long-Term Goal.

- **Sulphur dioxide:** This is present in the exhaust gases of aircraft engines. However, the concentrations in these emissions are much lower than in emissions from other types of engine owing to the significantly lower levels of sulphur impurities in aircraft fuel.

- **Nitrogen oxides:** Nitric oxide and nitrogen dioxide are formed in a spontaneous chemical reaction during all atmospheric combustion processes. There are several atmospheric reactions which can lead to the oxidation of nitrogen oxide to nitrogen dioxide, which is an essential precursor for the atmospheric reactions that produce photochemical smog. In Sydney, about three-quarters of nitrogen oxide emissions come from motor vehicle exhausts.

- **Suspended matter and total suspended particulates:** Various measures are used in respect of particles suspended in the atmosphere. The 'suspended matter' measure relates to particles mainly below about 5 μm in diameter but up to about 10 μm in size. The 'total suspended particulates' measure includes, in addition to these, larger particles up to about 25-50 μm in diameter. Suspended matter levels in Sydney are usually well below the standards specified in Table 15.3.1, but total suspended particulate levels in both city and suburban sites do exceed them from time to time. Levels of total suspended particulates are not expected to decrease until such time as the State Pollution Control Commission considers them to warrant further attention, identifies the major sources, and implements controls.

- **Lead:** The major source of lead in Sydney's atmosphere comes from the lead additives in petrol. The introduction of unleaded petrol by July 1985 and its use in all new petrol-engined vehicles made on or after 1 January 1986 will fairly rapidly reduce the emission of lead in Sydney, even if petrol usage increases. Lead concentrations in the air should be reduced as a result, and this pollutant is therefore not considered further in this discussion.

- **Carbon monoxide:** Concentrations of carbon monoxide tend to be very localized, and high values are only experienced in areas of high traffic density and poor dispersion, such as the central business district of Sydney. Carbon monoxide trends in Sydney over the last decade have been variable, showing first a decline, then a levelling out and now a further decline. It is considered that these recent reductions are the result of stricter controls on carbon monoxide emissions from motor vehicles.

15.3.2 Factors affecting air quality

The rate of dispersal of air pollutants is significantly influenced by climate, meteorology (particularly the frequency of inversions) and topography.

Climatic influences

The warmth of Sydney's climate and the prevalence of sunshine are conducive to the production of photochemical smog, and these climatic characteristics are also evident at Wilton. Climatic data for Wilton is presented in Figure 15.3.1. Compared with Sydney city centre, Wilton has lower rainfall, more sunshine, higher summer temperatures, and lower winter temperatures.

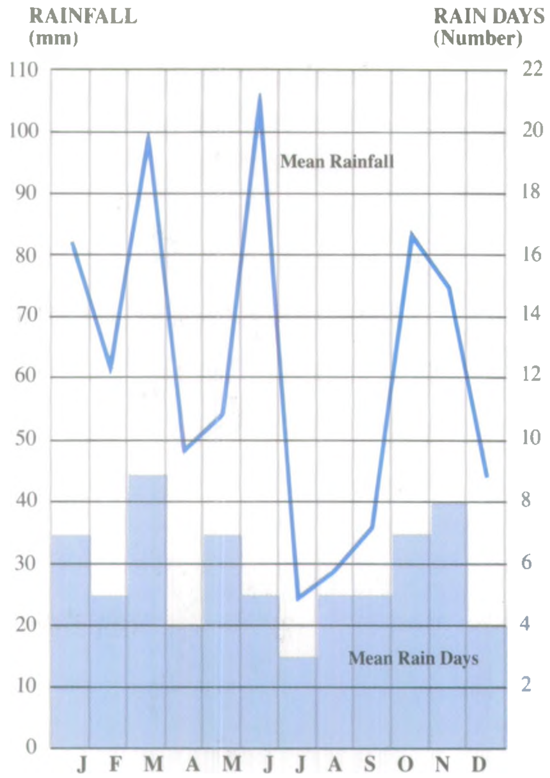
Wind speeds are greatest during the hottest time of the day when atmospheric instability is highest, and are lowest during the coldest time of the day when the atmosphere is generally most stable. Thus, winds in the area tend to be very light during the night, and to increase in strength during the day (Figure 15.3.2). Wind records at Picton (the nearest meteorological station with wind data available) indicated that compared with the city centre, Wilton has a much higher frequency of calm conditions.

Temperature inversions

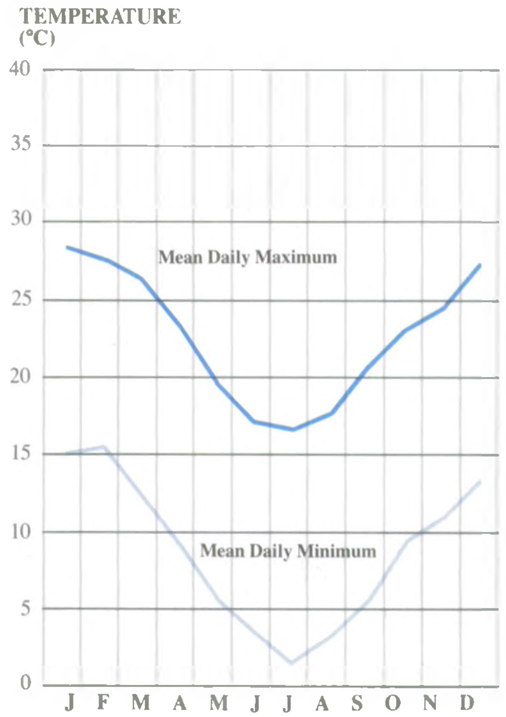
There is a band of atmosphere extending from the ground to an uncertain and variable height called the mixing layer, above which vertical mixing is significantly reduced. The height of this mixing layer is related to the local vertical temperature profile. The rate of change of temperature with height determines the stability of the atmosphere. The atmosphere is considered to be unstable when, under dry conditions, the temperature decreases at a more rapid rate than 3°C for each 300 m increase in elevation. Under such circumstances, vertical air movements are facilitated, pollutants are transported up and down, and mixing occurs.

When the temperature either decreases less rapidly with height or increases with height (a temperature inversion), the atmosphere is stable, and transport and dilution of pollutants is inhibited. During an inversion, there is generally little mixing above the base of the inversion. Thus, when a ground level inversion occurs for an extended period, nearly all the pollutants emitted close to ground level remain within about 100 m to 1,000 m from the surface, depending on the inversion height.

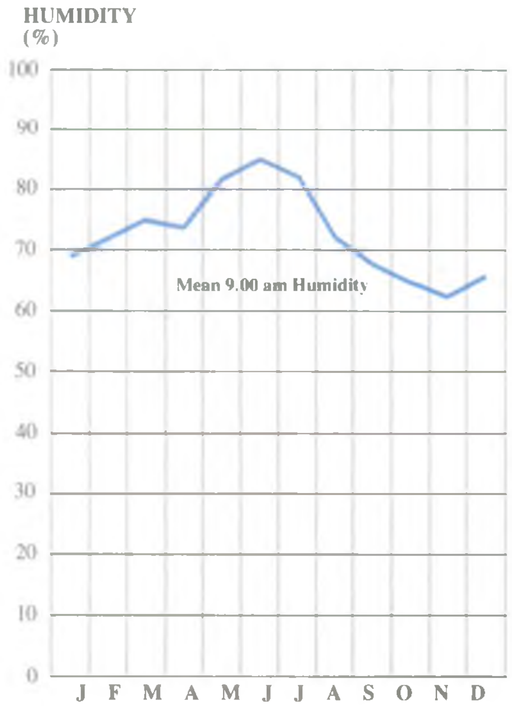
The frequency of inversions at Wilton has not been recorded, but it is expected that they would be more frequent, stronger, and deeper than at Kingsford-Smith Airport. Observations at Kingsford-Smith Airport over nearly two years revealed that, at 6 a.m., inversions were present on 79% of mornings, that 53% of the inversions occurred at heights of under 400 m, and that in 26% of cases the temperature difference between the base and the top of the inversion was more than 4°C (Colquhoun 1983).



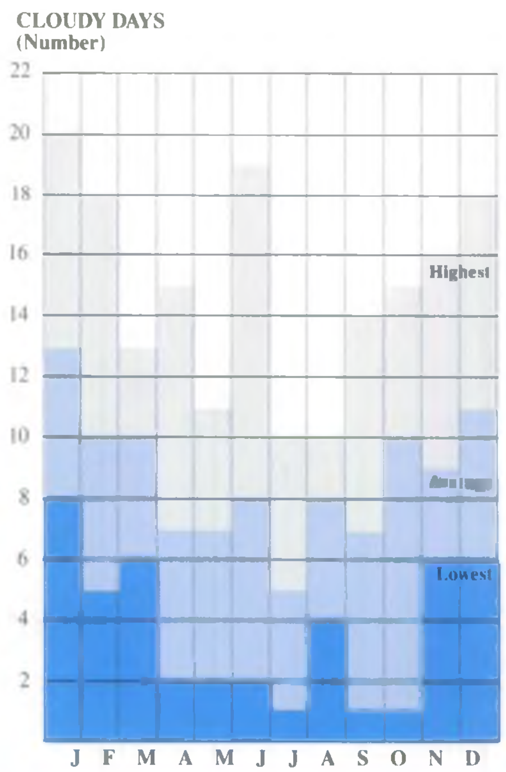
RAIN (WILTON POST OFFICE)



TEMPERATURE (PICTON)



HUMIDITY (PICTON)



CLOUD COVER (PICTON)

Figure 15.3.1
WILTON METEOROLOGICAL DATA

Source: Bureau of Meteorology

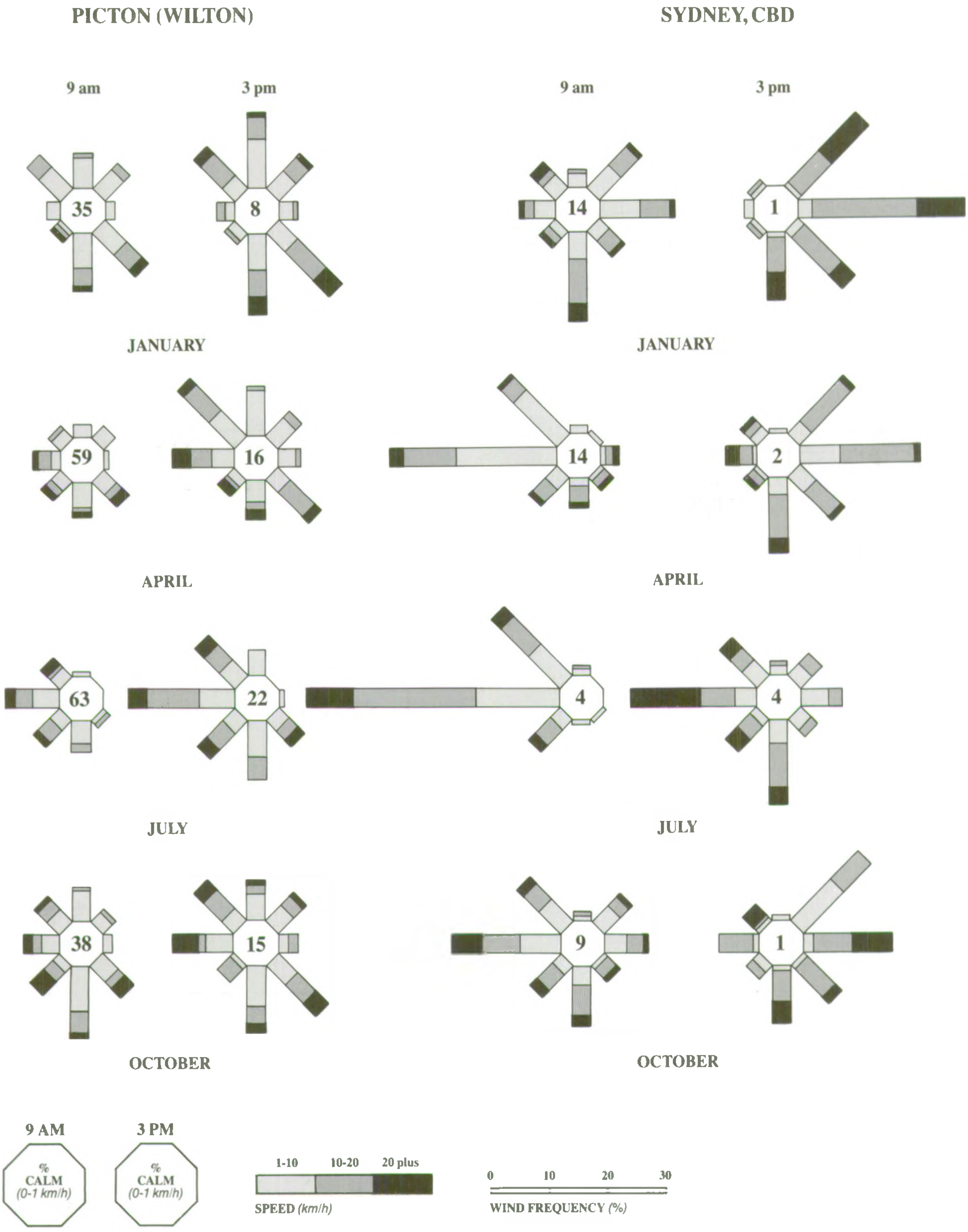


Figure 15.3.2
WIND CHARACTERISTICS

Topographical influences on air movements

Topography can affect the transport and dilution of air pollutants by inducing local flow patterns. Some of the topographic influences that are important for evaluating the effects of aircraft emissions include the channelling of flow through valleys, the persistence and intensification of inversions in valleys, circulations between land and water areas, urban-rural differences in surface roughness and thermal characteristics, and wind intensification on hills and ridges.

The Sydney Region consists of a large basin bounded on the east by the ocean, to the north and south by steep ridges and in the west by the Blue Mountains. For air quality purposes, the Sydney Basin can be conveniently divided into the Hawkesbury Basin, the Liverpool Basin (the closest to the Wilton site), and the Parramatta River Valley (Figure 15.3.3).

These basins influence air movement and the build up of pollutant concentrations. Recent studies have shown that trapping of various pollutants within the nocturnal—morning 'drainage' air flows and the late morning—early afternoon sea breezes is the principal cause of high concentrations of air pollution in the Sydney Basin (Hyde, Heggie and Malfroy, 1980).

Air drainage occurs as a consequence of differential temperature gradients between air immediately in contact with a cooling ground surface and air some distance above the ground. After sunset, the ground cools rapidly as a result of long-wave radiation from the surface, especially when the sky is clear. The rate of surface cooling is at a maximum for a few hours after sunset but, providing that radiation conditions remain constant, surface cooling will continue until sunrise.

If the topography is sloping, differences in temperatures, and hence density, within the near-surface layer will result in cold air drainage. A number of significant internal air drainage flows have been identified in the Sydney Basin (Figure 15.3.3), one of which, the south-west regional drainage flow is particularly relevant to Wilton.

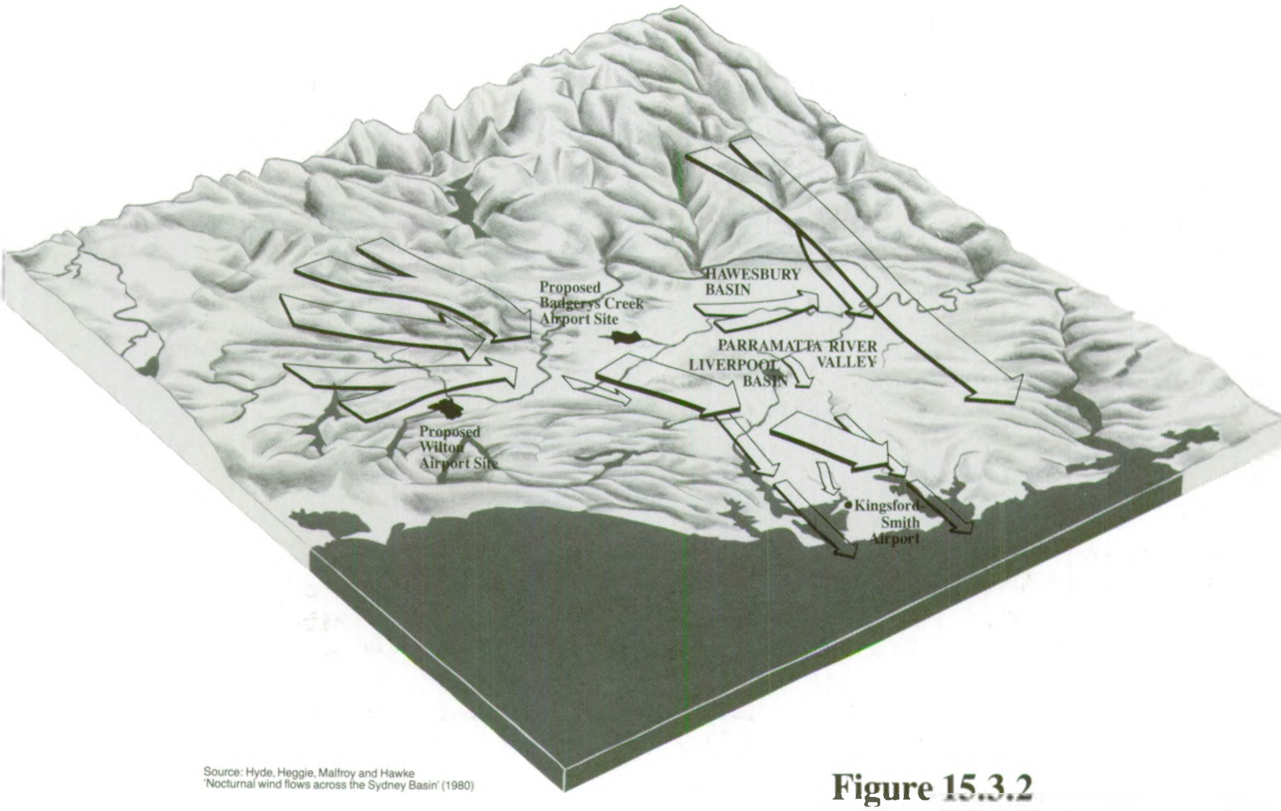
According to Hyde, Heggie and Malfroy, the south-west regional drainage flow has a source region bounded by the Illawarra escarpment to the east, the Mittagong ridge to the south and the Lake Burragorang Region of the Blue Mountains to the west. This flow occurred at Wilton on twenty-six nights during a forty-five day observation period in early 1980. Depending on day-to-day conditions, the south-west regional flow would carry emissions from Wilton to different parts of the Sydney Basin. An increase in emissions at Wilton can lead only to an overall decrease in air quality in the Sydney Basin.

15.3.3 Future pollution levels in the absence of airport development

No official forecasts of long-term pollution levels in Sydney have yet been issued by the State Pollution Control Commission. However, papers discussing future trends in emissions as distinct from pollution levels have been published by staff of the Commission (Eiser, Koo and Court 1983; Stewart, Pengilley, Brain, Haley and Mole, 1983) and, for the purposes of this study, provide a basis for estimating possible long-term emissions.

Motor vehicles are the major source of air pollution in Sydney. In 1980 they accounted for about half of all hydrocarbon emissions and about 75% of all nitrogen oxide emissions. Table 15.3.2 shows forecasts of motor vehicle emissions.

Assuming, for the purposes of this study, that the relative contribution of motor vehicles and other sources to the overall level of emissions remained the same as in 1980, and that aircraft movements at Kingsford-Smith Airport did not exceed its present capacity



Source: Hyde, Heggie, Malfroy and Hawke 'Nocturnal wind flows across the Sydney Basin' (1980)

Figure 15.3.2
TOPOGRAPHY AND AIR DRAINAGE FLOWS IN THE SYDNEY REGION

of 203,000 movements a year, total emissions in the year 2000 without a second Sydney airport would be as follows:

- hydrocarbons: 127,000 t/a
- oxides of nitrogen: 102,000 t/a
- carbon monoxide: 710,000 t/a
- particulates: 15,000 t/a.

Table 15.3.2 Emissions from motor vehicles in Sydney, 1976 to 2000 (t/a)

Pollutant	1976	1980	1986	2000
Hydrocarbons	97,900	87,000	78,800	62,000
Oxides of nitrogen	47,700	51,200	59,600	77,800
Carbon monoxide	670,000	640,000	660,000	540,000
Particulates	5,600	6,200	6,200	6,200

Source: Stewart, Pengilley, Brain, Haley and Mole 1983.

Although it is arguable whether emissions of hydrocarbons from stationary sources will fall at the same rate as those from vehicles, this has been the recent experience (Eiser, Koo, and Court 1983).

15.3.4 Airport related emissions

Additional emissions of pollutants would occur both at the construction and operational stages of airport development. Construction of the airport would involve stripping vegetation from extensive areas and redistributing large quantities of earth and stone about the site. During the late summer months, strong westerly winds coincide with hot, dry days, causing significantly higher than average levels of dust deposition throughout the area, and airport construction would inevitably involve work during these periods. However, the increase in pollutant emissions associated with airport operations would be much more significant than those stemming from airport construction, because of the pollutants involved and their long-term nature. Six main sources of pollutants would be associated with the operation of an airport:

- aircraft engine exhausts during operations
- aircraft fuelling systems
- ground service vehicles and equipment;
- aircraft engine emissions during maintenance
- fuel storage systems
- access traffic entering and leaving the airport.

An inventory of total annual airport related emissions, both from within and outside the airport site, has been estimated for the assumed worst case of 275,000 aircraft movements per year at a second Sydney airport at Wilton. This inventory is shown in Table 15.3.3, and a discussion of each of the main sources follows.

Table 15.3.3 Inventory of airport related emissions under worst case assumptions (t/a)

Source	Carbon monoxide	Hydro- carbons	Nitrogen oxides
On site:			
Aircraft emissions	1,411	518	798
Aircraft fuelling systems	-	2	-
Ground service vehicles	550	15	30
Maintenance	2	3	-
Fuel storage losses	-	36	-
Vehicle emissions	1,835	211	264
Total emissions on-site	3,798	785	1,092
Off site:			
Aircraft emissions	2,370	75	1,331
Vehicle emissions	19,669	2,259	2,833
Total emissions off-site	22,039	2,334	4,164
Total airport related emissions	25,837	3,119	5,256

Aircraft engine emissions during aircraft operations

The exhaust gases from aircraft engines consist mainly of substances not regarded as air pollutants (i.e. nitrogen, oxygen and water). Substances present in these exhaust gases that are regarded as air pollutants are particulate matter (smoke), carbon monoxide, unburnt and partially burnt hydrocarbons, and nitrogen oxides. The estimated total concentrations of all these pollutants in the exhaust gases do not exceed 700 ppm, but the amounts of the individual pollutants emitted vary greatly with the particular engine and especially with the part of the operational cycle involved.

The operational cycle of an aircraft normally comprises the following phases: taxiing or idling; taking off and climbing-out; cruising at altitude; approaching and landing. Engine emissions vary greatly between each phase because, at power settings other than the optimum design setting of cruise power, engine performance is less than optimum.

Emissions of carbon monoxide and hydrocarbons are highest when aircraft are idling or taxiing; the take-off and climb-out stages of the cycle, when engine combustion is close to the optimum, are characterized by low carbon monoxide and hydrocarbon emissions. With nitrogen oxides, however, the situation is reversed. Their formation is associated with efficient combustion when temperatures in the combustion chamber are very high, such as during take-off, climbing and cruising. However, except for the short period of take-off and climb-out, only small quantities of pollutants reach the ground, as emissions above an altitude of about 1,000 m are normally prevented from contributing to ground level concentrations by the presence of the mixing layer in the atmosphere.

Particulates are also produced during the take-off and climb-out phase and to a lesser extent during landing. These finely divided particulates were responsible for the smoke trails commonly seen from some earlier types of aircraft, but in recent times there has been considerable success in reducing the level of particulate emissions from aircraft engines and thus the smoke trails.

Aircraft fuelling systems

An essential part of any airport operation is the fuelling of aircraft, which is accomplished either by the use of tanker trucks or of a central underground fuelling system. The possibility of accidental spillage is substantially reduced by an underground fuelling system, which has the added benefit of being more efficient. Underground fuelling systems are installed at the major domestic and international terminals in Australia and would be installed for the level of traffic assumed for the worst case at Wilton.

Ground service vehicles and equipment

The power-operated ground service equipment for a commercial airport might include: light and heavy duty trucks, tractors, vans, towtugs and trucks, air starters, belt loaders, transports, portable air compressors, 400 Hz power generators, fork-lifts, cranes, welders, fuel trucks, aerial ladders and work platforms. As the ground vehicles at different airports will consume varying amounts of petrol depending upon such factors as airport size, layout and climate, the associated levels of pollutant emissions will also differ.

Aircraft engine emissions during maintenance

Typically, maintenance and ground testing of gas turbine engines involve running the engine almost entirely in idle and cruise modes. The amount of pollutants emitted depends on the emission rates for the particular engines, the time in each mode, and the number of maintenance checks performed daily or annually.

Fuel storage losses

The airport fuel storage tanks represent a source of hydrocarbon emissions. These emissions will vary with the type of tank (fixed or floating roof), tank diameter, type of fuel and whether a vapour recovery system is used.

Vehicle emissions

Motor vehicles coming to or from a second airport would produce emissions throughout the metropolitan area. In Section 15.4 it is estimated that an airport at Wilton would, under worst case conditions, generate on average approximately 54,000 vehicle trips per day (for passengers, visitors and employees) assuming rail access is available.

15.3.5 Assessment of effects and safeguards

By comparing estimated air emissions related to a second Sydney airport with the estimated total Sydney Region emissions, certain conclusions can be reached with respect to the air quality effects of airport development. Three steps are involved:

- consideration of the net addition to Sydney Region emissions that airport related emissions would represent;
- consideration of the consequent changes to the geographic pattern of emissions over the Sydney Region;
- consideration of the implications for pollution levels, taking account of dispersal patterns to the extent that these are known.

The estimates are set out in Table 15.3.4.

Table 15.3.4 Summary of long-term annual emissions, with and without second airport operations (t/a)

Item	Carbon monoxide	Hydro-carbons	Nitrogen oxides
Total Sydney emissions without airport	710,000	127,000	102,000
Airport related emissions:			
. By source:			
Vehicles	21,504	2,470	3,097
Other	4,333	649	2,159
. By location:			
On site	3,798	785	1,092
Off site	22,039	2,334	4,164
Estimated net addition as a result of airport	4,333	649	2,159
(% of total emissions without airport)	(0.6%)	(0.5%)	(2.1%)

Net addition to Sydney Region emissions

The airport related emissions, particularly those from vehicles, would not all be additional to the air pollutant levels that would occur in the absence of an operational airport at Wilton. The estimates for emissions in the event that airport development does not proceed are based on assumptions as to the total number of vehicles and average vehicle kilometres in the year 2000 (both of which would be higher than now); the airport would not necessarily add significantly to either figure, any more than would major new regional shopping centres, recreation centres, and other such major traffic generating projects built between now and 2000. Thus the net addition to total emissions is best represented by the figures given in Table 15.3.4 for other airport related emissions. On this basis the airport would, under worst case assumptions, represent increases over the estimated future level of emissions without the airport of 0.6% in the case of carbon monoxide, 0.5% in the case of hydrocarbons, and 2.1% in the case of nitrogen oxides. This presumes that none of the 275,000 aircraft movements could be accommodated in the Sydney Region unless a second Sydney airport were built. To the extent that some or all of these movements were previously accommodated at Kingsford-Smith Airport or at general aviation airports in the region then the net addition to Sydney Region emissions would be correspondingly less.

Impact of overall geographic pattern of emissions

Although airport related vehicle emissions would not be additional to total motor vehicle emissions in the Sydney Region, they would contribute to changes in the geographic pattern of emissions. Vehicle emissions are a significant component of total on-site airport related emissions, and these would represent a significant increase over the levels likely to be prevailing in the site area by the time the worst case level of operations was reached. At that time local emissions from sources unrelated to the airport would be much higher than at present because of a likely doubling of vehicular traffic (Section 15.4). Nevertheless, even for the worst case, total emissions would still be well below present emission levels (on a per square kilometre basis) in the city centre and inner city areas.

In the case of airport related off-site emissions, the pattern is more complex. The off-site aircraft emissions include those up to a distance of about 20 km from the airport. Vehicle emissions related to the airport would be dispersed throughout the metropolitan area, although about 50% would be within 60 km of the airport. As increases in vehicle emissions along routes taken by airport related traffic would, overall, be offset by numerous very small decreases in other traffic on many roads, the impact on the geographic pattern of vehicle emissions would only be significant along the major approach routes to the airport (Section 15.4).

Implications for pollution levels

It follows from the discussion of air drainage flows in Section 15.3.2 that airport related pollutants could be transported towards other pollutant source regions in the eastern half of the Sydney Region or north into the Hawkesbury Basin.

While any increase in local emissions can only degrade air quality in the Sydney Basin, it should be remembered that some airport related emissions would not enter the basin, because:

- some aircraft emissions would be on the ocean side of the Illawarra escarpment and would not therefore be transported into the Sydney Basin by drainage flows;

- some aircraft emissions would be at altitudes that preclude extensive mixing with the south-west regional drainage flow, the depth of which varies considerably from day to day;

- the south-west regional drainage flow does not occur every day, and indeed drainage flows occur less often at Wilton than, for example, at Campbelltown.

It is likely that, even under worst case assumptions, the contribution of a second Sydney airport to a degradation of air quality in the Sydney Basin would be significantly less than that deriving from the increase in motor vehicle emissions consequent upon the State Government's urban release programme in the Macarthur Region (for example, the population of the City of Campbelltown is forecast to rise by 139% between 1981 and 2001) and in new urban areas beyond those being considered in the present programme. The study by Hyde, Heggie, and Malfroy (1980) concluded that any large increase in emissions in the south-west of the basin should be avoided. Their study pointed to the northern and southern plateaux of the Sydney Region as being better areas for urban development from the air pollution point of view, although these areas would have to be investigated to confirm this. The proposed airport site at Wilton is closer to the southern plateaux than any of the potential urban areas under consideration and probably has less frequent drainage flows. While the airport would be unlikely to add significantly to the degradation of air quality in the Sydney Basin, its effects would be additive to those of urban development.

The pollutants of most concern are nitrogen oxides since, on the basis of the forecasts discussed in Section 15.3.3, pollution levels are likely to be significantly worse in the future even without airport development. During 1982 the State Pollution Control Commission's Objective for nitrogen dioxide was exceeded on two days at its Earlwood monitoring station. It may be presumed that, in the absence of any ameliorative measures, the Objective standard will be exceeded more often.

15.3.6 Ameliorative measures

As the operation of aircraft is world-wide, pollution from aircraft cannot be isolated within national boundaries. For these reasons it is essential that emission control standards have a high degree of commonality. The standards for jet aircraft engine emissions formulated by the International Civil Aviation Organization place limits on the maximum permissible emission levels of jet engines manufactured after 1 January 1985, both for existing jet engine types (some of which will have to be modified to achieve the reductions) and for future engine types. Because of the extreme difficulty of imposing tighter emission levels on aircraft in Australia than those applying internationally, and because aircraft in any case represent only a very small percentage of pollutant emissions, it is likely that unacceptable pollution levels would be tackled in other ways. As far as non-aircraft emissions at the airport are concerned (i.e. from ground vehicles, fuel storage and plant), it is anticipated that these would be controlled in accordance with the standards prevailing at the time the airport became operational.

With regard to the construction of the airport, the dust associated with earth moving and site preparation would arise mainly from the operation of mobile equipment over haul roads and cleared areas, and to a lesser extent from wind blowing across exposed areas. However, the emission of dust from these activities would be minimized by watering the working and haulage areas, and by establishing grass or other cover on the exposed areas as early as possible. Dust pollution of the water supply weirs at Pheasants Nest and Broughtons Pass is unlikely as these weirs are located about 3 km from the site and away from the direction of the strong prevailing winds.

15.4 ACCESS

This section examines the possible effects of future airport development at Wilton on road and rail transport in the Sydney Region. Alternative forms of ground access are also discussed and their capital costs estimated. As an input to the comparison of sites (Chapter 17) the future travel times by road and rail are estimated.

The assessment of effects is based on a 'worst case' of 13 million passengers per annum using the airport, and on the ground transport needs that this level of passengers would create. To establish baseline data for the evaluation of effects of ground access needs various assumptions as to the likely characteristics of future road and rail transport in the Sydney Region were made. These assumptions were based on the likely future Sydney metropolitan structure discussed in Section 14.8, which relates to a Sydney Region population of 4.5 million. Under the medium forecast of the Department of Environment and Planning this population would be reached about the year 2011, but it could occur either earlier or later than this forecast date.

15.4.1 The existing and anticipated road system without airport development

The road names used in this section are as shown on the Department of Main Roads Sydney Region Road Map; because of recent name changes they do not always correspond to names in common use. The freeway portion of the Hume Highway is for convenience referred to here as the South Western Freeway.

Sign posted distances from Sydney are measured from the GPO and generally refer to distances via state highways and main roads. They may not represent the shortest route available. Distances in this study were taken from Central station in order to place the road and rail calculations on a comparable footing.

The proposed airport site, which is shown on Figure 15.4.1, lies across Mount Keira Road about 5 km south of Wilton Road. The distance from Central station to the boundary of the Wilton site using existing roads is 81 km (via Canterbury Rd, Milperra Rd. and the SW freeway). However, the distance used for the access calculations was 71 km and is the sum of the link distances on the State Transport Study Group's 2015 road network plus the distance from the freeway to the airport boundary on the assumed airport access road. The 2015 road network is expected to be less circuitous than the existing road system and the airport road would be considerably more direct than the present route via Wilton and Mt Keira Road.

The existing road network

The major road serving the area is the Hume Highway (South Western Freeway), a four-lane, divided, access-controlled road which runs from south of Liverpool past Campbelltown and Wilton and on towards Mittagong. Access from the freeway to Mount Keira Road and the site area is via Picton Road and Wilton Road, a two-lane road of generally good standard that runs from Picton to Appin and has an interchange with the freeway.

East of Mount Keira Road, Wilton Road passes through Broughtons Pass, which involves steep grades, hairpin bends and a narrow bridge, severely restricting traffic capacity towards Appin.

Appin Road runs north from Appin toward Campbelltown and is a two-lane road of generally good standard. This road provides alternative access to the site from southern parts of Campbelltown, where access to the freeway is less convenient.

Mount Keira Road provides access south-east from the site towards Wollongong. Much of the road has been reconstructed to a generally high standard. Other roads in the area, such as Douglas Park Road, serve minor access functions and are generally two-lane rural roads of variable standard.

The anticipated road network

While there is, as yet, no government commitment to specific long-term changes to the road network, it is necessary for the purpose of this study to assume a likely general future road network. The future road network serving the area is unlikely to change to any great extent from that existing today, except that the South Western Freeway will probably be extended eastwards from Liverpool. Information on future urban growth provided by the Department of Environment and Planning (Section 14.8) suggests that, as urban development grows southwards, the southern links such as Appin Road will need to be progressively improved. It is possible that a new road may be constructed between and parallel to Appin Road and the freeway so as to act as a spine road for new development. Finally, it is currently proposed to relocate Mount Keira Road so that it connects to Picton Road west of Wilton.

Road traffic levels

Data published by the Department of Main Roads (1983) define annual average daily traffic flows for the various roads in the area, and these are set out in Table 15.4.1. Apart from the South Western Freeway and Camden Road, the network carries rather light flows, generally 6,000 vehicles per day or less. The South Western Freeway carries about 30,000 vehicles per day at its northern end, falling to less than half this figure south of the Campbelltown turnoff.

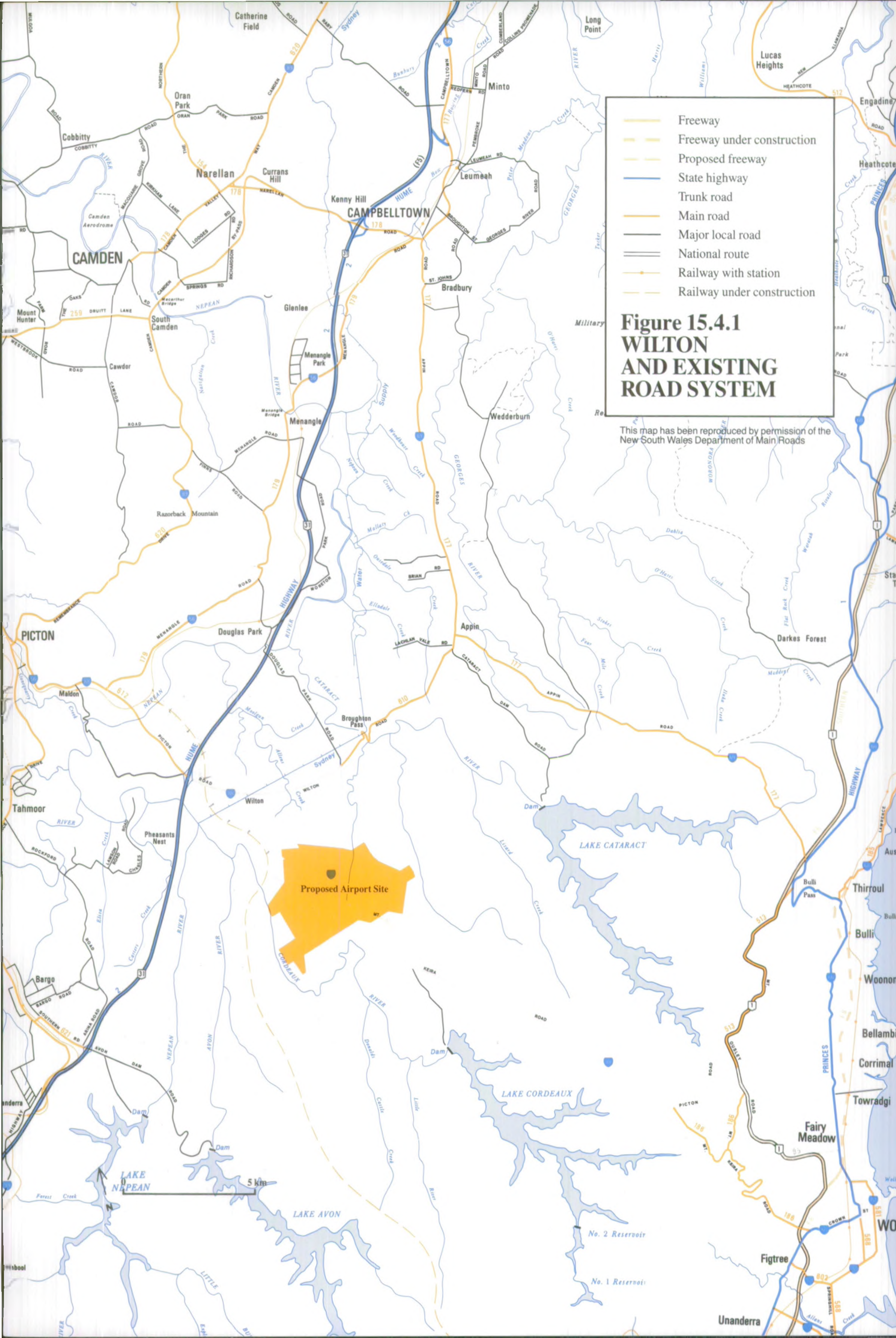


Figure 15.4.1 WILTON AND EXISTING ROAD SYSTEM

Table 15.4.1 Existing and forecast annual average daily traffic flows

Road	Location	Annual average daily traffic	
		1981/82	2011 (without airport development)
South-Western Freeway	East of Henry Lawson Drive	n.a.	30,000
	North of Campbelltown Ramps	30,000	50,000
	North of Camden Road	14,400	30,000
	North of Picton Road	13,200	25,000
Southern Freeway	North of Mt Ousley Road	20,000	60,000
Camden Road	West of Freeway	17,000	34,000
The Northern Road	North of Narellan	5,400	10,000
Hume Highway	North of Narellan	6,200	12,000
Picton Road	South of Maldon	3,000	8,000
Wilton Road	South of Appin	2,000	7,000
Appin Road	North of Appin	6,000	12,000
Mount Keira Road	South of Wilton Road	3,600	10,000
	6 km south of Wilton Road	3,100	9,000

n.a. Not applicable, as the South Western Freeway was not constructed at this location in 1981.

Source: Existing annual average daily traffic flows were derived from Department of Main Roads' publications giving figures for 1981 or 1982. The traffic flows for the year 2011 were derived from data provided by the State Transport Study Group and relate to a Sydney Region population of 4.5 million; this population is forecast to be reached about the year 2011, but could occur earlier or later.

Future traffic flows have been estimated using figures provided by the State Transport Study Group. However, these figures have been used only to examine corridors, and the Group's forecast increases have been adjusted for the purposes of this study by a comparison with historical growth rates. These forecast flows, which are set out in Table 15.4.1, must be treated with caution as they relate to predicted flows on a network thirty years in the future. They are thus dependent upon forecasts of population, employment, and the form of the future road network, as well as on various social and economic factors such as car ownership levels. Nevertheless, it is considered that they provide a reasonable basis for assessing the implications of airport traffic.

Adequacy of road network

Daily traffic flows can be used as a coarse measure of the adequacy of a road network in terms of capacity, by relating them to the number of lanes available. Table 15.4.2 sets out the maximum desirable average daily flows for different classes of road. It should be noted that these flows are in fact often exceeded, with resulting congestion and delays, and that the capacity of many sections of the network is defined by critical intersections rather than overall flows.

A comparison between the existing flows set out in Table 15.4.1 and the maximum desirable daily flows shown in Table 15.4.2 indicates that the existing road network in the vicinity of the site has adequate capacity to cater for current traffic flows. North of the site, where the South Western Freeway ends, the existing road network has very limited capacity to cater for growth.

Anticipated upgradings of road capacity

As traffic flows in the area increase in the future (without taking into account the airport development) the network would continue to be adequate except that the South Western Freeway would require six lanes between Campbelltown and Liverpool and Camden Road may require widening to six lanes.

Table 15.4.2 Maximum desirable average daily traffic flows*

Type of road	Maximum desirable average daily flows (vehicles per day)
Rural roads	
Two lanes	13,000
Four lanes, undivided	25,000
Four lanes, divided	30,000
Six lanes, divided	45,000
Four-lane freeway	50,000
Six-lane freeway	75,000
Urban roads	
Four lanes, undivided	13,000
Four lanes, undivided - with peak hour clearways	25,000-30,000
Six lanes, divided	45,000-50,000
Four-lane freeway	50,000
Six-lane freeway	75,000

* In consultation with the Access Working Group (see Appendix A), the Consultant defined maximum desirable flows as being the maximum flows compatible with a reasonable level of service (C to D as defined by the National Association of Australian State Road Authorities), on a road with priority at at-grade intersections.

15.4.2 Existing and anticipated public transport systems without airport development

The existing public transport network

The proposed site lies south of the Sydney Metropolitan Railways and east of the Main Southern Line, adjacent to the Maldon—Dombarton Railway currently being constructed (Figure 15.4.1). It lies 4 km from Wilton Loop on the Maldon—Dombarton Railway and a further 77 km from Sydney. Being in a rural environment it is not served by any significant local bus service. Even if there were any local bus operation in the vicinity it would only be operating from a railway station on the Main Southern Line such as Campbelltown, Menangle or Douglas Park. Travel by public transport to much of the rest of the Sydney region must therefore be via the Sydney Metropolitan Railways.

The Sydney Metropolitan Railways are divided into four more or less distinct operational groups (Figure 15.4.2):

- **Sector I:** Eastern Suburbs Railway (Bondi Junction to Central) to the Illawarra Line and branches (Central to Sutherland, Cronulla, Royal National Park, Waterfall and Helensburgh);

- **Sector II:** The City Railway (to/from Circular Quay) to the Bankstown Line (Central to Regents Park via Sydenham), the East Hills Line (currently Tempe to East Hills but to be extended to Glenfield), the Local Line (Central to Ashfield and Homebush), the Suburban Line (Homebush to Granville), the Main Southern Line (Granville to Campbelltown), and the Lidcombe—Cabramatta Line (via Regents Park);

- **Sector III:** The North Shore Line (Wynyard to Hornsby) via the City Railway (Central to Wynyard) to the Suburban Line (Central to Strathfield, Homebush, Lidcombe and Granville), the Main Northern Line (Strathfield to Hornsby and

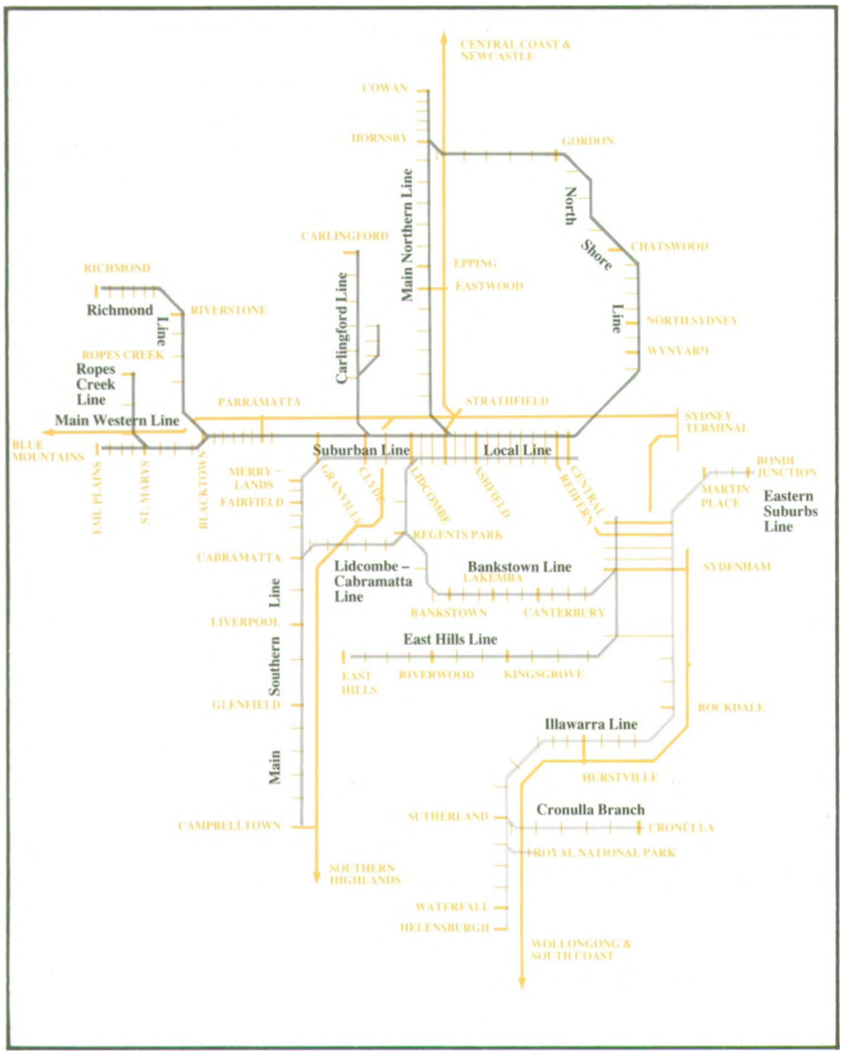


Figure 15.4.2 EXISTING SYDNEY METROPOLITAN RAILWAY SYSTEM

Sector I
Sector II
Sector III
Interurban

Cowan), the Clyde to Carlingford and Sandown Lines, the Main Western Line (Granville to Parramatta, Blacktown, St Marys, Penrith and Emu Plains), the Richmond Line (Blacktown to Richmond), and the Ropes Creek Branch (St Marys to Ropes Creek);

- **Interurban:** Sydney Terminal to the Central Coast and Newcastle, Sydney to the Blue Mountains, Sydney Terminal to the Southern Highlands, and Sydney Terminal to the Illawarra—South Coast. (Sydney Terminal is the terminal for interurban trains and is adjacent to Central station.)

Almost all the system described above is either electrified or in the course of being electrified.

Rail network loading

Figure 15.4.3 shows existing levels of inward bound passenger flows during the morning peak period for Sectors I, II and III operations, based on extended passenger counts prepared by the State Rail Authority of New South Wales between 1979 and 1980 as part of the data collected for the State Transport Study Group's 1981 Sydney Region Travel Survey.

Figure 15.4.4 shows a stylized representation of train services during the two-hour morning peak period. Essentially, in the inward bound direction, the trains on most lines are well occupied throughout the morning peak period, as shown in Table 15.4.3. As well,

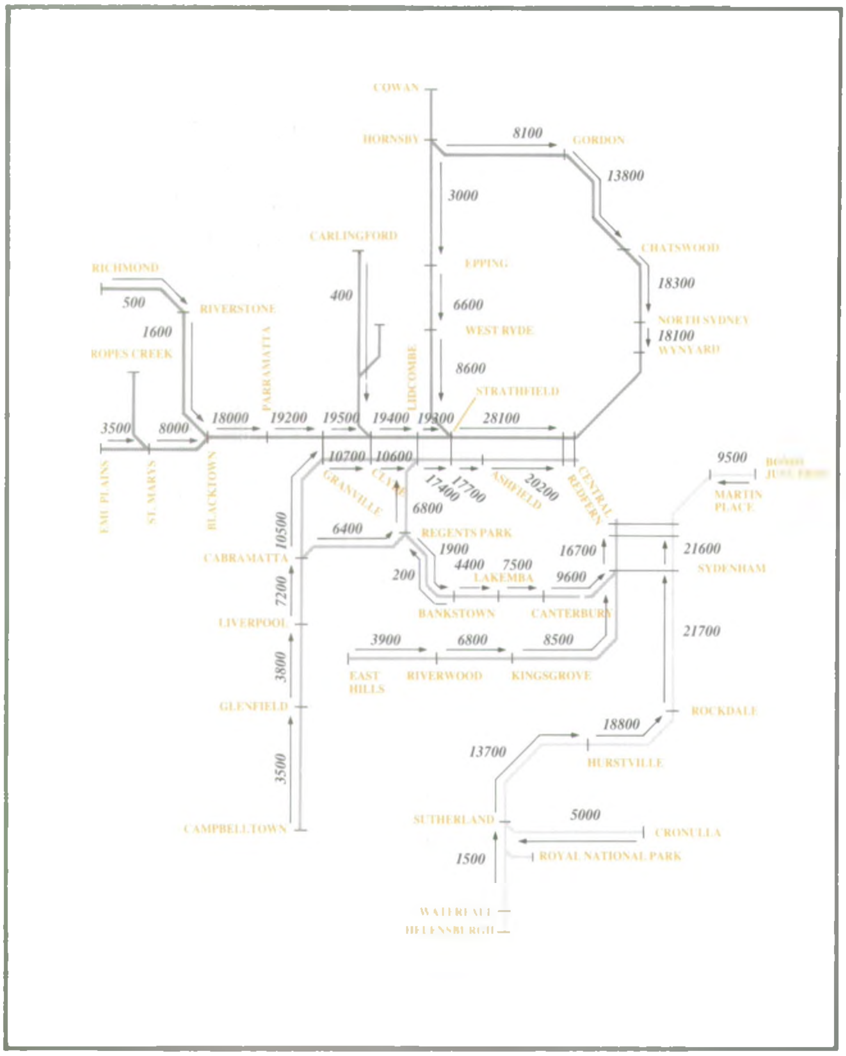


Figure 15.4.3
EXISTING INBOUND MORNING PEAK PERIOD PASSENGER FLOWS ON THE SYDNEY METROPOLITAN RAILWAYS

Sector I

Sector II

Sector III

inward bound track space is generally well occupied on the approaches to central Sydney, on the basis of the following practical track capacities:

- sixteen trains per hour for a mixture of stopping and through trains on the same track;

- twenty-four trains per hour for a homogeneous flow of trains (either all stopping or all through trains).

Nevertheless, potential still remains to accommodate more trains between Sydney and Strathfield by further rationalization of the use of the tracks in that section of railway. Elsewhere, there is spare capacity on lines outside the inner area, especially where there are multiple tracks. However, the exact determination of future line capacity and any need for additional infrastructure would have to be tested by timetabling and future studies.

This discussion of the use being made of the Sydney Metropolitan Railways relates only to passenger services, which account for roughly 2,300 distinct train trips on an average weekday. The network also caters for a significant number of freight trains, perhaps up to 200 trips on an average weekday, which must fit in with passenger train operations at different points around the system. Any discussion of rail system capacity therefore has to take into account the all-purpose nature of the Sydney Metropolitan Railways.

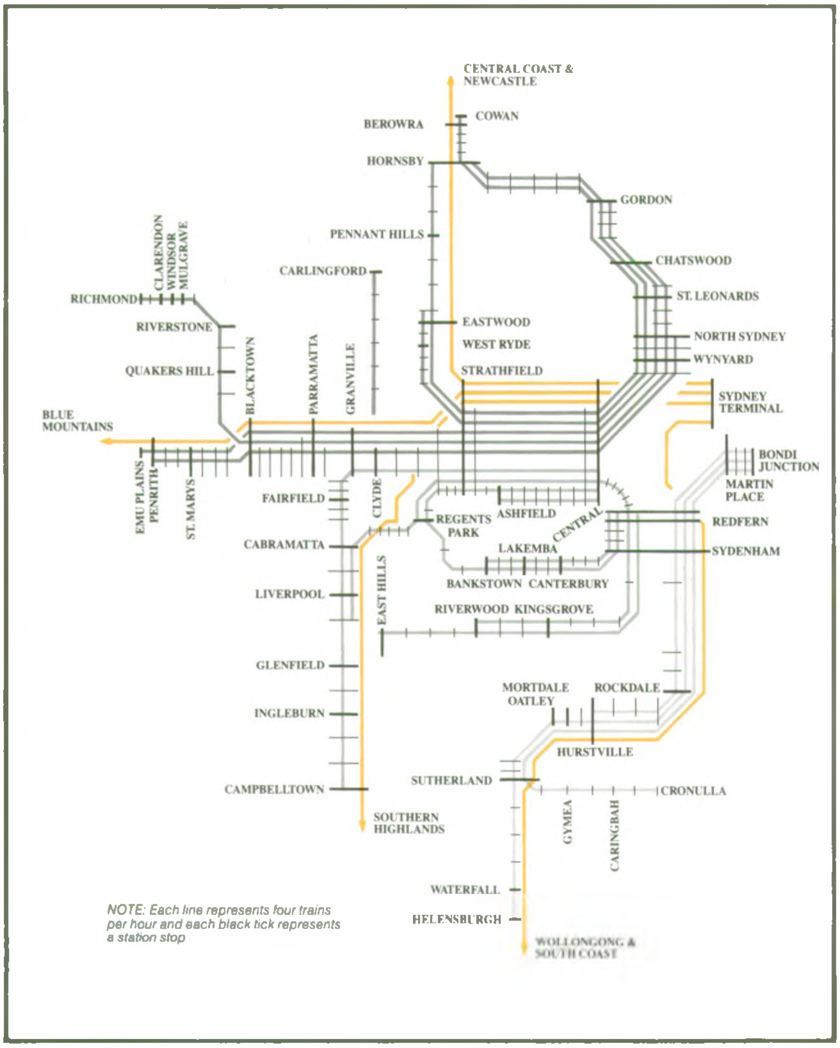


Figure 15.4.4
CURRENT PEAK PERIOD SERVICE ON THE SYDNEY METROPOLITAN RAILWAYS

Sector I
Sector II
Sector III
Interurban

Table 15.4.3 **Inward bound morning two-hour peak passenger and train movements on the Sydney Metropolitan Railways, by line**

Line	Peak morning inward bound passengers*	Station at which measured	Equivalent no. of double-deck cars**	Passengers per car	Proportion of seats occupied+ (%)
North Shore	18,300	North Sydney	164	112	93
Main Northern	8,600	Strathfield	90	96	80
Main Western	19,500	Granville	165	118	98
Local	20,200	Redfern	185	109	91
Bankstown	9,600	Sydenham	86	112	93
East Hills	8,500	Sydenham	74	115	96
Illawarra	21,700	Sydenham	164	132	110
Eastern Suburbs	9,500	Martin Place	156	61	51

* Source: Passenger counts prepared by the State Rail Authority between 1979 and 1980 as part of the data collected for the 1981 Sydney Region Travel Survey (State Transport Study Group 1982).

** Source: November 1983 Metropolitan Timetable, as representative of the current state of operations. Single-deck cars were equated to 0.67 of a double-deck car for seating purposes.

\+ Average seating of a double-deck car taken to be 120 seats.

Anticipated rail network

While large-scale changes to the network are not anticipated for the period up to about 2011, there are a number of foreseeable changes that could facilitate alternative passenger and freight travel patterns. These include:

- the current extension of the East Hills Line to Glenfield on the Main Southern Line, which would reorient travel between Campbelltown and Sydney;

- the possible direct linking of Merrylands on the Main Southern Line to Harris Park on the Main Western Line, which would permit direct passenger movement between Campbelltown, Liverpool, Parramatta, Blacktown and Penrith, and direct freight movement (primarily of coal) between the Main Western Line and the Main Southern Line;

- the current construction of the Maldon—Dombarton Railway from the Main Southern Line (south of Campbelltown) to the Illawarra Line, primarily for coal traffic;

- the possible mainline electrification south of Campbelltown to facilitate freight movement and to accommodate future commuting passenger needs;

- the completion of electrification to Port Kembla with the probable expansion of interurban services between Sydney and Wollongong.

While there are no existing estimates of future rail passenger movements on such an augmented Sydney Metropolitan Railways network, a possible pattern of inward bound train operations during the morning peak period is shown in Figure 15.4.5. For the purpose of presenting a base case against which the access needs of a second Sydney airport site can be assessed, it shows one way in which the Sydney Metropolitan Railway system might be operating in the long-term, including the East Hills—Glenfield and Merrylands—Harris Park connections. If implemented, such a pattern would accommodate an expansion of passenger services on the Main Northern Line, Richmond Line, Main Western Line, Main Southern Line and Illawarra Line. Moreover, since full length double-deck suburban or interurban trains are currently not being operated throughout the whole system there is even further scope for handling additional passengers within this operating pattern.

Such an augmented network similarly would have scope to handle additional freight movements, such as bulk coal and wheat. Increasingly, there will be major movements of both these commodities between the Main Western and Main Southern lines because of the existing and proposed deepwater coal and wheat terminals at Port Kembla, which will be considerably superior in throughput and shipping capacity to those in Port Jackson.

However, some proportion of any spare capacity might be taken up by non-airport travel demands not already anticipated. The future populations of the various potential areas for urban development (Section 14.8) are not yet known, and their pattern will affect rail travel demands along various routes. There may also be operational changes, such as a systematic increase in train speed, that could affect this assessment of spare capacity.

15.4.3 Transport implications of airport development

The worst case of 13 million passengers per annum was converted into total travel demands using the following assumptions:

- 20% of air passengers would be in transit and would therefore not require suburban transport to or from the airport;

- a busy day represents 17% of weekly passenger numbers;

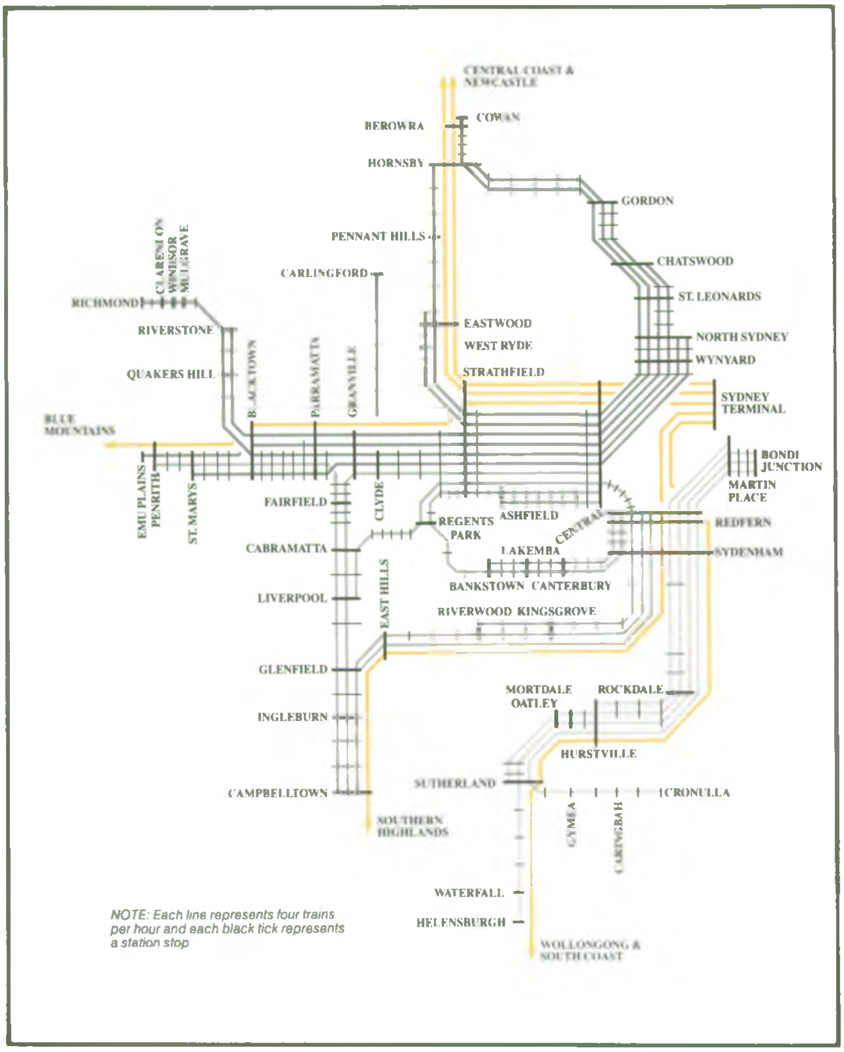


**Figure 15.4.5
POSSIBLE FUTURE PEAK PERIOD SERVICE ON THE SYDNEY METROPOLITAN RAILWAYS**

Sector I

Sector II

Sector III

Interurban

- 1% of air passengers (5% of transit passengers) would require transport to Kingsford-Smith Airport;

- a maximum of 10,500 people would be directly employed at the airport (Section 14.6);

- a further 2,100 employees would work at or close to the airport in airport related or multiplier jobs (all 900 airport-associated jobs, and half the sub-region multiplier jobs, Section 14.6).

The first two assumptions lead to an estimate of 34,000 air passengers travelling to and from the airport on a busy day. The basis of the 13 million passengers a year worst case is explained in Chapter 4. The assumptions concerning transit passengers are based on present patterns at Kingsford-Smith Airport. There are two reasons why the flow of passengers between the second Sydney airport and Kingsford-Smith Airport would be very small:

- about half of all transit passengers are making on-line transfers; that is, they arrive and depart on flights operated by the same carrier;

- in the worst case the traffic at the second Sydney airport would be substantially higher than that at Kingsford-Smith Airport today, and therefore there would be services to a wide range of destinations, sufficient to afford most travellers a reasonable level of service to major destinations, without the need to change airports to reach final destinations.

Groundside origins and destinations of air passengers

The number of passengers travelling to the airport from different parts of Sydney and adjacent areas was then estimated, based on the forecast population distribution in the year 2011, and the present numbers of air passenger trips per thousand population in different parts of Sydney. The geographical distribution of air passengers' groundside origins and destinations, as identified by Department of Aviation Surveys, is set out in Figure 15.4.6. There are significant differences between the patterns of groundside origins and destinations of Sydney residents, and those of non-residents. At present, Sydney residents account for 41% of passengers (excluding transit and transfer passengers) at Kingsford-Smith Airport, but the future ratio for a second Sydney airport is uncertain. It was therefore considered important to analyse a pattern of groundside origins and destinations that, like the current distribution, represented a mix of resident and non-resident travellers, but in addition, to consider the sensitivity of the results to alternative possible distributions biased towards either residents or non-residents. The implications of these alternative possible distributions were consequently examined, but it was concluded that in the case of road access the results of the analysis were generally insensitive to the distribution owing to the limited number of approach routes serving the site. The only distribution pattern that could affect the conclusions of this analysis was one in which origins/destinations were highly concentrated on the city centre. This was considered unlikely in practice. In the case of rail access, the distribution would affect the overall level of patronage, but the infrastructure requirements would not be significantly different.

Percentage of travellers using rail and road for ground access

Three possible levels of rail use for ground access were considered:

- a 'no-rail' case, with public transport access being mostly provided by a combination of local bus services, and tour and charter coach services;

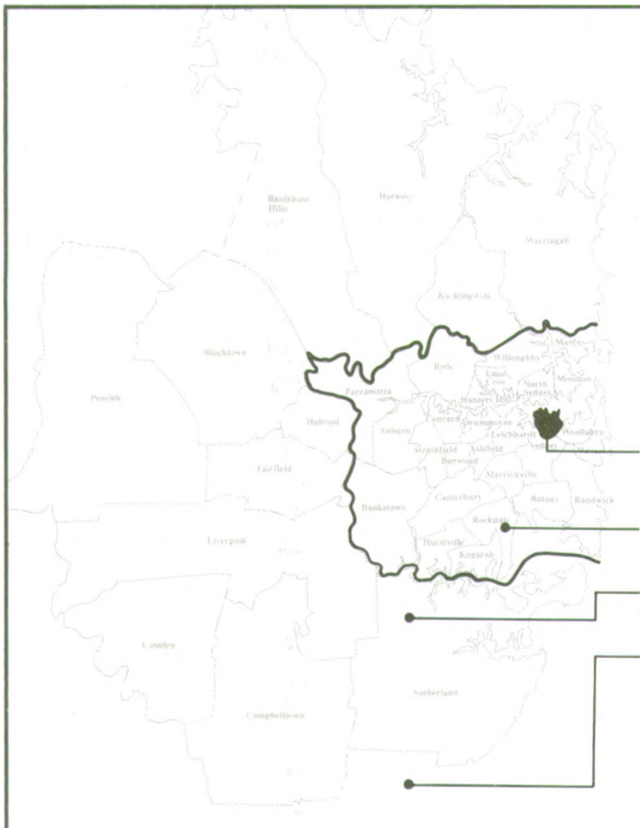
- a 'low-rail' case, which assumed low usage of a rail service between the city and a second Sydney airport;

- a 'high-rail' case, which assumed high usage of a rail service between the city and a second Sydney airport.

The first two levels were used to examine the worst case for the road network, while the last two were used as a basis for examining the worst case for the public transport network. In all three cases, public transport journeys from the airport were viewed as comprising two phases: new trunk services from the airport, followed by existing local services to ultimate destinations. In the no-rail case, the new trunk services would consist of scheduled bus services to various major centres around the Sydney Region. In the low-rail and high-rail cases, the new trunk rail services would run between the airport and Sydney Terminal with intermediate connections to suburban rail services.

Before making any assumptions about the share (expressed as a percentage) of total ground passenger movements taken up by each mode of travel, overseas experience related to multiple airports was reviewed. However, this information was not wholly conclusive, since it depended upon the efficiency of rail and public transport access to the airport in question. For example, although Paris-Orly and Roissy-Charles de Gaulle airports both have nominal connections by bus and rail, they contribute comparatively few passengers to the travel market because of the difficulty of access where shuttle bus services to/from railheads must be taken into account. On the other hand, London's Heathrow and Gatwick airports are well connected to the London Underground and to the British Rail Southern Region Brighton Line respectively, and have extensive bus and coach connections. However, the relative proximity of Heathrow to central London increases the bus, coach and taxi share of travel compared with Gatwick, thereby accounting for much of the difference in the rail mode percentages between the two airports.

Source: Department of Aviation surveys at Kingsford-Smith Airport, 1983



	SYDNEY RESIDENTS %	NON RESIDENTS %	ALL PASSENGERS %
CITY	6	43	29
INNER AREAS	59	39	47
OUTER AREAS	32	7	15
OTHER AREAS	1	6	4
NOT STATED	1	5	4
TOTAL	100*	100	100*

*NOTE: *Does not add up to 100 due to rounding*

Figure 15.4.6
GROUNDSIDE ORIGINS AND DESTINATIONS OF AIR PASSENGERS, 1983

The British Airports Authority, in preparing the case for a third major airport for London at Stansted, was considering a relatively remote airport site (52 km to St Pancras station in central London). In working out the indicative percentage share for each travel mode for the no-rail, low-rail and high-rail cases presented in Table 15.4.4, the British Airports Authority's determinations of travel mode percentages were used, as well as information on currently available methods of transport access to Kingsford-Smith Airport, and the conclusions on use of public transport presented in the Major Airport Needs of Sydney Study.

Table 15.4.4 Indicative percentage share of ground access for each travel mode for each case

Mode of travel	No-rail case (%)	Low-rail case (%)	High-rail case (%)
Private vehicle	65	45	35
Taxi*	5	5	5
Bus **	15	15 (Bus and Coach combined)	15 (Bus and Coach combined)
Coach+	15		
Rail	-	35	45

* The taxi percentage share is a residual, given the long taxi journeys envisaged.
** Regular scheduled bus services to selected points throughout the Sydney Region.
\+ Tour and charter coach services for specific group travel needs.

From the available information on public transport access to airports, there appears to be relatively little variation in the percentage share enjoyed by rail travel in those cases where rail access of a reasonable standard is available. Nevertheless, there could be a wide variation in the total public transport share of airport access to a second Sydney airport. This is because the public transport share would depend partly on the characteristics of air passengers in terms of such factors as purpose of travel and place of residence (i.e. whether the traveller is a Sydney resident or a visitor), and partly on how the public and private transport options compare in terms of speed, cost and reliability. None of these factors can be predicted with any certainty for a 13 million passenger airport, which can only develop in an environment that would be substantially different from that of today. It is therefore necessary to consider a range of different cases for transport access (Table 15.4.4).

Origins and destinations of rail and road users

The indicative percentages for each travel mode were used as the basis for estimating separate distributions of groundside origins/destinations for those air travellers travelling by rail and those travelling by road. In the no-rail case, it was assumed that in-vehicle travel times by bus or coach would be 10% longer than comparable private vehicle times, and that the origins/destinations of travellers by the various transport modes would have similar distributions over the Sydney Region. In the low-rail and high-rail cases, some areas of Sydney were significantly more accessible by rail than road while the opposite situation applied to other areas. The indicative travel mode percentages were therefore modified upwards or downwards respectively according to the ratio of rail times to road times. This technique was applied to two alternative rail access routes to Wilton (via Douglas Park and via Appin), and it was found that the route via Appin yielded a higher share for the rail mode of travel (Section 15.4.5). The public transport trips estimated for the no-rail and low-rail cases under the Douglas Park alternative (i.e. the rail alternative with the lower level of rail patronage) were then subtracted from total trips to give two distinct worst cases for road: one in which all airport related travel was done by road, and one in which the maximum of airport related non-rail travel was done by road.

Estimated total demands for ground travel

To obtain figures for the total travel demands by rail and road for a worst case of 13 million passengers it was also necessary to consider the travel requirements of those travelling to an airport to greet air passengers as well as the requirements of airport employees and other airport users.

As far as road travel was concerned, applying the indicative road travel percentages (Table 15.4.4) to the figure of 34,000 passengers on a busy day, gave figures of 17,000 air passengers travelling by car or taxi in the low-rail case, and 24,000 in the no-rail case. Experience at Kingsford-Smith Airport indicates that after making allowance for those travelling to the airport to greet passengers and for vehicle return trips, these figures would rise to 25,000 and 35,000 vehicle trips. After allowing for other vehicle trips to the airport concerned with airport business, freight deliveries and servicing, the figures would rise further to 39,000 in the low-rail case, and 54,000 in the no-rail case. Finally, it was necessary to allow for travel by employees, which added a further 15,000 vehicle trips per day (assuming a maximum of 85% of employees travelling to work by car in both the low-rail and no-rail cases). The overall totals were therefore estimated at 54,000 vehicle trips per day in the low-rail case, and 69,000 in the no-rail case.

As far as rail travel was concerned, it was estimated that some 11,800 air passengers would travel by rail in the low-rail case, and 15,600 in the high-rail case. As with road travel, there would also be other airport users, including people travelling to the airport to greet air passengers. On the basis of information given for Stansted, these additional groups could amount to about 10% of the number of air travellers. Partly because most employees would live within 30 km of the airport, there is not likely to be a high flow of employee travel by rail, although overseas experience suggests that the proportion of employees travelling by rail would not be insignificant. Thus a minimum of 10% and a maximum of 20% of airport and airport-associated employees were assumed to travel by rail. Both these cases were considered because, unlike road travel, the overall rail travel numbers are sensitive to the proportion of employees who travel by rail, especially during peak hours.

15.4.4 Impact of airport development on anticipated road network flows

To estimate the impact of airport related traffic on anticipated road network flows, assumptions were made as to the routes that vehicles would use to travel to and from the airport.

The alternatives are limited by the fairly restricted existing network in the site area and by the need to minimize adverse impacts on residential areas. The possibility of using the Macarthur spine road for access from the north was rejected because of its potential impact on existing and future residential areas. This left two approach routes to the airport, the first and predominant one being via the South Western Freeway and the second being via the Southern Freeway and Mount Keira Road.

The vehicle trips from each district were then added to those on the appropriate approach route, to give an estimate of future traffic when the airport was operating under worst case conditions. These future traffic flows, estimated both with and without available rail access, are shown in Table 15.4.5.

Table 15.4.5 Anticipated road network flows and lane requirements

Road	Location	Average daily traffic			Number of lanes required		
		No airport	With airport		No airport	With airport	
			With rail	No rail		With rail	No rail
South Western Freeway	East of Henry Lawson Drive	30,000	51,000	66,000	6D	6F	6F
	North of Campbelltown ramps	50,000	84,000	100,000	6F*	6F+	6F+
	North of Camden Road	30,000	65,000	80,000	4D**	6F	6F+
	North of Picton Road	25,000	62,000	77,000	4	6F	6F
Narellan Road	West of freeway	34,000	36,000	36,000	6D	6D	6D
The Northern Road	North of Narellan	10,000	11,000	11,000	2	2	2
Hume Highway	North of Narellan	12,000	13,000	13,000	2	2	2
Picton Road	South of Maldon	8,000	17,000	17,000	2	4	4
Wilton Road	South of Appin	7,000	9,000	9,000	2	2	2
Appin Road	North of Appin	12,000	14,000	14,000	2	2	2
Mount Keira Road	South of Wilton Road	10,000	12,000	12,000	2	2	2
	6 km south of Wilton Road	9,000	15,000	15,000	2	2	2

* F indicates an access-controlled facility.
** D indicates a divided at-grade facility.
\+ Flows in excess of desirable level.

Comparison of the future traffic flows shown in Table 15.4.5 with the maximum desirable daily flows shown in Table 15.4.2 allows a clarification of the changes required in the capacity of the road network. The lane requirements for various sections of the road network are also summarized in Table 15.4.5 for future conditions, with and without the airport development. It is necessary to compare the network requirements based on an assumption of no airport development with those assuming airport development at Wilton, in order to separate the effects of the airport from the effects of natural growth.

To cater for 13 million passengers a year at the airport under the assumptions made, it would be necessary, even if rail access were available, to undertake the following additional works:

- widening of the South Western Freeway from four to six lanes between Wilton and Campbelltown and between Liverpool and Henry Lawson Drive;

- widening of Picton Road from two to four lanes between Picton and the South Western Freeway (this need may or may not arise depending on future patterns of urban development, rural subdivision, and road network changes);

- construction of a six-lane road from the South Western Freeway to the airport entrance, preferably access-controlled.

In addition to the above, Mount Keira Road might require four lanes east of the airport entrance. All other roads would function satisfactorily with their existing cross-sections. However, it should be noted that the forecast flows on the freeway between Campbelltown and Liverpool could exceed the desirable maximum set out in Table 15.4.2. The result of this would be a degree of congestion and delay at peak periods that could only be overcome by the construction of a new facility, such as the Georges River Parkway. If such a new facility were not available by the time airport activity reached 13 million passengers a year and the Sydney Region population reached 4.5 million, there would be an increase in delays and congestion on the South Western Freeway between Campbelltown and Liverpool.

If the airport were developed without rail access, the major additional impact would be on the airport access road from the airport, which would have to be access-controlled, and on the South Western Freeway between Campbelltown and Liverpool which would be carrying flows well in excess of the desirable maximum. This would place considerable pressure on the South Western Freeway, requiring either that it be widened to eight lanes, or more likely that a new facility such as the Georges River Parkway be constructed.

It should be stressed that the works listed above are not recommendations and should not be used for planning purposes, as the intention in compiling this list has merely been to identify the possible scale of worst case effects in the event of future airport development. If the airport were to be developed, detailed studies of alternative access arrangements would be necessary to enable road access to be designed in accordance with traffic forecasts that could at that stage differ significantly from today's worst case assumptions.

Considerations for land use

Since most of the traffic to and from the Wilton site would travel along the South Western Freeway, the environmental impact of increased traffic flows should be fairly low. Depending upon the final population distribution in the Camden—Picton area there might be significant increases in flows on Picton Road west of the freeway if this route is more attractive than the freeway. Such an increase could affect properties along this road. Picton Road east of the freeway would have its whole character changed from a two-lane rural road to a busy six-lane divided road, unless a new access-controlled road on a different alignment (to the south of the existing road) were built to carry traffic from the freeway to the airport entrance. If no rail access were available and this resulted in a need for a new route to relieve pressure on the South Western Freeway, there would be significant land use considerations in determining a new route.

Traffic flows on Mount Keira Road south of the airport entrance would increase significantly. However, there is little development along the road as it is predominantly in water catchment areas. The small increase in traffic on Appin Road should not have any major environmental or traffic implications.

15.4.5 Impact of airport development on anticipated rail network flows

The additional rail passenger movements would, in part, differ in magnitude and direction depending upon the way in which the site was linked to the rail network. By the time the airport was developed, local bus services might very likely have been extended through the developing Appin and Douglas Park areas towards the site. However, because of their circuitous nature, the travel time involved, and the conflict with their prime function, such services would be suitable only for access by local employees.

As the proposed site is more or less remote from railway lines, deliberate decisions on trunk routes would be required, whether road or rail-based access systems were being considered. However, a road-based access system would have to connect with the Sydney Metropolitan Railways to assist distribution of airport generated travel throughout much of the region; otherwise it would have to reproduce a similar geographical complexity in order to provide effective access by public transport to the airport.

The Sydney Metropolitan Railways already play a significant role in travel by public transport at a regional level, and are capable of absorbing the extra rail travel generated by a second Sydney airport. Two rail options are apparent:

- a trunk route via Wilton Loop and Maldon Junction, in common with the Maldon—Dombarton electrified freight railway currently being constructed, thence via the Main Southern Line to Glenfield, the East Hills Line and the Illawarra Line to Sydney.

- a trunk route via a new railway line from the airport through Appin to Menangle Park and thence via the main Southern Line to Glenfield, the East Hills Line and the Illawarra line to Sydney; this line could be developed for suburban as well as airport services.

Possible rail flows for each of the two alternatives are summarized in Tables 15.4.6 and 15.4.7. The peak hour flows assume that:

- the peak hour for air travellers coincides with that of other travellers;

- 10% of the daily flow occurs in the peak hour and this divides evenly by direction;

- 70% of travel by employees in one direction occurs during the same peak hour as for air travellers and in the same direction.

The flows shown in these tables are similar for both route options. Irrespective of the route option adopted, a range of possible rail operations was considered for a service between the city and the airport. The range included:

- an extension of an adjacent suburban service running to Central Station and the city railway;

- an additional interurban service integrated with the existing Central Coast and Mountains interurban services and running to Sydney Terminal;

- a separate (i.e. with dedicated trains) interurban-style service running to Central Station and the city railway;

- a separate (i.e. with dedicated trains) interurban-style service running to Sydney Terminal.

Table 15.4.6 Estimated rail passengers for Wilton via Douglas Park, by category of traveller and period

Period	Category of travellers	Low-rail case		High-rail case	
Busy day	Air travellers	11,800		15,600	
	Others	1,200		1,600	
	Employees*	2,000	(4,000)	2,000	(4,000)
	Total	15,000	(17,000)	19,200	(21,200)
Peak hour	Air travellers	590		780	
	Others	60		80	
	Employees*	700	(1,400)	700	(1,400)
	Total	1,350	(2,050)	1,560	(2,260)

* Assuming a minimum of 10% (the first figure) and a maximum of 20% (the figure shown in brackets) of all airport and airport-associated employees travel by rail.

Table 15.4.7 Estimated rail passengers for Wilton via Appin, by category of traveller and period

Period	Category of travellers	Low-rail case		High-rail case	
Busy day	Air travellers	12,000		15,800	
	Others	1,200		1,600	
	Employees*	2,000	(4,000)	2,000	(4,000)
	Total	15,200	(17,200)	19,400	(21,400)
Peak hour	Air travellers	600		790	
	Others	60		80	
	Employees*	700	(1,400)	700	(1,400)
	Total	1,360	(2,060)	1,570	(2,270)

* Assuming a minimum of 10% (the first figure) and a maximum of 20% (the figure shown in brackets) of all airport and airport-associated employees travel by rail.

This last — a separate interurban-style service running to Sydney Terminal — was considered the most appropriate for an airport express rail service because of the need for an identifiable and reliable service, able to accommodate the lengthy stops at stations that would be necessary for luggage handling. Interurban-style trains (such as the air-conditioned double-deck trains to the Central Coast and the Blue Mountains) would offer a satisfactory level of comfort to induce air passengers to use an airport express service. They would also offer good point-to-point travel times for the limited-stop services necessary to cut to a minimum the rail access time between the city and the airport. These services would make a small number of intermediate stops (say, three or four), thus allowing efficient distribution of air passengers to areas other than the city by connecting with suburban services. It is expected that with some operational modifications Sydney Terminal station would not only be capable of handling the airport express services, which would require the equivalent of two tracks, but could

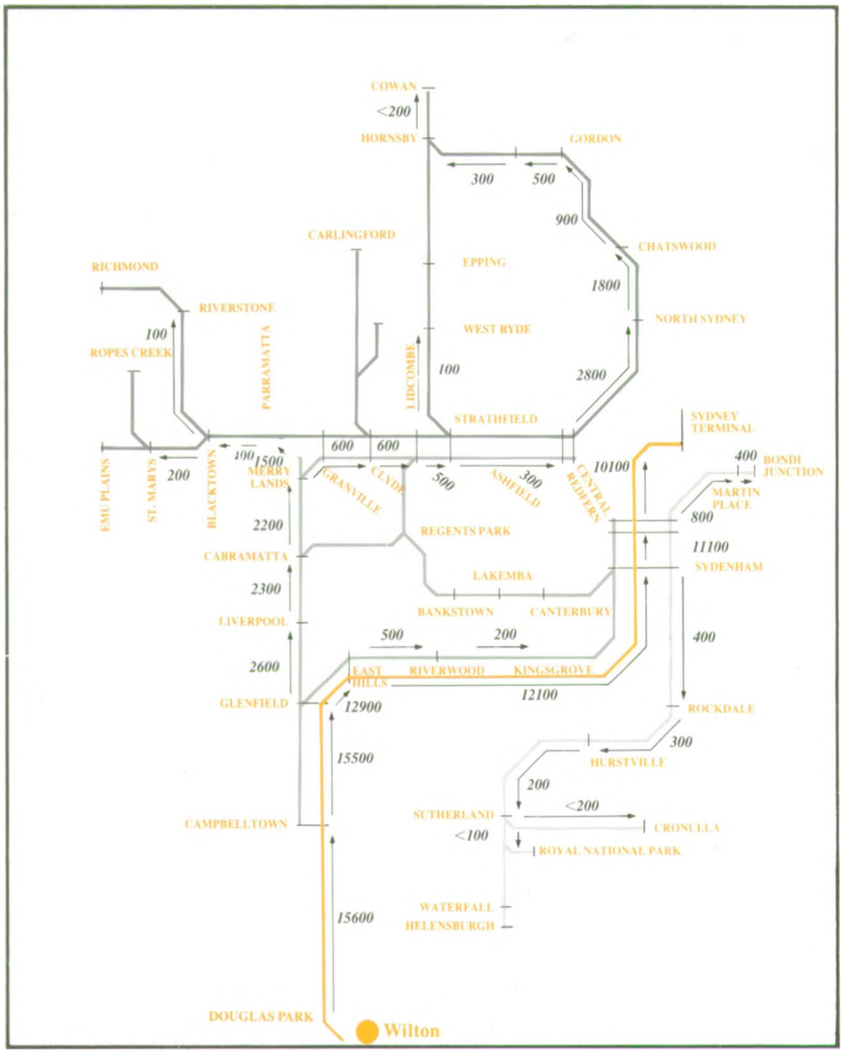


Figure 15.4.7
FLOWS OF AIR PASSENGERS BY RAIL FROM WILTON DOUGLAS PARK OPTION, FUTURE RAIL SYSTEM

also be developed to handle transfers to suburban trains, and to road transport links such as buses, coaches, taxis, and private vehicles.

Because an airport express service would be carrying a combination of air travellers, airport employees and others to eventual destinations throughout the Sydney Region, it would be distributing passengers into the Sydney Metropolitan Railways at selected points along its route. From those points, travellers would take regular suburban and interurban services to complete their journeys. Figure 15.4.7 shows the distribution of air travellers from the airport express route via Douglas Park, and Figure 15.4.8 shows the corresponding distribution of air travellers from the rail route via Appin.

15.4.6 Consequent changes to the transport system

This section summarizes the changes to the transport system that might be necessary to cater for the maximum additional travel that could be generated by an operational airport. The cost of these changes is also estimated.

Changes to the road network

At or before the start of airport construction, it would be necessary to relocate Mount Keira Road eastwards from its present route across the proposed site, and to construct the access roads connecting the site to the road network. The timing of the relocation of Mount Keira Road could be determined by general traffic growth and could occur well before the commencement of airport construction. Possible routes for the relocations and access roads are shown on the master plan discussed in Chapter 13.

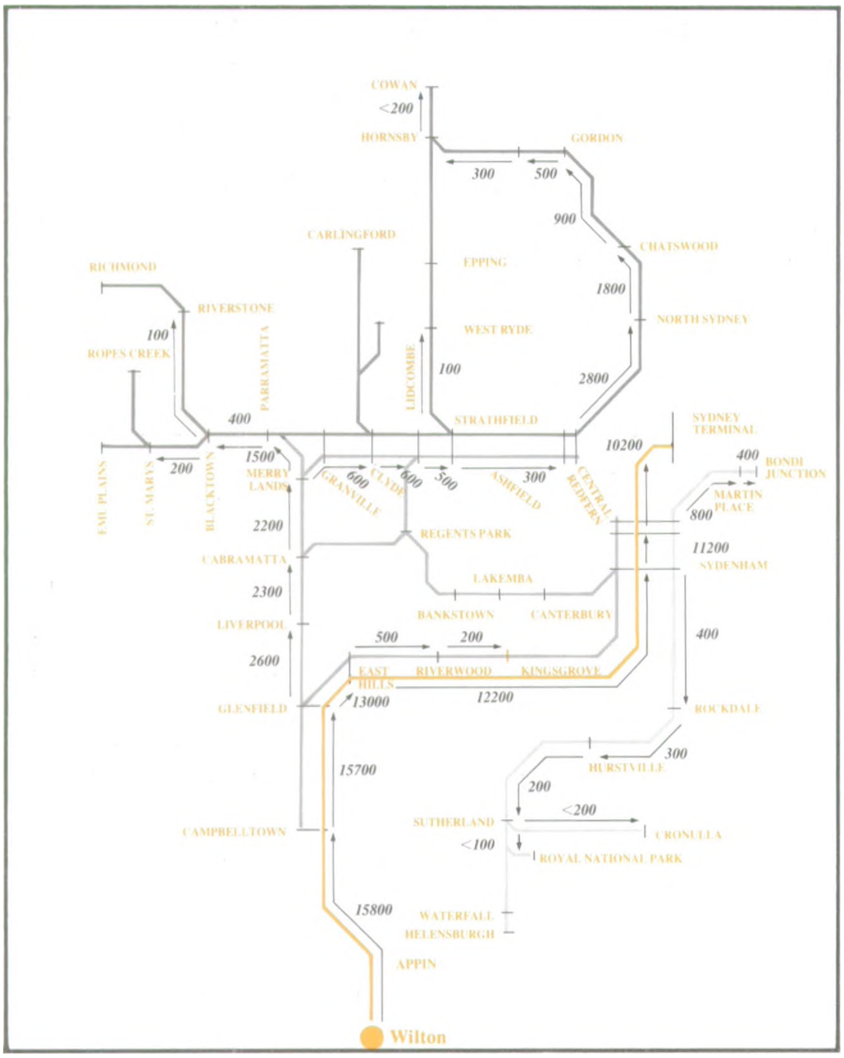


Figure 15.4.8
FLOWS OF AIR PASSENGERS BY RAIL FROM WILTON APPIN OPTION, FUTURE RAIL SYSTEM

Progressive changes to the surrounding road network would take place in response to demand generated by population growth and growth in air traffic. The network changes that would be necessary to accommodate the worst case, with 13 million air passengers, have already been discussed (Section 15.4.5). It should be noted that the South Western Freeway provides a good connection from Wilton to Kingsford-Smith Airport for the small proportion of passengers (1% or 300-400 per day) that might need to transfer between the two airports. It is assumed that a coach service would be provided for these passengers.

The cost of these changes to the road network have been estimated using unit costs provided by the Department of Main Roads (Table 15.4.8). Costs vary greatly depending upon whether the roads are located in non-urban, outer or inner urban locations. The Wilton airport site benefits from the fact that many of its requirements for roadwork are located in non-urban areas. Applying the unit costs to the works described above gives an estimate of the capital cost of road works of about $154 million if rail access is available and about $237 million if it is not.

Changes to the rail system

In addition to the physical connection of the site to the Sydney Metropolitan Railways network, a number of other measures would have to be taken to fit an airport express service into the expected pattern of suburban and interurban rail services existing at that time. However, transferring passenger flows at various points in the rail network would not warrant any special addition to non-airport services. Basically, this is because air travellers and others would be more or less evenly distributed throughout the day so that the small hourly flows that they would generate could be accommodated just as easily on peak or counter-peak suburban or interurban trains. During the peak hour, flows of airport and airport-associated employees would be of a similar magnitude to the flows of air travellers and others (Table 15.4.6 and 15.4.7), but they would most likely disperse fairly quickly once the airport express services reached major stations on the Main Southern Line. Also, the employee flows would most likely be running counter to Sydney, Liverpool and Campbelltown, etc. peak commuter flows and so would be easily absorbed into relevant suburban or interurban services.

Table 15.4.8 Road construction unit costs*

Cross-section	Total cost/kilometre ($m)**		
	Inner urban	Outer urban	Non-urban
Six-lane freeway	17.50	12.25	7.10
Four-lane freeway	12.50	8.75	5.10
Six-lane divided road	10.00	7.00	4.05
Four-lane divided road	7.50	5.25	3.05
Four-lane road	6.30	4.40	2.55
Two-lane road	3.80	2.65	1.50

* Costs are for constructing new roads. Upgrading costs are equal to the difference between costs for the existing and future cross-section.

** Costs are derived from unit costs supplied by the Department of Main Roads and are expressed in 1984 dollars.

The infrastructural changes required for a route via Douglas Park would include:

- provision for an airport express terminal complex at Sydney Terminal station;
- provision of two additional electrified tracks on the Illawarra Line between Erskineville and Sydenham over a distance of 3 km;
- provision of two additional electrified tracks on the East Hills Line between Tempe and Kingsgrove (6 km) with a suitable junction with the Illawarra Line between the Meeks Road and Wolli Creek junctions;
- duplication of the Maldon—Dombarton single track electrified freight line from Maldon Junction to Wilton Loop for 8 km;
- construction of a 4 km double track electrified spur to the airport plus the provision of a two track terminus.

The Main Southern Line would already be electrified from Glenlee to Maldon Junction, so that probably no special measures for airport express trains would be needed.

For the Wilton via Appin route these infrastructural changes would comprise:

- provision for an airport express terminal complex at Sydney Terminal station;
- provision of two additional electrified tracks on the Illawarra Line between Erskineville and Sydenham over a distance of 3 km;
- provision of two additional electrified tracks on the East Hills Line between Tempe and Kingsgrove (6 km) with a suitable junction with the Illawarra Line between the Meeks Road and Wolli Creek junctions;

- construction of a 30 km double track electrified railway, possibly to be jointly used by suburban trains south of Campbelltown and airport express trains, with provision for nine or ten suburban stations, one intermediate terminus for suburban trains and a joint three-road terminus at the airport.

The level of service for airport express trains in either direction was assumed to be as follows:

- four trains per hour for two peak hours in the morning and two in the evening;

- two trains per hour for the balance of fourteen hours of a working railway day (say, 0600-2400 hours).

It is estimated that eleven four-car interurban-style trains (including one spare) would be required for the level of traffic predicted under the high-rail case on either route.

The identification of rail infrastructure requirements attributable to the airport has been based partly on the assumed nature of the airport express service and on the assumptions concerning future spare capacity in the network. There may be other, as yet unidentified, calls on critical rail capacity that may affect requirements for additional infrastructure but unless that is the case, the infrastructure requirements are fairly insensitive to the level of forecast air traveller, other traveller and employee flows by rail. If travel were, say, 30% less than the level anticipated, the same sized trains would still be needed, but if it were 30% more, then six-car trains would be required. Notwithstanding the levels of rail travel estimated (which lie in the range of rail passenger flows encountered at major overseas airports served by rail), provision of a rail link would be a more major policy issue than provision of the necessary highway infrastructure.

Costs of rail infrastructure requirements

The costs of the rail infrastructure requirements were estimated, including any changes to the established railway network, using a table of unit costs derived from data on current construction costs supplied by the State Rail Authority for two current railway construction projects (the East Hills—Glenfield Railway and the Maldon—Dombarton Railway).

The resulting schedule of infrastructure and rolling-stock costs for both alternatives is shown in Table 15.4.9. On the basis of the assumptions made about rail capacity, total costs of infrastructure and rolling-stock for the Douglas Park route would be about $85 million or about $144 million, depending on whether or not the costs of the additional tracks between Tempe and Kingsgrove and between Erskineville and Sydenham (which would be used by other services also) are included. For the Appin route, total infrastructure and rolling-stock costs would be about $54 million, about $113 million, or about $237 million, depending on the inclusion of the cost of facilities also used by other services.

Appraisal of rail access options

Capital costs are only one of several factors that might determine the choice between rail access options. The alternative routes for the proposed Wilton airport site would affect the suburban development of the Macarthur area. The route via Douglas Park would pass skirt development and would only function as a through route to the airport. The route via Appin, roughly 5 km shorter, could form an integral part of a new suburban rail route south of Campbelltown through the developing South Macarthur area. If this were so it would form a major means of access for airport employees in one direction and a major means of access for journey-to-work movements from Macarthur to points as far north as Sydney and Parramatta city centres. On the basis of trial estimates for potential suburban rail patronage prepared by the State Transport Study Group for the Sydney Urban Expansion studies it could carry 41,000-47,000 airport and other passengers per day.

Table 15.4.9 Schedule of infrastructure and rolling-stock costs for the alternative routes to Wilton

Cost item	Costs ($million) by route				
	Via Douglas Park		Via Appin		
	Joint airport and freight line, and excluding shared facilities*	Joint with freight line; otherwise wholly attributable to airport	Excluding new suburban line and other shared facilities*	excluding new suburban line but otherwise wholly attributable to airport	Wholly attributable to airport
Airport terminus	2	2	2	2	2
Spur to Wilton Loop	9	9	-	-	-
Additional track, Maldon Junction—Wilton Loop	22	22	-	-	-
New line, Macarthur—Appin—airport	-	-	-	-	124
Additional two tracks, Tempe—Kingsgrove	-	46	-	46	46
Additional two tracks, Erskineville—Sydenham	-	13	-	13	13
Sydney Terminal station	4	4	4	4	4
Total infrastructure	37	96	6	65	189
Rolling-stock (11 trains)	48	48	48	48	48
Total rail requirements	85	144	54	113	237

* That is, facilities shared with other passenger traffic.

Other factors relevant to the appraisal of the rail options are operating costs (represented largely by train hours per day, and carriage kilometres per day), travel time, and numbers of air passengers likely to be attracted. Table 15.4.10 is an overall comparison of the two options. On all criteria except the important attributable capital cost item, Appin is the superior option. However, as the capital costs are sensitive to future capacity being available, and as the differences on some items are not sufficiently significant to ensure that the relative merits of the two routes might not be reversed in the future, there is an argument for keeping both options open.

Table 15.4.10 Comparison of the rail options for Wilton

Item	Via Douglas Park	Via Appin
Minimum attributable capital costs,	$m 85	$m 54
Maximum attributable capital costs,	$m 144	$m 237
Train hours per day	105.6	99.7
Carriage km (thousands per day)	28.5	26.8
Air passenger rail trips (thousands per day)	15.6	15.8
Air passenger rail hours (thousands per day)	22.9	22.1
Average end-to-end duration of trip (hours)	1.5	1.4
Average end-to end length of trip (km)	85.1	80.1

Necessity of rail access

While the provision of adequate road access arrangements is essential to the operation of an airport, this is not necessarily the case with rail access; many international airports, including all those in Australia, are without direct rail access. A decision to provide rail access would need to take account not only of the airport-related access issues discussed here but also of operational considerations relating to the rail system as a whole. A decision could be many years off.

15.4.7 Comparative travel times to the airport

With or without rail access, the adequacy of ground access arrangements discussed above depends primarily, though not exclusively, on travel times between the airport and passengers' groundside origins or destinations. Figure 15.4.9 shows isochrone diagrams for peak hour travel to and from the airport by road and rail. These travel times are for end-to-end duration of the trip ('door to door'), and enable an assessment of the comparative accessibility of different parts of the Sydney Region by road and rail from the airport. On the basis of the assumed distribution of air passengers' groundside origins and destinations, overall average travel times in peak hours (end-to-end trip duration) for air passengers would be as follows:

- by road — 102 minutes
- by rail via Douglas Park — 88 minutes
- by rail via Appin — 84 minutes.

Overall, and on the basis of the assumed distribution of air passengers' groundside origins and destinations, a conventional rail link could provide access times comparable to those achievable by road. However, as the comparative rail and road travel times vary from area to area, so would the overall average travel times for all passengers vary according to any differences in the future distribution of groundside origins and destinations from that assumed above.

Concentrated distribution
With a more concentrated distribution, with more groundside trips beginning or ending in the city centre, rail would be significantly faster than road for the majority of travellers. This is evident from a consideration of the travel times between city and airport, which would be as follows:

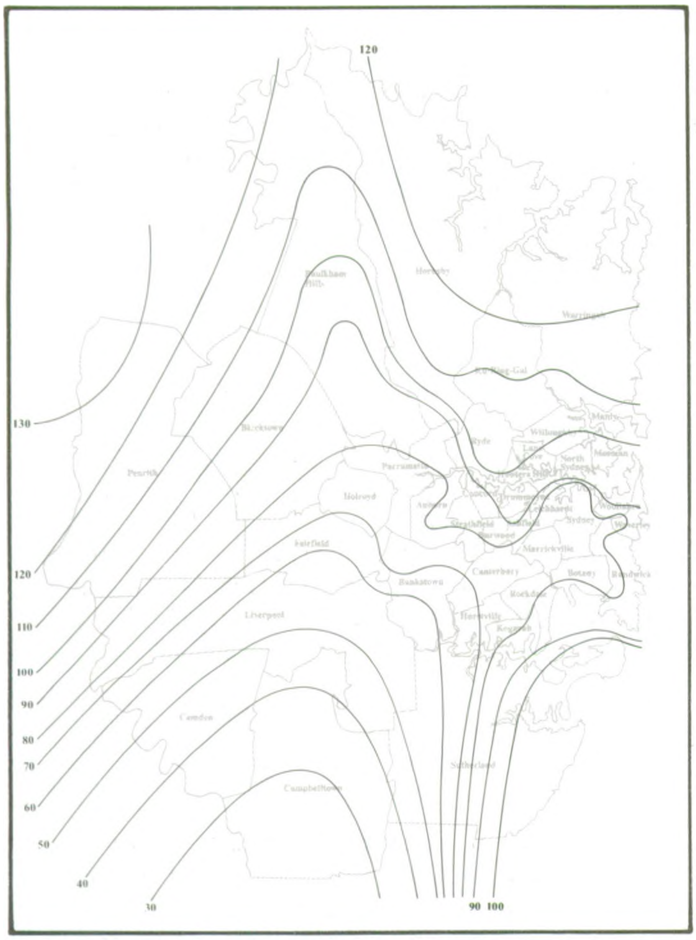
- by road — 104 minutes
- by rail via Douglas Park — 77 minutes
- by rail via Appin — 72 minutes.

A more concentrated distribution of groundside origins and destinations would most likely arise if a higher proportion of air passengers were visitors than the present 59%. Visitors (other than those visiting friends and relatives) would also be more dependent on public transport, and rail patronage by air passengers would be higher for this reason.

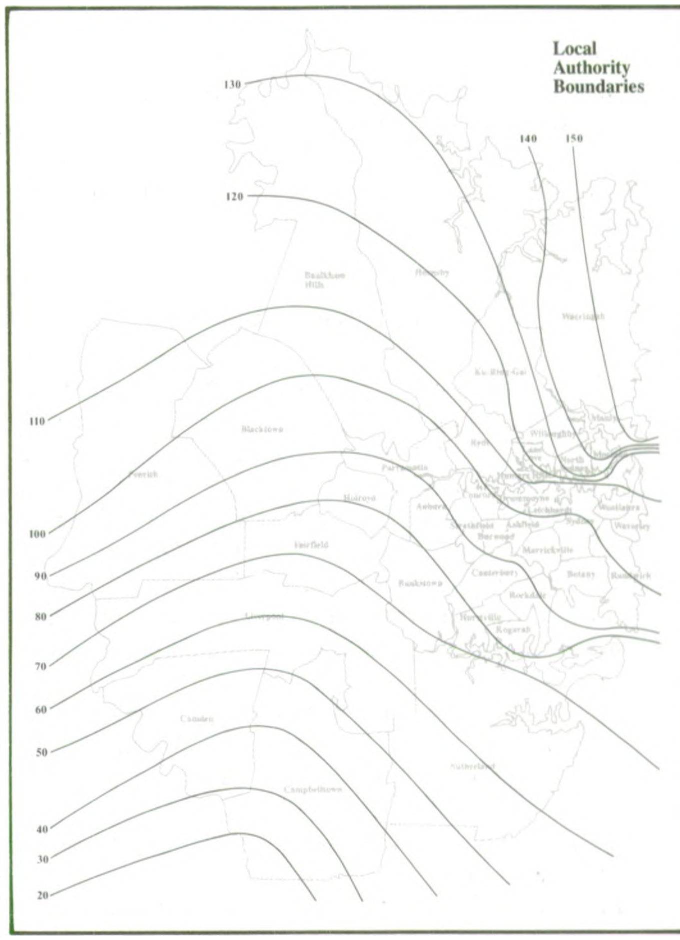
Dispersed distribution
On the other hand, a more dispersed distribution of groundside origins and distributions might well arise if a higher proportion of air travellers using the airport were Sydney residents than at present. In this situation, overall average travel times by road would be less than by rail, and rail patronage by air travellers would overall be less.

High speed ground transport
Several high speed systems have been suggested for access to a second Sydney airport. These include:

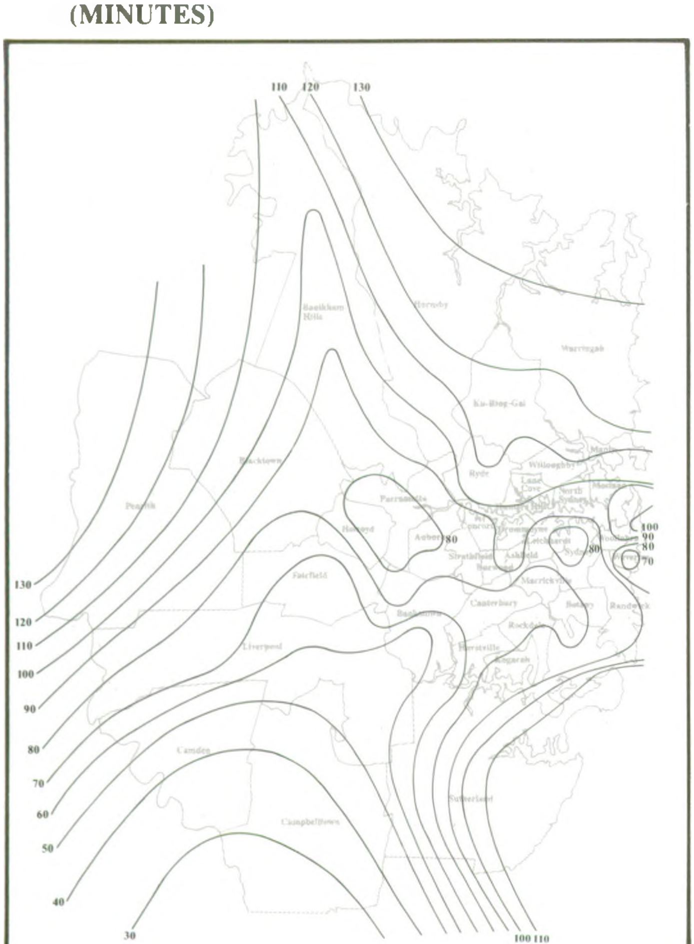
- high speed roads
- XPT-type train services



WILTON VIA APPIN RAIL TIMES (MINUTES)



WILTON ROAD TIMES (Minutes)



WILTON VIA DOUGLAS PARK RAIL TIMES (MINUTES)

Figure 15.4.9 ESTIMATED FUTURE TRAVEL TIMES WILTON

- a Trans-rapid Maglev System
- the high speed railway scheme recently put forward by CSIRO.

While the analysis of airport access in this Draft Environmental Impact Statement has assumed conventional transport systems, the conclusions are not likely to be significantly affected by the possible introduction of high speed road or rail systems. The reasons are as follows:

- even when fully developed, a second Sydney airport would not by itself generate sufficient groundside traffic to justify heavy capital investment in a high speed rail or road route;

- even if a high speed rail or road route could be justified on wider economic grounds it would only benefit a proportion of air travellers according to the location of their groundside origins or destinations (for example, if a high speed rail service made no stops between the city centre and the airport, only about two-thirds of those air travellers using the service would have significantly faster travel times);

- comparative travel time is only one of a number of factors affecting an air traveller's choice between rail and road access modes, other factors being whether or not the traveller is being met, whether he or she has a vehicle in Sydney, is travelling alone or accompanied, can afford a taxi, has a lot of baggage, and what his or her attitudes are to public transport. If feasible, high speed road and rail access systems would certainly save time for many air travellers.

However, taking the distribution of groundside origins and destinations into account, the improvement in the overall average ground travel time of air passengers would be perhaps several minutes, and at a substantial cost, which would be borne in part by the air traveller.

15.5 INFRASTRUCTURE AND ENERGY CONSUMPTION

This section gives an account of existing infrastructure that would be affected by selection of the Wilton site for airport development, and describes in general terms the infrastructure and energy resources that would be needed to support a second airport. The assessment of effects associated with specific infrastructure proposals would require further investigation once the sites or routes for these facilities were determined

Information for this section has been obtained from the Electricity Commission of New South Wales, the Australian Gas Light Company, the Metropolitan Water Sewerage and Drainage Board, Telecom Australia, the Metropolitan Waste Disposal Authority and the Department of Mineral Resources. The Department of Aviation, and commercial suppliers of electricity, gas and other services have provided information on energy and fuel consumption at Kingsford-Smith Airport, as a guide to requirements at a second major airport.

Figure 15.5.1 shows the location of various infrastructure services in relation to the proposed site.

15.5.1 Electricity

Existing service

At present several electricity supply lines traverse parts of the proposed site. The major one is the Sydney West—Avon 330 kV transmission line which crosses a 2 km section of the site along a north/south ridge between Cascade Creek and Wallandoola Creek. This is a major link in the Electricity Commission's interconnected high voltage system,

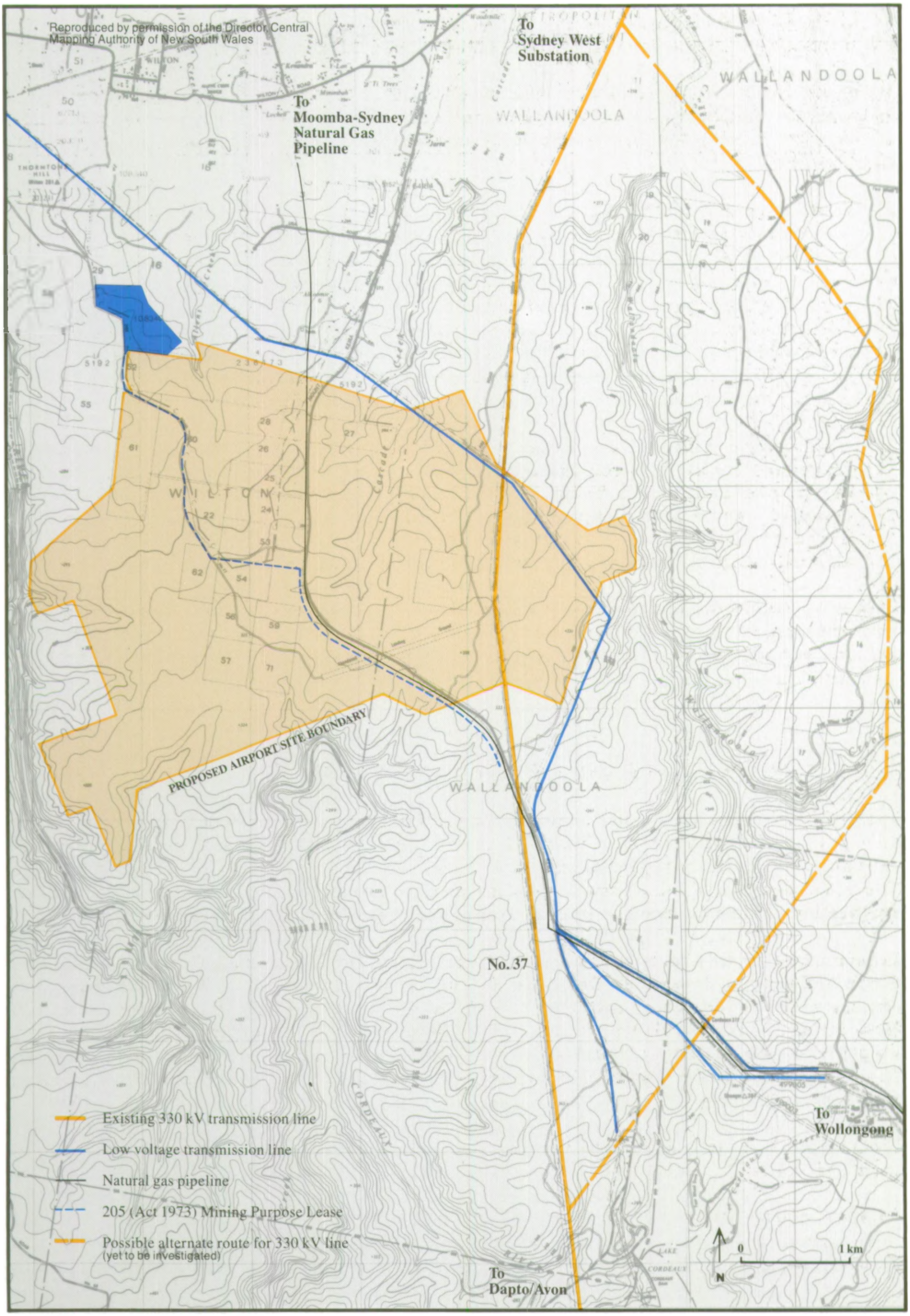


Figure 15.5.1
INFRASTRUCTURE

NOTE: Proposed Kemps Creek to Marulan area (alternative) 500 kV line not located on this map but parallels approximate line of F4 South Western Freeway (Hume Highway) to the west of the proposed airport site.

transmitting bulk energy to the south and south-west regions of the State. The other is a low voltage power line traversing the north-eastern section of the site for a distance of about 2.5 km.

Proposed service

If a second airport were to be located on the site, both these lines would need to be relocated. The major line could be moved to the east of the ravine formed by Wallandoola Creek. The Department of Aviation would advise the Electricity Commission as soon as a decision on a second Sydney airport site had been made so that, if Wilton were selected, planning and design of the relocated route could begin as early as possible, and so avoid unnecessarily disrupting bulk power supplies to the south and south-west of the State.

The low voltage power line could be relocated within the service easement that would run parallel to the proposed new route of the Mount Keira Road. Part of the line might have to be placed underground to keep it below the operational clearance levels required in the vicinity of the runway approach paths.

The disconnection and removal of existing domestic and industrial supply lines within the site would not be expected to cause any major disruption to power supplies and would be undertaken in conjunction with the relocation of the present land owners.

The Electricity Commission is investigating the possibility of replacing a number of lower capacity lines to the south and south-west of the State with a 500 kV transmission line linking its Kemps Creek substation with a proposed 500 kV substation in the Goulburn—Marulan—Burraby area. The proposed location of this line is unlikely to be affected by the operation of an airport at Wilton, although detailed design work would be necessary to confirm that the final alignment and height of the towers were compatible.

The Electricity Commission often equips its power lines for transmitting control signals and associated conversation, and this could affect the operation of some navigational aids proposed for the airport. The final positioning of the relocated transmission lines and of the navigational aids would therefore need to be considered jointly, in order to avoid such potential conflict.

15.5.2 Gas

At present a 4 km section of the Australian Gas Light Company's natural gas supply line passing between Wilton and Wollongong traverses the proposed site, and would need to be relocated within the service easement beside the rerouted Mount Keira Road. This work would be phased in with airport construction so that gas services were not unnecessarily disrupted.

15.5.3 Water supply

The proposed site is in an area not presently served by a reticulated water supply nor scheduled to receive one in the near future. The provision of a water supply for a future airport and adjacent development would therefore require the construction of a new system consisting of a water treatment plant, pumping station and water mains. The source of supply would be the Cataract River at Broughtons Pass. The possible maximum water requirements for a second airport hservoirs with Sydney's water supply system. Thave been assessed by assuming that development at the site would be similar to that at Kingsford-Smith Airport, except that facilities for major aircraft maintenance and large-scale catering are not likely to be provided there. Requirements for tourist, transport, warehouse and light industrial developments adjacent to the airport have been assessed as equivalent to those for a population of 10,000 people.

On this basis, the airport would use an average of 3.8 ML of water per day, with a maximum consumption of 9 ML/d and a maximum peak-hour consumption of 0.75 ML; the adjacent development would require an average of 6 ML/d, with a maximum consumption of 11 ML/d and a maximum peak-hour consumption of 0.83 ML. Special storage on the proposed site would be set aside for water that might be needed for fighting fires.

Facilities needed to serve a future airport and adjacent development would include:

- a pumping station at river level at Broughtons Pass;
- a water treatment plant and pumping station on a site above the river;
- a reservoir on high land close to the airport site;
- rising mains between the pumping stations, water treatment plant and reservoir.

The airport supply would be taken off by a connection to the rising main where it passed the site.

The rising main would be constructed for most of its length within cleared land. However, part of the route would ascend the steep slope on the side of the Cataract River at Broughtons Pass where there is the potential to cause long-term scarring up to 10 m wide along this section of pipeline; re-establishment of vegetation in this area would therefore be necessary to prevent erosion.

Another part of the route would be through wooded terrain where construction would cause short-term disturbance. A service road would be constructed alongside the rising main for access to the water treatment works, pumping stations and reservoir.

The Metropolitan Water Sewerage and Drainage Board has indicated that it would need to be provided with the financial or material resources to design and construct these facilities, because its own resources are fully committed in servicing areas to be released under the New South Wales Government's Urban Development Program. As soon as a decision had been made on construction of a second airport, arrangements would therefore need to be agreed on between the Commonwealth and the State, to enable adequate and timely provision of such services.

15.5.4 Sewerage

No sewerage facilities are located within the Metropolitan Catchment area of the proposed site. The only freehold property on the site is not connected to a reticulated sewerage system but uses on-site land disposal methods to treat household effluents.

As there are currently no sewage treatment schemes in the vicinity of the site and none is scheduled under short to medium-term urban development proposals, a new sewerage facility would be needed. A site for this facility might have to be selected at some distance from the airport if it were to serve both the airport and the surrounding development.

The plant would have to be constructed in stages, and the size of each stage and of the total plant would depend on the rate of airport development and of the surrounding areas that might be served by the same plant. Neither of these factors can yet be assessed, nor is it possible at this time to estimate effluent quantities. However, if it were ultimately sized for the maximum capacity of the airport (the worst case), and for the development in surrounding areas, then the equivalent population capacity of the plant would be 30,000, including 10,000 equivalent population for development in areas surrounding the airport.

While there is no definite proposal at this stage, it is assumed that treated effluent would be discharged into Allens Creek. An alternative or supplementory method of disposing of treated effluent would be to use it as needed for irrigation purposes rather than discharging all of it into the river system. This method would also be considered, particularly if the water pollution control plant were located within the airport site and served only the airport development.

15.5.5 Telecommunications

Existing service

Existing services traversing the site would be disconnected and removed.

Proposed facilities

If an airport were constructed on the proposed site, more telecommunications facilities would be needed in the area to deal with the increased amount of telecommunications traffic and ensure that it did not disrupt existing services. However, because of the rapid changes being made in telecommunications technology, little is known about the type of facilities that would suit a future airport. There is some speculation that cable easements would not be required, as communication dishes and satellites would be used instead. However, if such easements were required, it is expected that they would be incorporated within existing road corridors.

15.5.6 Waste disposal

Existing infrastructure

There is a 6 m wide easement, registered under a Mining Purpose Lease MPL 205, traversing the proposed site. It carries a water pipe used to transfer wastewater from the Cordeaux mine pit-top facilities, located some 6 km to the south-east of the proposed site and within the Metropolitan Catchment, to an area of about 35.5 ha outside the catchment and adjacent to the north-western boundary of the proposed site, where the wastewater is disposed of by spray irrigation.

This pipeline would have to be relocated, as would the present disposal site, as the latter would be affected by the proposals for an access road. The pipeline could be placed within the service easement that would parallel the relocated Mount Keira Road and a site further along this road would need to be prepared to dispose of the wastewater from the mine.

Proposed facilities

The second airport at maximum development would generate about 16,000 m^3 of solid waste weekly, which would be disposed of in regional sites operated by the Metropolitan Waste Disposal Authority.

15.5.7 Energy consumption

The energy requirements of a second airport cannot be accurately estimated at this stage, but it is possible to provide some indication based on past and present consumption of electricity, liquid fuel and gas at Kingsford-Smith Airport (Table 15.5.1).

As the proposed site is close to electricity and gas services, no major extensions to the existing infrastructure would be required. Diesel and petrol could be transported by road from either Sydney or Wollongong or by the proposed rail link from Sydney to distribution facilities at the site. The tranport of fuels to the site by road or rail would comply with the provisions of the Dangerous Goods Act, 1975, and these should preferably come from Sydney to avoid transporting large quantities of fuel through the Metropolitan Catchment.

Table 15.5.1 Energy and fuel consumption at Kingsford-Smith Airport

Component	Consumption					
	Domestic	International	Department of Aviation	Maintenance and cargo facilities	Miscellaneous	Total
Electricity (kW.h) July 1983-July 1984	13,690,393 262,307*	5,725,017	21,133,785	42,950,142	596,043	84,357,687
Gas** (MJ) Dec. 1983-Dec. 1984	14,800,000	n.a.	49,348,000	n.a.	n.a.	64,148,000
Aviation fuel (L) Jan. 1984-Jan. 1985	192,733,802+	560,681,399	n.a.	n.a.	n.a.	753,415,201
Vehicles Diesel fuel (L) Jan. 1984-Jan. 1985	253,217	500,000	105,558	n.a.	n.a.	858,775
Petrol (L) Jan. 1984-Jan. 1985	972,497	752,000	201,358	n.a.	n.a.	1,925,855

* Separate consumption for general aviation.
** Does not include 186,790,000 MJ consumed by Qantas Cookhouse.
\+ Includes fuel for general aviation.
n.a. Not applicable.

15.6 LANDSCAPE AND VISUAL QUALITY

This section discusses the results of the assessment made of the landscape character and relative visual quality of the proposed site. The method of assessment is based on that developed by the United States Department of Agriculture's Forest Service (1974) and modified by the Department of Environment and Planning (1981). It involves the identification of topographic units within the proposed site (as the determinants of landscape character), and the evaluation of their relative visual qualities based on generally accepted community visual preferences or responses. However, it is recognized that individual response to the visual quality of a landscape is subjective and, in some instances, might differ from this generalized assessment.

The landscape character of a site can be described in terms of the landform (terrain/topography), land cover (vegetation type and land use), and water form (drainage). In expansive landscapes, particular landscape zones can also be identified, such as a coast zone, mountain region or plateau. The visual quality of these landscape features when compared with the surrounding region can be categorized as follows:

- distinctive (unusual and superior);
- common (ordinary and widespread);
- minimal (inferior).

15.6.1 Landscape features

The proposed site is contained within a single landscape zone, although it comprises a number of different landforms: the most predominant and common of these are the plateau and slope features, which cover about 70% of the site. Eucalypt vegetation covers over 90% of the site. Previous European occupation is evidenced by an old abandoned airstrip and by previously cleared areas which had been used for farming. Parts of the northern portion of the site which had been cleared and which are not within the Metropolitan Water Catchment are still used for farming.

The site contains about 14 km of stream and creek channels, of which about 80% are in minor drainage swales. The most significant of the channels occur along Allens and Cascade creeks. There are also a number of artificial farm dams or small water storages on the site. All creeks are either intermittent or contain a small flow of water which is charged by groundwater seepage.

15.6.2 Visual quality

Seven viewing points from which to observe the site were selected for analysis to determine the important elements contributing to the visual landscape character (Figure 15.6.1). These viewing points were analysed with respect to the following criteria:

- observer position
- dominant distance relationships
- form and contrast
- spatial definition
- landscape composition types.

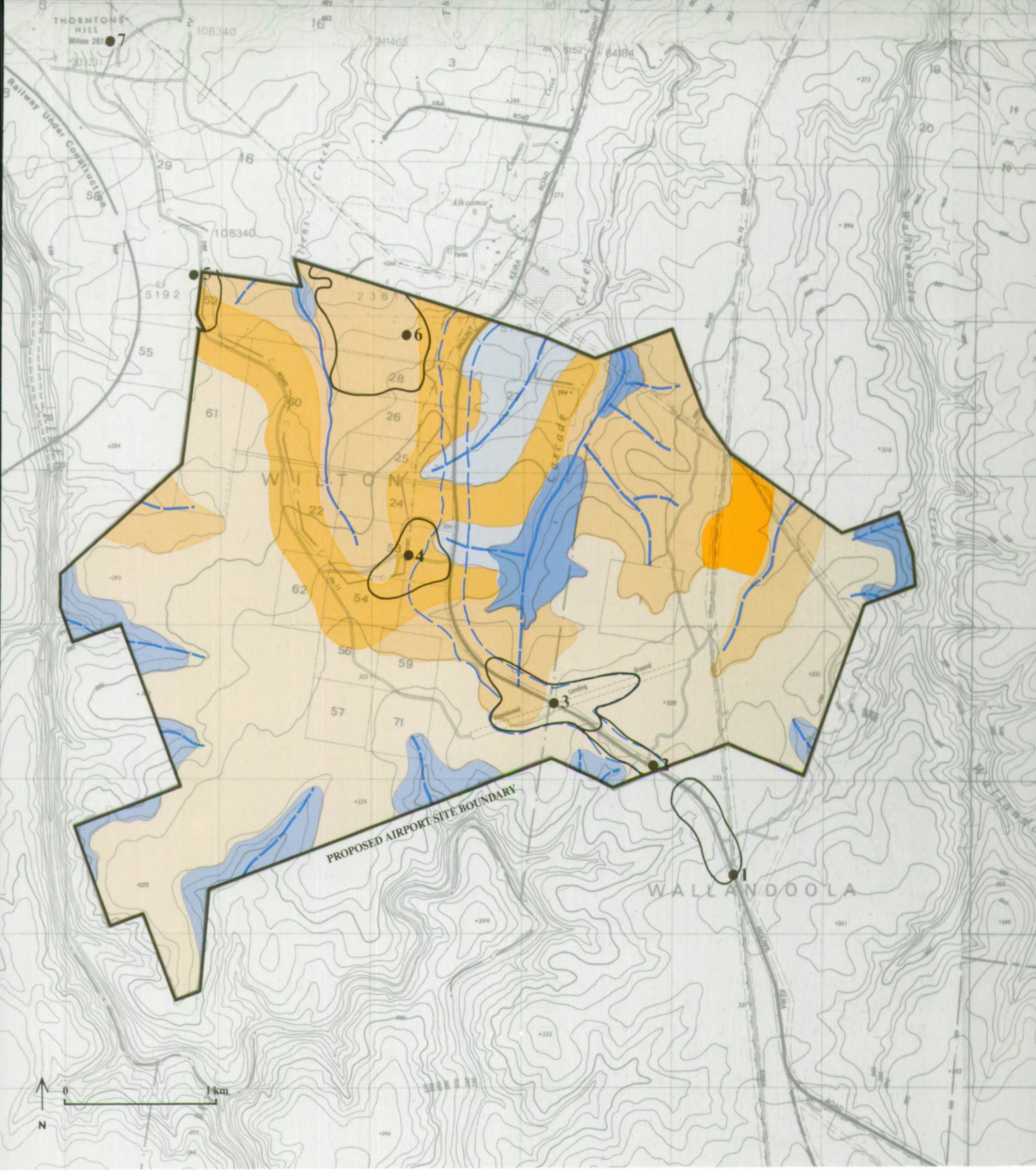
The viewing points were selected because of some distinctive feature, such as high ground or varied landscape components, in order to obtain a representative sample of the site's visual elements. The visual catchments of these viewing points and that of Mount Keira Road, which passes through the site, were then mapped.

Five of the six viewing points give the observer a level view. This reflects the relatively flat nature of the terrain and the fact that the major portion of the landform is classified as plateau. Most of the views are enclosed by the forest and understorey vegetation, with the maximum distance of any view within the site being about 1 km (Viewing Point 3). The majority of viewing points give only short views of up to about 0.5 km.

It is not possible to obtain foreground or middle ground views of the proposed site from public areas in the general vicinity. This is mainly because the site is surrounded on three sides by water catchment areas to which public access is prohibited. The only area outside the site from where immediate views of the site can be obtained is from private property in the vicinity of Thorntons Hill (Viewing Point 7). Around the Razorback Range there are areas where the site can be seen from a distance of about 12-14 km, but access to these points would also be restricted because of private land ownership. However, the significance of these viewing points is low, as they are some distance away and are at about the same elevation as the site.

Figure 15.6.1 shows the classification of landscape features and their visual quality based on the analysis of the views from these six viewing points and an assessment of the proportion of each landscape feature within the proposed site. The site is located in a plateau landscape which is common throughout the surrounding region. This plateau is incised by deep gorges and punctuated by small hills. While the gorge landscape features would be classified as 'distinctive' in what is otherwise a very 'common' landscape, more distinctive landscape features occur to the north (Razorback Range) and west (Burragorang Valley and Mandemar Range) and these would be unaffected by airport development. There is, however, a small portion of high ground on the eastern side of the proposed site between Wallandoola Gorge and Lizard Creek which might require selective clearing of forest vegetation in order to maintain the required approach path clearance surface. This would involve an area of about 25 ha. Table 15.6.1 summarizes the site's landscape character.

From the information in Table 15.6.1 and the analysis of the landscape from the selected viewing points, it is clear that the proposed site does not contain any significant or prominent features that can be viewed from public roads in the area. Over 80% of the site is classified as being of minimal landscape or visual quality. The only distinctive landscape and visual features consist of a small part of Cascade Creek and a small section of escarpment on the eastern boundary which forms part of the Wallandoola Gorge. However, these cannot be seen from any public road and occupy only about 5% of the site.



Landscape character			Visual quality
Landform	**Waterform**	**Landcover**	
Valleys and	Creeks	Vegetation, rock	Distinctive
Swales	Creeks	Vegetation, rock	Common
Ridge	—	Vegetation	—
Slope	Drainage swales	Vegetation	—
Ridge	—	Vegetation, pasture	Minimal
Slope	Drainage swales	Vegetation, pasture	—
Plateau	—	Vegetation	—

VISUAL CATCHMENTS

- Mount Keira Road
- ●1 Location of viewing point
- Visual catchment from viewing point

Figure 15.6.1
LANDSCAPE CHARACTER AND VISUAL QUALITY

Table 15.6.1 Landscape character of the site

Landscape feature			Visual quality	Proportion of site	
Landform	Water form	Land cover		Hectares	%
Valleys and swales, 30 m elevation range	Creeks	Vegetation, rock	Distinctive Common	70 115	5 8
Ridges, 10 m elevation range		Vegetation	Common	20	1
Sloping and undulating, 50 m elevation range	Drainage swales	Vegetation	Common	60	4
		Partially vegetated, grazing land	Minimal	360	25
Plateau, 50 m elevation range		Vegetation	Minimal	180	13
Ridges, 40 m elevation range		Vegetation pasture, grazing land	Minimal	635	44

15.6.3 Future built form

The preliminary master plan for the future airport (Figure 8.3) comprises two widely spaced runways, one 2,500 m long and the other 4,000 m long, with associated approach lighting and taxiways. The runways are spaced 1,660 m apart, with the area between reserved for passenger terminal development, car parks and airport apron areas. A limited number of sites would be available for commercial development, such as hotels and other airport related services. Separate areas for freight handling, aircraft maintenance and general aviation would be provided outside the area between the two runways. The master plan also incorporates areas for additional facilities located around the perimeter of the site, including navigational aids, control tower, fire stations and fuel storage and distribution facilities.

Most structures would have a relatively low profile to avoid creating height obstacles in the operational airspace around the runways. The tallest structure would be the control tower.

15.6.4 Assessment of impacts and safeguards

As the current management practices relating to the protection of the Metropolitan Water Catchment would be continued until airport construction began, maintenance of the present landscape and visual quality of most of the site would be ensured. The small portion of land that is privately owned could also be maintained in its present condition if there were no changes to the present land use; otherwise it might revert to a semi-natural condition until the construction phase.

During construction, most of the site would be cleared of vegetation and of existing structures, and earthworks would level much of the high ground. To minimize the visual effects of site clearing and development during the construction phase, the following measures would be adopted:

- wherever possible a screen of vegetation would be provided or maintained around those parts of the site perimeter from which major site clearing and construction would be visible to the public;

- rehabilitation and landscaping of disturbed areas would be undertaken within the framework of the construction schedule.

The site's landscape and visual character would be irreversibly altered by airport construction, as it would be transformed from its present largely natural vegetated form to one that had marked linear and block built forms surrounded by areas of natural landscape to the east, west and south. These forms would dominate the landscape when viewed from the air, but would be made aesthetically acceptable when viewed from ground level by careful design and extensive landscaping and tree planting around major buildings and car parks. During the operational phase it might be necessary to selectively clear vegetation impinging on the required approach path clearance surface about 2 km from the eastern end of the long runway. However, the effect of this is considered to be minimal, as it would involve only a small area of land and this would not need to be totally cleared of all existing vegetation.

CHAPTER 16
The Biological Environment and Effects of the Proposal

Introduction

This chapter describes the flora and fauna at the proposed site, assesses the impact of site acquisition and airport development, and outlines environmental safeguards and monitoring proposals.

The assessment described here was made before the bushfire of 2-6 March 1985, the effects of which are described in Section 12.3. However, the fire is not expected to produce any significant long-term impact on the flora or fauna of the proposed site, and the assessment made here is not invalid as a result of the fire.

16.1 FLORA

The proposed airport site at Wilton consists largely of relatively undisturbed native vegetation of high floristic value. An assessment of the site and its close environs was carried out in order to:

- determine what types of vegetation were present and map their occurrences;
- determine what plant species were present;
- assess the conservation status of the vegetation types and the various species;
- assess the impact of the proposed acquisition and of future airport development on the native flora of the area;
- indicate appropriate measures to safeguard the flora or to mitigate the impact;
- identify the need for further studies or monitoring programmes.

After inspection of aerial photographs, geological and topographic maps, a reconnaissance schedule was drawn up to ensure that a representative range of vegetation types was visited. Transects were conducted accordingly, and species and communities present were recorded. Based on field notes and computer classification of the floristic data, a list of vegetation types was derived and their occurrences were mapped using the field notes and interpretation of aerial photographs. A two-way table of frequency of occurrences of plant species in the vegetation types was compiled with the aid of a computer.

The conservation status of vegetation types and plant species was assessed in consultation with the National Herbarium of New South Wales, and by using published information from references such as Benson (1980), Jacobs and Pickard (1981), Leigh et al. (1981), Beadle et al. (1982), and Keith (1984), and unpublished species lists.

16.1.1 Description of existing flora on the proposed site

In the following description the main emphasis is on the proposed airport site itself, shown in Figure 16.1.1, but consideration is also given to adjacent areas, such as the Allens Creek valley, that would be affected by the airport development.

Much of the area lies within a proclaimed water catchment and carries native vegetation in more or less undisturbed condition, as evidenced by the large number of native plant species present: about 350 species were located. The floristic value of the site is heightened by the inclusion of a remnant stand of open forest developed on ridge-top shales of the Wianamatta group, and is further enhanced by the fact that most of the original vegetation of this geological unit in the region has been cleared for agricultural uses.

Vegetation types

Five vegetation types were recognized on the proposed site, on the basis of inspection and computer analysis. The distribution of the types is shown in Figure 16.1.1 and comprehensive species lists for each type are provided in Appendix K.

- **Type 1: swamp—wet heath:** Areas with a permanently or intermittently elevated water-table occur along drainage lines on sandstone plateaux and here the vegetation may be heath or sedgeland; shrubs such as Baeckea diosmifolia, Melaleuca thymifolia, Banksia robur and B. paludosa and sedges such as Empodisma minus, Baumea rubiginosa and Chorizandra cymbaria are common. Many of these occurrences are too restricted to map but the most extensive examples are shown in Figure 16.1.1.

- **Type 2: scribbly gum woodland:** The broad sandstone ridges and plateaux carry woodland dominated by various mixtures of Eucalyptus sclerophylla (a scribbly gum), E. gummifera (red bloodwood) and E. oblonga (a stringybark); E. sieberi (silvertop ash) may also be present. East of the proposed site, E. sclerophylla is sometimes replaced by E. haemastoma (another scribbly gum). The trees are about 10-15 m tall and of woodland form, i.e. branching from below half height. The canopy is open and there is a dense shrub understorey containing species such as Leptospermum attenuatum, Eriostemon australasius, Banksia spinulosa and Grevillea mucronulata. Graminoids (grasses and grass-like plants) include Entolasia stricta, Cyathochaeta diandra and Lomandra obliqua. The distribution of scribbly gum woodland is shown in Figure 16.1.1.

- **Type 3: peppermint woodland:** On sandstone hillsides, particularly those with a southerly or easterly aspect, scribbly gum woodland (vegetation type 2) grades into slightly taller woodland or open forest dominated by Eucalyptus piperita (Sydney peppermint), E. punctata (grey gum) and E. sieberi (silvertop ash); E. gummifera (red bloodwood) and E. agglomerata (blueleaf stringybark) also occur. The dense shrub layer contains Acacia terminalis, Banksia serrata, B. spinulosa, Grevillea mucronulata and many others. Commonly occurring graminoids include Lomandra longifolia and Schoenus melanostachys. Distribution is shown in Figure 16.1.1.

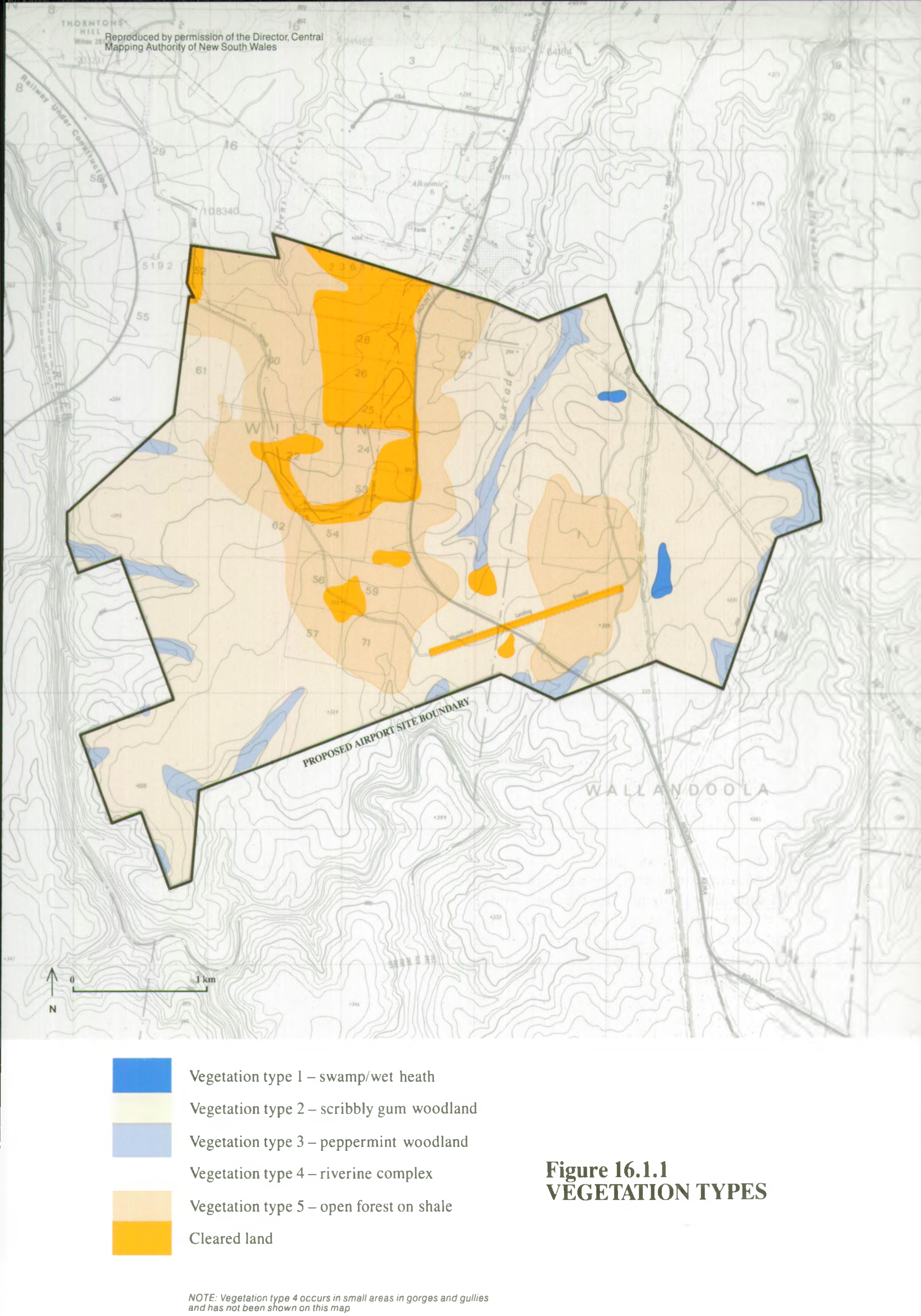


Figure 16.1.1
VEGETATION TYPES

- **Type 4: riverine complex:** Peppermint woodland extends to the banks of open streams; in more enclosed valleys and gorges, however, stream margins carry a distinctive vegetation type, the composition of which depends on the degree of enclosure. In very confined gorges, vegetation of simplified rain forest form occurs. Trees present may include Eucalyptus saligna (Sydney blue gum), E. elata (river peppermint), Callitris muelleri (a native cypress), Tristania laurina (water gum) and Ceratopetalum apetalum (coachwood); E. pilularis (blackbutt) occurs along Allens Creek. Shrubs may include Acacia parramattensis, Backhousia myrtifolia, Bursaria spinosa, Tristania neriifolia, Prostanthera spp. and a Notelea sp. Ferns include Todea barbara (king fern), Cyathea australis (a tree fern), Pteridium esculentum (common bracken) and Blechnum cartilagineum. Since this type occurs only in gullies and gorges, it has not been possible to map its distribution.

- **Type 5: open forest on shale:** On ridges with a capping of Wianamatta shale, scribbly gum woodland grades into a taller community, with trees about 30 m tall and of forest form, i.e. branching only in the upper half of their height. Trees may include E. globoidea (a stringybark), E. paniculata or E. crebra (ironbarks) E. pilularis (blackbutt), E. longifolia (woollybutt), E. resinifera (red mahogany) and E. punctata (grey gum); E. gummifera (red bloodwood) occurs in the transition zone. Shrubs are few, the understorey generally comprising forbs and graminoids such as Dianella spp., Helichrysum spp., Lomandra spp. and Wahlenbergia spp.

Significance of the vegetation types

The vegetation types occurring within the proposed site are important in themselves and also as habitats for significant plant and animal species; they also help determine the quality of water draining from the catchment area. The floristic significance of each is discussed below:

- **Type 1: swamp—wet heath:** Examples of swamp—wet heath vegetation are of limited extent and are not known to contain any plant species of particular conservation interest.

- **Type 2: scribbly gum woodland:** Stands of scribbly gum woodland are widely distributed and in good condition, apart from minor disturbance by mineralogical survey teams and from illegal dumping of cars; similarly well-preserved examples occur in the surrounding catchment area. Several plant species of special significance occur here.

- **Type 3: peppermint woodland:** Stands of peppermint woodland occur along hillsides flanking major watercourses in the area, generally in less accessible locations than those exhibiting scribbly gum woodland and hence even better preserved. Several plant species of particular importance occur here. The surrounding catchment area contains further examples of this type.

- **Type 4: riverine complex:** Riverine complex vegetation occurs in the deeper gorges that fringe the site, for instance in the gorge of the Cordeaux River and its tributaries. Although there are some similar gorges elsewhere in the region the total extent of this vegetation is very limited, and hence its vulnerability to disturbance is probably high. Several important plant species occur in it.

- **Type 5: open forest on shale:** Open forest occurs on shale-capped plateau areas in the centre of the proposed site. The occurrences are in moderately good condition, although some logging has taken place in the past. The stands are readily accessible from public roads and, in consequence, have suffered to some extent from illegal usage; in addition, the fire frequency has probably been somewhat higher than desirable. Despite these incursions, no major weed infestations have occurred.

The type appears to differ significantly from the vegetation on other shale capped ridges in the area. Several of these other stands were inspected, but none contained Eucalyptus pilularis or E. paniculata, two tree species commonly occurring on the proposed airport site. Thus, the site appears to retain one of the last remaining stands of this tree association in the area.

This particular vegetation type has floristic affinities with the E. pilularis—E. saligna forest remnants on Wianamatta Shale in the northern Sydney area, and the ironbark forest remnants of the Cumberland Plain, but has significant differences from both of these.

Plant species present

About 350 species of native vascular plants (ferns, conifers and flowering plants) were recorded, and these are listed in Appendix K.

Significance and conservation status of the plant species

The site is of significant value for the conservation of the flora of the Sydney Region and the State. Many of the plant species are important either because their distribution is restricted or because their occurrence in this area is outside their previously known range. The significance of some particularly important species is discussed below:

- Acacia oxycedrus occurs in vegetation type 3 (peppermint woodland) in the western part of the proposed airport site; few occurrences are known in the southern Sydney region, although it is common on the Hornsby Plateau, including parts of Ku-ring-gai Chase National Park.

- The small shrub Austromyrtus tenuifolia occurs in vegetation type 4 (riverine complex) along the Cordeaux River gorge; it is listed as rare, though not endangered, by Leigh et al. (1981). It is reserved in several national parks in New South Wales.

- The fern Blechnum ambiguum occurs under rock ledges in sheltered gorges of tributary creeks of the Cordeaux River; Leigh et al. (1981) list it as vulnerable, i.e. likely to be threatened with extinction in the future, as it is not considered to be adequately represented in State reserves.

- Bossiaea neo-anglica was collected from vegetation type 3 (peppermint woodland) in the eastern part of the site; in the Central Coast region it was previously known only from the Picton—Thirlmere area.

- The mat-forming prostrate shrub Darwinia grandiflora occurs on sandstone rock platforms along Wallandoola Creek (vegetation type 3); this occurrence may represent its known western limit. It is listed as rare by Leigh et al. (1981), but has the protection of being represented in a proclaimed reserve.

- The small shrub Dodonaea falcata J.G. West occurs in vegetation type 2 (scribbly gum woodland), for instance at the western end of the future airport's northern runway. Previous Herbarium specimens for this species have come only from the Howes Valley area and the Bondi area. It is no longer known at Bondi, but has been recorded in Castlereagh State Forest (D. Benson, National Herbarium of New South Wales, pers. com.). The recorded occurrence of this species on the site represents a significant extension of its known range. It is not known to be present in a nature reserve or national park.

- Epacris coriacea was found in vegetation types 2 and 3 (scribbly gum woodland and peppermint woodland) in the western part of the proposed site. Previous collections in the Herbarium have come from the eastern escarpment of the Woronora plateau, and its occurrence on the proposed airport site represents a western extension of its known range. It is not, however, listed as endangered.

- A form of Grevillea capitellata, which is believed to occur only in the Appin district, occurs in vegetation types 2 and 3 (scribbly gum and peppermint woodland) on the proposed airport site.

- Hibbertia nitida occurs in vegetation types 3 and 4 (peppermint woodland and riverine complex) in various parts of the proposed site, and these occurrences mark the south-western limit of its known distribution. It is listed as rare by Leigh et al. (1981); it is, however, represented in a proclaimed reserve.

- Leucopogon amplexicaulis occurs in vegetation type 3 (peppermint woodland) in the eastern part of the site. It is listed as rare by Leigh et al. (1981); it is, however, known to occur within State reserves.

- Lomandra fluviatilis was noted near Wallandoola Creek; this occurrence probably represents a slight south-west extension of its known range. It is listed as rare by Leigh et al. (1981); it is, however, known to occur within a proclaimed reserve.

Perceived trends in the absence of airport development

Provided the Metropolitan Water Sewerage and Drainage Board continues to control the area and manage it as at present, changes to the vegetation should be slow and of limited extent. Frequent hazard-reduction burning might bring about a simplification of the shrub layer; activities associated with the assessment and extraction of coal deposits would have some impact just as they have had in the past; and accessible ridge-tops would continue to suffer illegal usage.

16.1.2 Assessment of effects and safeguards

This discussion is confined to assessment of the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further investigation once the locations for these facilities were determined.

No adverse effects on the flora are envisaged specifically as a result of land acquisition, so long as present land management practices continue; however, if any break occurred in the continuity of management, resulting in increased public access to the site, rapid deterioration of ridge-top areas, including the open forest on shale plant community, could be expected as a consequence of activities such as rubbish disposal, dumping and stripping of motor vehicles and the use of off-road vehicles.

Construction and operation of the future airport would have serious effects, both direct and indirect.

Direct effects

Airport construction would result in the clearing of the vegetation cover from the site and hence would destroy most, if not all, occurrences of the five vegetation types located within the site, all of which are of floristic value, and would thereby also reduce available habitat for many important plant species, including six that are classified as rare. Loss of the riverine complex vegetation (type 4) occurring in deep gorges on the western part of the proposed site, as a result of cut-and-fill operations during construction, would be particularly serious, as this type is confined to small isolated occurrences within the region, and it contains the fern Blechnum ambiguum, which is classified as vulnerable or threatened by extinction. Also of significance would be the substantial loss of the open forest vegetation (type 5) occurring on shale-capped plateau areas in the middle of the future runway, as this occurrence represents the only known example of this important and unusual plant community within a radius of 25 km of the proposed site.

Indirect effects

Unless safeguards were adequate and effective, the construction and operation of the future airport could have extensive indirect effects on vegetation not directly affected by the clearing of the site, as a consequence of:

- drainage changes, erosion and siltation
- pollution
- changes in the fire regime
- increased access to native bushland.

Drainage changes, erosion and siltation
The drainage scheme at present proposed for the site (Section 15.2) is intended to contain run-off from the developed areas of the site and divert it to Allens Creek. The reduced streamflow rates in the tributary gorges of the Cordeaux River might affect vegetation type 4, particularly communities of the fern Blechnum ambiguum; conversely, vegetation along Allens Creek might be affected by any increase in flow rates or change in flow patterns, or by erosion or siltation. If extreme weather conditions were experienced, especially during airport construction, and the structures intended for drainage diversion and erosion control failed, then plant communities and habitats might be destroyed along watercourses all around the site. Such a contingency would affect vegetation in type 4 and also in type 3, which contains the rare species Hibbertia nitida, Darwinia grandiflora and Lomandra fluviatilis.

Altered groundwater movements could affect vegetation type 3 (which includes several rare plant species), growing on hillsides downslope of the proposed site; depending upon the treatment given to surfaces from which the vegetation cover had been removed, this effect could become progressively more marked during the operation of the future airport.

Water quality
During airport construction nutrients from sewage or contaminents from accidental spillages, for example of petroleum products, could affect areas downslope of the site. Nutrients leaching from disturbed shale soil could disrupt plant communities growing on sandstone and adapted to low nutrient availability. If herbicides and pesticides were used on grassed areas after airport development, there would be some danger of aerial drift or groundwater movement causing them to affect surrounding native vegetation.

During airport operation, stormwater discharged into Allens Creek might carry propagules of plants introduced to the airport site, or pollutants such as nutrients, acids, greases and detergents, all of which could affect the ecology and floristic composition of the site. Unburnt and partially burnt fuel, released by aircraft during takeoff and landing, could damage riverine vegetation immediately beyond the ends of the runways. In certain circumstances, it is necessary for aircraft to jettison fuel before landing, and this could cause extensive destruction of vegetation within the site and surrounds.

Fire
During airport construction accidental fires, for instance from the burning of wind-rowed logs, or the operation of earth-moving equipment, or from carelessness on the part of construction workers, could spread to surrounding bushland. Easier public access, particularly during construction activities, could also lead to more fires, whether deliberately lit or accidental. Once the airport was operational, the need might arise for more frequent hazard-reduction burning. Over a long period a regime of more frequent fires, from whatever cause, would drastically simplify the plant communities.

Increased access to native bushland

During airport construction, opportunities might arise for unauthorized public access to the proposed site and surrounds, and this could result in an increase in the incidence of dumped vehicles, rubbish, and unauthorized off-road vehicle tracks. During airport operations, safety regulations might require further removal of vegetation for the construction of emergency access roads, and there would be renewed risk of creating erosion channels and of introducing exotic plant species.

Ameliorative measures

Little could be done to reduce the direct impact of airport development on the flora of the proposed site. The destruction of such an integrated and well-preserved example of the regional vegetation would constitute a permanent and very significant loss. Measures would be taken, however, to limit the extent of native bushland areas damaged:

- Off-site clearance would not be undertaken unless it was necessary for aircraft safety in order to maintain flight clearance levels;

- Species chosen to revegetate the site would be selected so as to minimize the risk of invading surrounding areas. Species needing frequent watering or with high nutrient requirements or species that propagate prolifically would not be used;

- Embankments above surrounding bushland would be replanted with selected local native species;

- Continuing monitoring programmes would assess the performance and impact of the revegetation programme, the incidence of weed infestation in the surrounding bushland, and any floristic changes in adjacent areas.

The extensive indirect effects of airport development would be minimized, and in some instances could be prevented, by appropriate safeguards. Thus the drainage scheme proposed for the site (Section 15.2) incorporates structures to minimize the risk of sedimentation occurring in Allens Creek during construction work, and once in operation the system of retention basins should ensure that streamflow rates in Allens Creek remain fairly similar to those at present experienced. It may also prove possible, in the final design, to leave some or all of the catchment to the tributary gorges unaffected. Safeguards incorporated in the drainage scheme should prove adequate to allow containment and safe disposal of all contaminated wastewater.

Pollution of surrounding bushland during construction would be minimized by providing adequate toilet facilities for construction staff and by ensuring that relatively nutrient rich shale soils were not used to construct embankments upslope of surrounding sandstone areas. The risk of altering the floristic composition of surrounding areas through the use of herbicides and pesticides could be mitigated by controlled use. All these substances are in use at Kingsford-Smith Airport, with strict controls to ensure that only the least toxic are used and to avoid aerial drift, and no problems are known; similar precautions would be taken at the second Sydney airport, including measures to minimize the contamination of groundwater flows.

The risk of destroying vegetation through emergency dumping of fuel is probably slight. Such incidents occur infrequently and, except where there is immediate danger to the aircraft and its occupants, the procedure is carried out in an area and at an altitude that will result in no adverse effects on the ground. Investigations have shown that if fuel is dumped above 300 m, there is little likelihood of any flammable mist accumulating near the ground, or that humans or animals will suffer any toxic effects. When released above 1,820 m, the fuel vaporizes completely before reaching the ground. The final responsibility for the decision to dump fuel, for the altitude at which dumping is carried out, and for the area in which it is dumped remains with the pilot in command of the aircraft who is required to have reasonable regard for the safety of people and property on the ground.

During airport construction, the Department of Aviation would institute measures such as staff education and strict maintenance of equipment in order to minimize the danger of accidental fires. Any deliberate alteration to the existing fire regime would as far as possible be consistent with the preservation of the surrounding vegetation, and would be accompanied by a comprehensive assessment of long-term effects. Precautions would be taken against unauthorized public access: the site would be fenced at the start of construction work with a 2 m chainmesh fence and strict site security would be maintained. Construction of access roads would be limited to permit essential emergency access only.

16.2 FAUNA

This section discusses the wildlife resources of the proposed airport site at Wilton and evaluates the effects on them of site acquisition and airport development. The site and its environs were assessed in order to obtain detailed information about its utilization by fauna. The area was surveyed to establish the distribution, status and habitat preferences of terrestrial vertebrates located; information about the presence of any rare or endangered species was obtained; and the ecological value of each wildlife habitat was estimated.

The survey area (Figure 16.2.1) was divided into several habitats and each was sampled for fauna using various techniques described by Denny (1984) and briefly outlined in Appendix L. Detailed journal surveys were undertaken in both the open forest on shale and the scribbly gum woodland, making use of such techniques as analyses of habitat, trapping for mammals and herpetofauna, spotlighting transects, general observation, and recording of frog calls. Other habitats were sampled by general observation and recording of frog calls.

Cleared land was sampled where accessible, and both Allens and Cascade creeks were traversed on foot. Allens Creek was also inspected downstream of the airport site. The inventory of fauna located during the survey was supplemented by observations from people living in the area, including staff members of the CSIRO Division of Entomology, the Metropolitan Water Sewerage and Drainage Board, and the Maldon—Port Kembla Railway, and by reference to the records of the Australian Museum, and to Dames and Moore (1975, 1983).

16.2.1 Description of the proposed site

The southern part of the proposed airport site intrudes into the Metropolitan Water Catchment area, to which public access is limited; hence the vegetation is still in relatively good condition and contains a wide range of native species. However, as it is a policy of the Metropolitan Water Sewerage and Drainage Board to burn the forest understorey periodically, many middle and lower strata plant species are low in density and the ground cover within the timbered areas is marshy grassland. The vegetation is described in detail in Section 16.1.

Description of wildlife habitats

For the purpose of the faunal survey, the following categories of habitat within the survey area were used:

- **Open forest on shale:** This habitat is mainly found as a relatively dense tree cover in the south-western quarter of the site. It consists of a forest of several eucalypt species with a sparse middle and lower storey; as a result of burning in recent years, the understorey is not always present. Habitat analysis (Appendix M) shows shrub density is low (100 per hectare) while tree cover is typical of a sclerophyll forest, i.e. about 1,000 per hectare. Litter mass (about 200 g) is relatively low for this environment, compared with 330 g for similar areas in the Blue Mountains (Denny 1982). It has been established that the amount of litter accumulation within an area is a function of the regeneration age since fire (Fox et al. 1979), and it may therefore be concluded that the relatively low amounts of litter in this case indicate an unnaturally short duration between fires.

Within the habitat, patches of previously cleared land support a good grass cover. There is a small dam with dense littoral vegetation of bulrushes and other plants.

- **Scribbly gum woodland:** Mainly found to the east of Mount Keira Road, along a ridge running north-south from Wilton Road, this habitat occupies much of the eastern part of the study site. It comprises many heath species and has a sparser tree cover but denser understorey than the open forest on shale. It is associated with poor soils derived from sandstone, and part of the groundcover consists of sandstone rocks.

  The low litter mass is typical of a scribbly gum woodland habitat. There are several watercourses running through this habitat and draining into Cascade Creek. Small swamps are found in some of the low-lying areas. Although the major part is within the catchment, it is possible for the public to find access and, in consequence, there is an accumulation of rubbish, dumped cars, and several trail bikes.

- **Cleared land:** Although still containing some representatives of the original open forest, most of this habitat is introduced grassland and pasture species. There are several small dams, some of which have established littoral vegetation. The experimental orchard run by CSIRO is located here, although it is outside the proposed airport boundary.

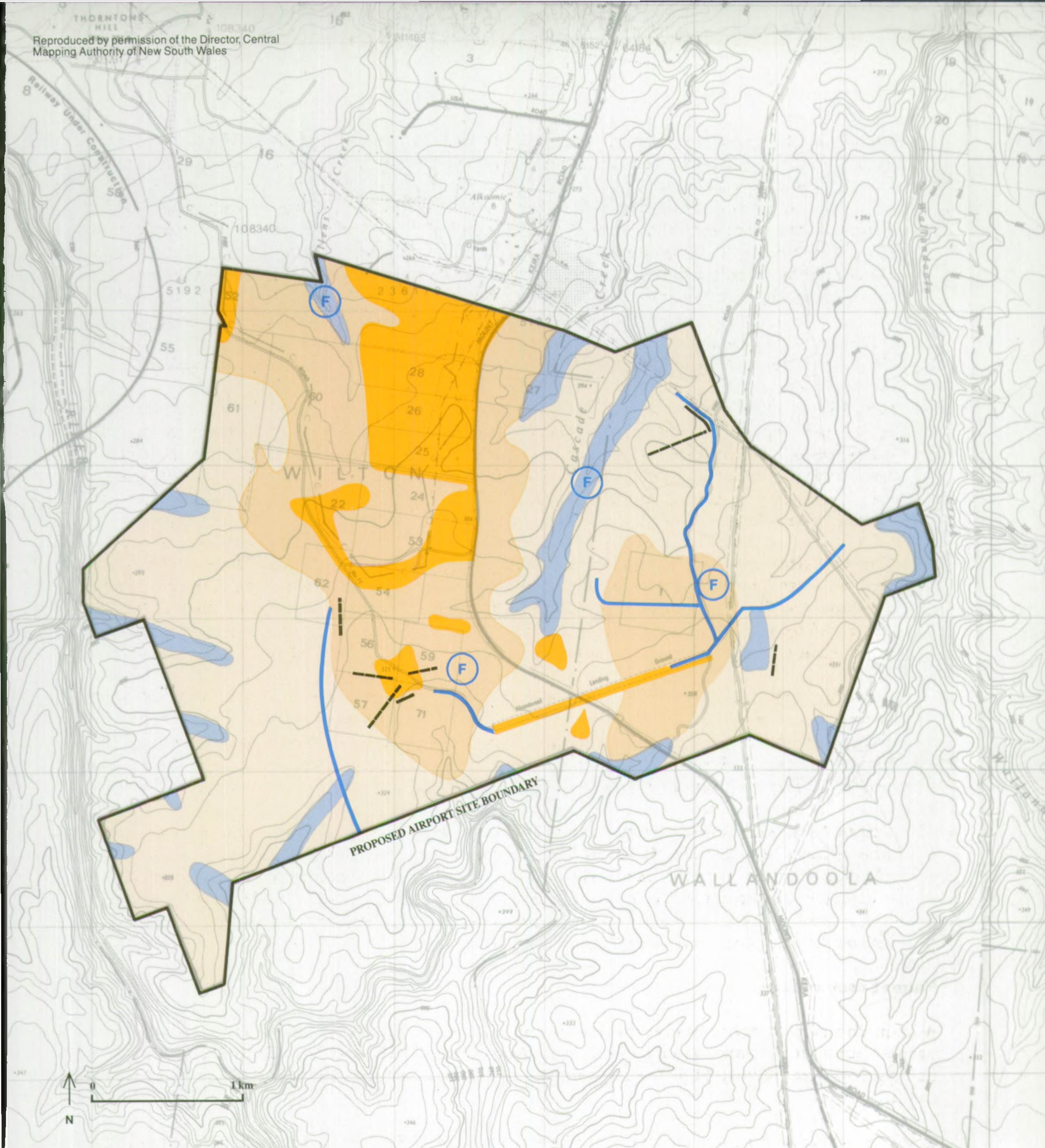
- **Creek-line woodland:** Several large watercourses run through the survey area. These include Cascade, Clements and Allens creeks. Although some pass through cleared land, the creeks have retained their streamside vegetation; this is mainly an extension of the open forest found in the surrounding lands, but in places is quite dense and contains some wet sclerophyll species. All the creeks contain water and in Allens Creek there are some rather large pools.

Faunal assemblage

Within the survey area, twelve native mammal, ninety-six bird, nine reptilian and eleven amphibian species have been located (see Appendices N, O and P). Such an assemblage of species is relatively high for so small an area, and reflects the wide range of habitats available.

Each major faunal group located contained species which utilize different aspects of the environment at Wilton. Among the avifauna was a group of birds which utilize the aquatic habitats. Eight bird species were found associated with farm dams and creeks, and included the great cormorant, grey teal, and Eurasian coot.

Within the trees and shrubs that were in flower were at least ten species of honeyeater, for example the eastern spinebill and white-eared honeyeater. Other bird species utilizing nectar, fruit and seeds from the middle and upper storey vegetation included the mistletoebird, pigeons and finches. Seed-eaters were also represented by a wide range of parrots. Insectivorous birds included many species of thornbill. Larger carnivorous and carrion feeding birds included the wedge-tailed eagle, brown goshawk, grey butcherbird and Australian raven.



HABITAT TYPES

- Cleared land
- Open forest on shale
- Scribbly gum woodland
- Creekline woodland

SAMPLE SURVEY SITES

- Frog call recording site
- Elliott trap line
- Cage trap
- Spot lighting transect

Figure 16.2.1
WILDLIFE HABITATS AND SAMPLE SURVEY SITES

A similarly diverse range of species was found within the mammals located at Wilton. Herbivorous marsupials such as the red-necked wallaby, eastern grey kangaroo and common wombat were commonly found in the survey site. There was also ample evidence for the presence of the omnivorous long-nosed bandicoot. Arboreal species present included two species of possum, as well as the greater glider and the koala.

However, small ground mammals were not frequently located. The brown antechinus and bush rat were the only two native species observed in the survey site, although the introduced house mouse was also found. Larger carnivorous mammals were represented by introduced cats, dogs and foxes. The low diversity of small ground mammals (at least another five species should be found in the area) is possibly due to the low density of ground vegetation which, in turn, stems from current agricultural practices and the frequent burning of the catchment area. It may be due also to the occurrence of heath species: as Kikkawa et al. (1979) have pointed out, 'abundance of animals is frequently low, and food chains are reduced and simplified, in consequence of low primary production in heathland'.

The diversity of reptiles located during the survey was relatively low, because of the cool conditions still prevailing during the spring sampling period and the short survey time. Within the central highlands (Newnes Plateau—Colo River) forty species of reptile are known (Australian Museum 1979), and the range for most of these extends as far as the Wilton area. The number of amphibian species located was relatively high owing to the number of rivers and creeks in the area.

Status

Nearly all mammals, reptiles and amphibians located in the survey area are regarded as wide-ranging and common, and are not classed as endangered. An exception is the koala, which has suffered a decline in population size over the past hundred years, primarily as a result of the destruction of habitat (Pearse and Eberhard 1978); a group of scientists recently stated, '(we) consider that the koala is neither rare nor endangered. However, the vulnerability of localized populations to environmental factors such as overgrazing, disease or fire, emphasizes the need for active management practices' (Bergin 1978). This species has been placed in Schedule 12 of the National Parks and Wildlife Act, 1974 (Endangered Fauna) as fauna of special concern.

The majority of bird species located in the survey site are classed as moderately common, common or abundant in the region, State and continent (Appendix O). Several species that are uncommon and scarce in the Illawarra Region, such as the common bronzewing, hooded robin and sulphur-crested cockatoo, are not given such a low status — i.e. are not considered to be in such low numbers — over a wider range, and hence cannot be regarded as in need of special conservation measures.

Some of the species located are regarded as having a declining status as a result of the destruction of their habitats, e.g. wonga pigeon, spotted quail thrush and red-rumped parrot (Reader's Digest 1976); and others are regarded as being in need of special protection because of their limited distribution (gang-gang cockatoo), or specific habitat preference, as in the case of the origma (Australian Museum 1979). Some of these species are listed in Schedule 12 of the National Parks and Wildlife Act, 1974, as fauna of special concern (e.g. spotted quail thrush), vulnerable and rare fauna (e.g. gang-gang cockatoo and turquoise parrot), or threatened fauna (e.g. eastern bristlebird). Other birds, such as the raptors, are classed as uncommon or scarce overall, because of their large home ranges and infrequent sightings, but none is regarded as threatened.

Habitat preferences

Of the four habitats sampled, the open forest on shale supported the highest diversity of bird and mammal species. Within the avifauna, thirty-eight species were located in the open forest on shale habitat, thirty-three in the scribbly gum woodland, thirty-four in the cleared land and ten along Allens Creek.

The scribbly gum woodland did not produce the expected number of bird species. In a study of heathland vegetation at Holsworthy, Bell (1966) recorded thirty-six bird species and a population density of about 3.3 birds per acre. Many of the characteristic plant species in this habitat were not flowering during the time of the present survey, and because of this some of the birds dependent upon nectar were missing. The relatively high number of bird species in the cleared land was due to the variety of niches it afforded, such as grassland, scattered woodland, orchard and dams; the only two introduced bird species located during the survey were found within the cleared land habitat. Green (1984) has shown that introduced birds favour exotic plant species and artifical structures more than native birds do.

A similar pattern of habitat occupation was observed for the mammal fauna, where the open forest on shale supported a higher number of species than the other habitats. The understorey conditions created by the management policies of the Metropolitan Water Sewerage and Drainage Boards are attractive to the herbivorous species found on the site. Areas containing contiguous forest and grassland also provide ideal conditions for animals that graze during early morning and evening and shelter during the day.

The two habitats with large amounts of native vegetation contained the greatest diversity and density of species in the survey site. The variety in plant species and structure provided a wide range of niches for many species.

A relatively short sample time was spent in the creek-line woodland (Allens Creek), and as a result it did not yield high numbers of species, except for amphibians. The ground vegetation along the creek banks was denser than that found elsewhere because the wetter areas had been less affected by burning. It is anticipated that a longer survey time would have markedly increased the record of species diversity here.

Ecological value

Many parameters are used to assess the ecological value of an area. However, those most important, in terms of wildlife utilization, are based upon whether an area:

- has a high diversity of faunal species
- is used by rare or endangered species
- has potential habitat for scarce or important fauna.

The survey area at Wilton satisfies all three criteria. The number of native faunal species found in the proposed airport site was high compared to the number in similar areas in the region. The airport site at Badgerys Creek (Section 11.2) had sixty bird species, while the larger Cumberland State Forest has a recorded 101 species (Hoskens 1979), and Penrith Lakes, sixty-six (Penrith Lakes Development Corporation Ltd 1983). By comparison, ninety-six bird species were recorded at the Wilton site. Similarly, there is a diverse mammal and amphibian fauna at Wilton compared with other areas.

The survey site yielded several species that are regarded as being threatened, including seven bird species and one mammal, the koala. There is habitat available within the site with the potential to support other native species not located during the survey period, such as several species of rodent, marsupial mice, gliders and larger dasyurids.

While it can be concluded that the whole survey site is of high ecological value, the southern part is the more important. It lies within the Metropolitan Catchment area and retains a good cover of native vegetation. A greater number of birds and mammals was found here than in the northern part of the site, which is mainly cleared land. For instance, forty-seven bird species were found in the vegetated areas of the southern part while only thirty-four species were found in the cleared land. In the context, too, of the wider region extending for some 25 km around Wilton, the southern part of the proposed site is of high intrinsic ecological value.

Recent bushfires have affected all the proposed site. However, such fires are a natural phenomenon in the Australian bushland and the area has a long fire history. The Metropolitan Water Sewerage and Drainage Board has had a policy of low intensity burning in the catchment area for many years and the fauna appear to be able to cope with this practice. Post-fire regeneration of vegetation will occur and many of the animals displaced by the recent fire will recolonize the area.

16.2.2 Assessment of effects and safeguards

This discussion is confined to assessment of the effects of the proposed acquisition and of future airport development at the site. Assessment of associated effects arising from induced development or from the location of new road or rail access routes would require further investigation once the locations for these facilities were determined.

Although change of ownership of the site would have no foreseeable effect upon the fauna, construction of the airport (which would require the removal of the vegetation from most of the site) would have impacts upon many wildlife species.

In view of the dependence of many of the faunal species upon the native vegetation, which covers about 90% of the site, its destruction would result in loss of habitat for many animals. The chances of successful colonization of unfamiliar territories by animals displaced during development have not been adequately documented; however, Ewer (1968) describes the process of invasion of new territory by mammals in the following way:

> If an animal is extending its range or has been forced by circumstances into a new area, then of course it shows investigatory exploration, with its attendant caution and readiness for instant flight. Once territories have been established, the animal within whose domain an encounter goes well has the advantage, since he has the assurance based on familiarity, while the interloper is on unfamiliar ground. Within this sliding scale, the establishment of stable territories would be extremely difficult and costly, in terms of the severity of fighting that would be necessary for an owner to maintain his area.

This implies that an invader would be at a considerable disadvantage and, in most cases, would not survive displacement.

Abundant habitat is available outside the airport site, and some displaced individuals might be able to colonize such areas. However, it could be assumed that there would be a serious fall in the population of fauna occupying the airport site. In many cases, a fall in numbers would have little effect upon the overall status of the species as most of those located are of widespread and common occurrence. However, several birds and one mammal were located that are classed as being in low or declining numbers, and the development of land within the timbered southern section of the site might have an adverse effect upon the overall status of these species.

Other effects during the construction phase, such as increased dust and noise levels, would be temporary.

In addition to the direct effect of habitat loss during the construction phase, several indirect effects of airport operation could influence the population status of the wildlife. Once the airport was functioning, some species would recolonize the area. These would include avifauna well adapted to urban conditions, such as the introduced birds, the common starling, common mynah and spotted turtle-dove, and native birds such as the masked lapwing, Richard's pipit, black-faced cuckoo-shrike, and galah. The planting of native flowering shrubs within the airport would attract many nectar-feeding birds, such as honeyeaters. Van Tets (1969a) listed seventy-one bird species located at Kingsford-Smith Airport, and it could be assumed that a population of some of these species would be found at Wilton. There is the possibility that collisions between aircraft and avifauna could occur in the vicinity of the airport, and might involve species such as raptors that have conservation value. Similarly, some animals and herpetofauna would return to the area; for instance, the planting and mowing of grassy borders would attract native and introduced herbivores, which would utilize the grassland for feeding and the adjoining forest for shelter. However, after a time, some of them would move away again, unable to tolerate the disturbance from bright lights and the noise of aircraft and other vehicles. These displaced animals might not be able to colonize adjoining areas.

Because of the importance of the Wilton area as a source of potable water for the Sydney metropolitan area, all waters leaving the airport site would be contained and treated (Section 15.2). Consequently, there would be some risk that several small watercourses would be disrupted, and that Allens Creek would be affected by a changed water regime. As well as providing a unique habitat, watercourses and their streamside vegetation are used by many animals as movement corridors between preferred habitats; operation of the airport might thus disrupt some of the north-south faunal movement along the small creeks.

Ameliorative measures

Little could be done during the construction phase to reduce the impact from habitat loss. However, disturbance to fauna would be minimized by limiting the amount of clearing to that required for each stage of construction. Off-site clearance would not be undertaken unless it was necessary for aircraft safety in order to maintain flight clearance levels. As the presence of koalas has been recorded within the site (Dames and Moore 1983; J. Wrigley, Metropolitan Water Sewerage and Drainage Board, pers. com.) it would be searched prior to airport construction, and any koalas found would be moved to favourable locations outside the area.

Landscaping would be designed to minimize the attraction to those birds that may be a hazard to aircraft. However, small birds such as honeyeaters might be expected to recolonize some of the native shrubs planted on the site. The presence of such bird species is unlikely to seriously affect air traffic. The Department of Aviation would undertake a detailed and continuing assessment of the likelihood of bird/aircraft collisions once the airport became operational, and would implement whatever measures might be needed to minimize the hazards of bird strikes. The risk of accidents arising if herbivores strayed onto runways, taxiways, etc. should be slight, as the the site would be fenced at the commencement of construction with a 2 m chainmesh fence.

Disturbance of water flows and the risk of water pollution would be kept to a minimum by the implementation of the water management policy described in Section 15.2. Baseline water flow rates along Allens Creek would be obtained prior to airport construction and these rates used as a basis for water release during airport operation. This should result in the retention of watercourse vegetation and some degree of water ponding would continue, as before airport development. Monitoring of the vertebrate and invertebrate (terrestrial and aquatic) animal populations associated with Allens Creek, both within the future airport boundaries and further downstream, would provide an efficient indication of ecological changes that ultimately might affect the Hawkesbury—Nepean river system. Siltation of watercourses should not occur over the long term under the soil conservation measures proposed in Section 15.1.

PART D

COMPARISON OF THE BADGERYS CREEK AND WILTON SITES

CHAPTER 17

Comparison of the Badgerys Creek and Wilton Sites

17.1 FORM OF THE COMPARISON

The comparison of the two short-listed sites takes the form of a continuous table which follows the sequence of Chapters 7-11 (Badgerys Creek) and Chapters 12-16 (Wilton). For each site the relevant environmental factors are described in summary form with these descriptions located side by side in the first two columns of the table. Beneath each description is an assessment of the environmental effects arising from site acquisition or airport construction and operation.

The third column of the table comprises an assessment of the significance of the difference between the two sites on each environmental factor. These assessments of the significance of the differences between the two sites are quantified where possible; in other cases the assessment represents the Consultant's judgement.

Column three of the table contains new material (the assessment of differences) not provided in Chapters 7-16, including a discussion on the relative accessibility of the Badgerys Creek and Wilton sites and the implications of accessibility for the role and timing of airport development.

No attempt is made to weight the factors listed in Table 17.1, nor is a site recommended. However, Chapter 18 describes the results of the public information programme conducted by the Department of Aviation and contains descriptions of:

- the views of residents in the Badgerys Creek and Wilton areas as made known to the Department of Aviation;
- summaries of major written submissions made to the Department of Aviation by organized groups.
- the results of a wider survey of community attitudes toward the proposed second Sydney airport.

This information can provide a guide as to how various groups may assess the relative significance of the environmental factors listed in Table 17.1.

17.2 THE COMPARISON TABLE

Table 17.1 Comparison of the Badgerys Creek and Wilton sites

<table>
<tr><th colspan="2">Description and assessment</th><th rowspan="2">Significance of difference</th></tr>
<tr><th>Badgerys Creek</th><th>Wilton</th></tr>
<tr><td>LOCATION AND SITE DESCRIPTION
(Chapter 7)</td><td>(Chapter 12)</td><td></td></tr>
<tr><td>The proposed site is located in the City of Liverpool, 46 km directly west of Sydney and 48 km by road from the city centre. The proposed site contains a mixture of agricultural and rural residential uses and incorporates the village area of Badgerys Creek. The surrounding area is also used for agricultural purposes, as well as for a number of research, teaching, defence and communication establishments.</td><td>The proposed site is located in the Shire of Wollondilly, 64 km directly south-west of Sydney and 81 km by road from the city centre. About 95% of the proposed site forms part of the Metropolitan Catchment for water supply; the remainder is used for agricultural purposes. The site is bounded by agricultural land to the north and by the Metropolitan Catchment to the east, south and west.</td><td>The Badgerys Creek site is some 33km by road closer to the city centre than the Wilton site. The predominant land uses at Badgerys Creek are agricultural and rural residential, whereas the Wilton site largely used for water supply catchment.</td></tr>
<tr><td>THE PROPOSAL AND PRELIMINARY MASTER PLAN
(Chapter 8)</td><td>(Chapter 13)</td><td></td></tr>
<tr><td>Description: 1,770 ha of land would be acquired.</td><td>Description: 1,440 ha of land would be acquired.</td><td>The Badgerys Creek site is 23% larger than the Wilton site.</td></tr>
<tr><td colspan="2">The airport layouts for both sites are similar in terms of runway alignment and facilities. Both are designed with widely spaced parallel runways of 4,000 m and 2,500 m in length with a 1,660 m separation which can accommodate aircraft with wing spans up to 95m. The maximum level of development (worst case) could accommodate about 275,000 annual aircraft movements, and about 13 million annual passenger movements.</td><td>There are minor differences in the orientation and preliminary layouts, to take into account obstacle clearance, airspace considerations, earthworks, and noise effects at each site.</td></tr>
<tr><td>Assessment: The second airport would require substantial changes to the existing airspace arrangements, and would reduce the amount of non-controlled airspace available for general aviation which would have to use areas further to the south and north of the Badgerys Creek area.</td><td>Assessment: The second airport would require minimal changes to existing airspace arrangements. However, there would be limited access for general aviation to the south and south-east coast due to a long corridor of controlled airspace which would extend south from Kingsford-Smith Airport to beyond Wilton.</td><td>If the second airport were located at Badgerys Creek, the airspace arrangements in the Sydney Region would require comprehensive restructuring. Minor restructuring would be required if the airport were located at Wilton.</td></tr>
<tr><td>LAND ACQUISITION
(Section 9.1)</td><td>(Section 14.1)</td><td></td></tr>
<tr><td colspan="2">The proposed airport site will be announced after an assessment has been made of public and governmental submissions received on this Draft Environmental Impact Statement and after the Commonwealth and New South Wales governments have consulted on acquisition procedures. Once the site has been announced, the acquisition process and implementation of planning controls will commence.</td><td>The acquisition process to be adopted would be the same irrespective of the site selected.</td></tr>
<tr><td>Description: The market value of land and improvements within the proposed site has been estimated at approximately $31.5m.</td><td>Description: The market value of land and improvements within the proposed site has been estimated at approximately $1.8m.</td><td>The market value of land and improvements is estimated to be $29.7 million higher at Badgerys Creek.</td></tr>
<tr><td colspan="2">These values do not include allowance for severance, injurious affection, disturbance or any other factors that might be important components of compensation for compulsory acquisition.</td><td></td></tr>
<tr><td>There are approximately 241 separate land titles and 207 dwellings within the proposed site boundary; the resident population is estimated to be 750 people.</td><td>There are approximately eighteen separate land titles and one dwelling within the proposed site boundary; the resident population is therefore estimated to be less than ten people.</td><td>About 750 residents would eventually be displaced by the acquisition of the Badgerys Creek site. Less than ten residents would be displaced by the acquisition of the Wilton site.</td></tr>
<tr><td>Assessment: The effects of land acquisition are likely to be:
. social effects which cannot be ameliorated by monetary compensation
. severance.</td><td>Assessment: The social effects of land acquisition are likely to be minimal, as large numbers of existing residents would not be displaced. However, some severance of private land would occur, and certain proposals for property development would be adversely affected.</td><td rowspan="2">The effects of land acquisition would be significantly greater at Badgerys Creek than at Wilton, due to the displacement of a greater number of existing residents.

For the interim period between acquisition and construction, a land management plan would be prepared and implemented by the Commonwealth.</td></tr>
<tr><td colspan="2">The assessment of associated effects arising from the acquisition of new road or rail access routes would require further investigation once the locations of these facilities had been determined.</td></tr>
</table>

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment		Significance of difference
Badgerys Creek	Wilton	

NOISE

(Section 9.2)	(Section 14.2)	
Description: About 6,368 ha of land lie within the 20 ANEF noise contour for the worst case level of airport operations. Under existing planning controls, there could be a maximum of about 1,951 people living within the 20 ANEF contour who could thus be affected by aircraft noise.	**Description:** About 6,786 ha of land lie within the 20 ANEF noise contour for the worst case level of airport operations. Under existing planning controls, there could be a maximum of about 130 people living within the 20 ANEF contour who could thus be affected by aircraft noise.	The area of land outside the proposed site that would be affected by airport related noise is 500 ha greater at Wilton than at Badgerys Creek, due to the differing areas and shapes of the two sites.

Potential noise-affected areas and noise-affected population within the 20 ANEF contour for Badgerys Creek and Wilton are shown below:

Maximum number of residents								
Zoning category	Badgerys Creek—ANEF contours 20-25	25-30	30-40	40+	Wilton—ANEF contours 20-25	25-30	30-40	40+
Urban/urban release	252	-	-	-	-	-	-	-
2 ha minimum	466	-	-	-	50	-	-	-
16 ha minimum	92	38	4	-	61	-	-	-
20 ha minimum	-	-	-	-	19	-	-	-
40 ha minimum	529	342	198	4				
CSIRO	10	3	-	-	-	-	-	-
University	-	4	9	-	-	-	-	-
Totals	1,349	387	211	4	130	0	0	0

Significance of difference: There are 1,821 more people who could be affected by aircraft noise at Badgerys Creek than at Wilton. Nearly 93% of the land within the 20 ANEF at Wilton is zoned for water catchment purposes and is thus uninhabited.

Assessment: For the worst case level of airport operations and the maximum residential development permissible under present land use controls, aircraft noise could:

Badgerys Creek	Wilton	Significance of difference
'seriously' affect a potential 364 future residents, while 1,115 residents could be 'moderately' affected (including those seriously affected).	'seriously' affect a potential 18 future resident (approximately), while 68 residents could be 'moderately' affected (including those seriously affected).	Noise from airport development at Badgerys Creek could seriously affect about 318 more residents and moderately affect about 942 more residents than at Wilton.

ARCHAEOLOGY

(Section 9.3)	(Section 14.3)	
Description: The area comprises a single environmental zone which has been disturbed by past and current agriculture and residential development. Previous and current archaeological investigations indicate that the Aboriginal archaeological significance of the area is relatively low. One archaeological site, a sparse stone artefact scatter, was found during the field survey.	**Description:** The area contains two general environmental zones of archaeological sensitivity. Previous and current archaeological investigations indicate that the Aboriginal archaeological significance of these zones is relatively low, although two rock shelter sites containing Aboriginal drawings and possible archaeological deposits were located within the site.	The archaeological significance and sensitivity of both sites are relatively low. In the case of Badgerys Creek, the scientific importance of artefact sites is likely to be low because of the disturbed nature of the site.
Assessment: The only sites likely still to survive are stone artefact scatters and, since the proposed site has been extensively disturbed, the potential value of any such artefact sites is likely to be low. The exception to this would be any sites on the banks of Badgerys Creek which, in some areas, are relatively undisturbed.	**Assessment:** The proposed airport site has remained largely undisturbed; hence the scientific importance of any artefact sites is likely to be relatively high, although the number and significance of these sites are not likely to be great. No artefact scatters were found, and although two art sites were located on the proposed site, these were poorly preserved and some of the artwork has faded or is partly obscured.	The relatively undisturbed condition of the Wilton site would tend to suggest that the scientific importance of sites would be high. However, the frequency of sites is low and other representative sites occur adjacent to the proposed site. The art sites at Wilton are poorly preserved in contrast to other art sites located in the area.

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment: Badgerys Creek	Description and assessment: Wilton	Significance of difference
CONCERNS OF ABORIGINAL PEOPLE (Section 9.4)	**(Section 14.4)**	
Description: The airport site is within the Gandangara Local Aboriginal Land Council area. There are about 4,800 Aboriginal people in this Land Council area.	**Description:** The airport site is near the boundary between the Tharawal and Illawarra local Aboriginal land councils. There are about 6,500 Aboriginal people in these two land council areas.	No sites of potential significance to Aboriginal people were identified within the proposed Badgerys Creek or Wilton sites.
Assessment: The Gandangara Local Aboriginal Land Council has expressed opposition to the development of the site on the grounds that it would adversely affect the quality of their environment and way of life.	**Assessment:** The Tharawal and Illawarra local Aboriginal Land Councils have indicated conditional support for airport development. However, they have also expressed concern about the likely effects on the surrounding country, which is both traditionally and historically important to them.	The Gandangara Local Aboriginal Land Council has expressed opposition to the development of an airport at Badgerys Creek; the Tharawal and Illawarra local Aboriginal land councils have indicated conditional support at Wilton.
EUROPEAN HERITAGE (Section 9.5)	**(Section 14.5)**	
Description: Four main historical themes of European settlement and development were identified, beginning with the initial settlement of the area in 1813. There were subdivisions of these early grants throughout the mid to late 19th century as a result of land speculation and, during the period to the mid-20th century, further subdivision led to the development of small farms and associated housing. More recently, development has intensified with the predominant agricultural enterprises consisting of battery hen farms, horse studs, market gardens, dairying and grazing, and further construction of rural residential housing.	**Description:** Because of poor land and unfavourable terrain, European settlement was delayed until the late 19th century. Settlement of the area was characterized by small-scale domestic development, often associated with cattle grazing. Many of the small domestic land portions not originally appropriated by the Metropolitan Water Sewerage and Drainage Board for catchment protection have subsequently been acquired for that purpose. A small aircraft landing strip was built on the proposed site during World War II, but is now abandoned.	The land within the Badgerys Creek site has national historical value because of its association with a pre-eminent early colonial family, one of whose members — Gregory Blaxland — was the first to cross the Blue Mountains. Much of the land within the Wilton site has been held by the Crown, and the small portion of the land granted to Thomas Mitchell in 1835 that is contained within the site is not considered to be of great historical significance.
Assessment: The majority of standing historical structures within the site are of local importance only and no physical evidence of the initial settlement phase exists. A slab shed and woolshed are the only physical evidence of significance originating in the mid to late 19th century. Vicary's Winery (consisting of a vineyard and house) established in 1917 is the only known item of regional heritage significance to occur within the site. No known historic buildings or items of heritage value have been registered or recorded within the 25 ANEF contour.	**Assessment:** There are no surviving structures of any kind relating to the early settlement and development within the proposed site. No known historic buildings or items of heritage value have been registered or recorded within the 25 ANEF contour.	The Wilton site contains no standing structures relating to early European development. Most of the standing structures on the Badgerys Creek site are of only local importance and of minimal heritage value. However, three items of heritage value were identified, one of which is of regional significance.

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment: Badgerys Creek	Description and assessment: Wilton	Significance of difference

ECONOMIC EFFECTS

(Section 9.6) **(Section 14.6)**

Description: Both sites are located near the Sydney metropolitan urban fringe and have experienced rapid population growth during the intercensal period 1976-1981.

Social/economic indicator	Badgerys Creek	Badgerys Creek sub-region	Wilton	Wilton sub-region	Sydney Region
People in same dwelling as in 1976 (%)	42	45	37	49	52
People aged under 15 (%)	34	30	34	29	24
Population growth, 1976 to 1981 (%)	64	17	52	19	3
Employment in agriculture (% of total employment)	42	2	*	1	-
Employment in manufacturing (% of total employment)	25	27	*	36	23
Employment in trade (% of total employment)	9	21	*	15	20

* The 'journey to work' census tables indicate that there were very few jobs in Wilton in 1981.

In June 1984, unemployment in both Liverpool and Penrith was 13.3% and 11.1% respectively, compared to the Sydney average of 11%.

In June 1984, unemployment in Wollondilly was 7.7% which is significantly below the average for Sydney (11%). However, unemployment in Campbelltown and Wollongong (13.1% and 14.2% respectively) was much higher.

Significance of difference: In Badgerys Creek, agriculture is the main economic activity, whereas in Wilton it is mining and manufacturing.

Both areas have experienced rapid growth over the last decade, and the sub-regions around both sites are expected to undergo substantial change by the time a second Sydney airport became operational. The Badgerys Creek sub-region is expected to grow by 59% by the year 2001, and the Wilton sub-region by 42% (excluding growth in Wollongong.)

Assessment: The economic effects arising from land acquisition are likely to be small when compared with the economic effects of constructing and operating the airport. About 7,000 person-years of work would be required to construct the airport. Assuming a peak year construction workforce of about 1,600 jobs, construction employment flow-on in the Sydney Region would be about 1,800 jobs of which between 600 and 1,100 would be jobs in the sub-region.

Direct employment associated with a second Sydney airport operating at 13 million annual passenger movements could be as high as 10,500 jobs in the sub-region. Airport associated employment and induced employment could add a further 600 to 1,000 jobs, while flow-on employment in the Sydney Region could be up to 10,500 jobs of which up to 2,300 could be within the sub-region. A total of about 22,000 new jobs could be created by the airport operations under the worst case of 13 million annual passenger movements.

Significance of difference: There is no significant difference between the sites in terms of the economic effects. However, the relatively higher unemployment rates in parts of the Wilton sub-region might be partially alleviated if the airport were developed there and if it reached a high level of operations.

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment: Badgerys Creek	Description and assessment: Wilton	Significance of difference
AGRICULTURE (Section 9.7)	(Section 14.7)	
Description: The suitability of land for agriculture within the proposed site and 25 ANEF contour is good. About 79% of the proposed site and 74% of the area within the 25 ANEF contour is used for agricultural activities, principally grazing, dairying, and horse agistment, spelling and training. Horse spelling, egg production, and horse training are the principal activities in terms of gross value of production. Other uses include piggeries, nurseries, vegetable growing and broiler production.	**Description:** The suitability of land for agriculture within the proposed site is generally poor. About only 4.5% of the proposed site is used for beef cattle grazing and for the agistment and spelling of racehorses. All of the land outside the airport site within the 25 ANEF contour comprises uncleared forest and is not used for agricultural production.	The Badgerys Creek site is extensively used for agriculture whereas the Wilton site has little agriculture use at present.
Assessment: The gross value of production from areas within the site and the 25 ANEF contour is $8.3 million, of which about $5 million is from within the site. This total amount of $8.3 million represents about 17% of the combined value of the agricultural production of the cities of Liverpool and Penrith. The area is important for the number of broiler chickens produced and the production of tomatoes for the fresh vegetable market.	**Assessment:** The gross value of production from agricultural land within the airport site is about $195,000. This represents about 0.3% of the value of production in the Wollondilly Shire.	The contribution to local agricultural production from the Badgerys Creek site is significantly greater than it is from Wilton. Both areas are likely to suffer a loss of agricultural production due to the indirect effects of any development associated with the proposed airport. However, this loss is likely to be much greater at Badgerys Creek than at Wilton.
The effects of noise on agricultural uses within the 25 ANEF contour are likely to be small. There is no evidence that aircraft engine exhaust emissions affect vegetable or crop production. The effect of aircraft noise on livestock is likely to cause some concern initially, although evidence suggests that livestock become conditioned to such a changed environment. Conditioning of chicks to noise may cause problems for poultry farmers.		There is also likely to be some loss of agricultural production in the future due to residential or urban development; this is also likely to be greater at Badgerys Creek than at Wilton.
REGIONAL PLANNING (Section 9.8)	(Section 14.8)	
Description: Sydney's population is expected to continue to expand over the next few decades. Current predictions are that it will reach about 4 million people by the turn of the century and about 4.5 million people by 2011, although rates of growth may fluctuate causing these figures to be reached either sooner or later than these forecast dates. The future strategic direction of metropolitan planning for this expected increase in population will depend on a number of factors, including the location and employment opportunities related to a second Sydney airport.		The sequence of urban development will be examined in the Macarthur Regional Environmental Study currently under preparation by the Department of Environment and Planning and scheduled for public exhibition late in 1985. Both sites are located in the Macarthur Sub-Region, but each site has a different set of potential urban areas presently identified in the vicinity.
Assessment: A decision on a second airport site will remove the necessity to restrain urban development in areas near other candidate sites. At the sub-regional level, subsequent airport development and land use requirements for activities associated with that development could be readily accommodated. While some displacement of existing uses would occur, the main effect of a future airport would be to change the sequence in which the potential urban areas already identified were developed rather than to add to the total extent of urban development.		
While the extent of effects of electromagnetic interference, noise and other impacts associated with an airport on various research and technical facilities is uncertain, some facilities would become inoperable if a high level of aircraft operations occurred.	If planning measures were adopted at the acquisition stage to control incompatible land uses at Wilton, no further effects should be occasioned by aircraft if operations reached the worst case level. The likely effects of sterilization of coal resources beneath the site cannot be determined at this stage, because the timing of both the airport development and coal extraction is uncertain.	The development of an airport at Badgerys Creek could render some research and technical facilities in the vicinity of the site inoperative. However, the long-term future of these facilities in their present locations is very uncertain even without airport development given the prospect of future metropolitan growth and technological change.

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment: Badgerys Creek	Description and assessment: Wilton	Significance of difference
GEOLOGY **(Section 10.1.1)**	**(Section 15.1.1)**	
Description: Unconsolidated Quaternary sediments and consolidated Triassic rock (Bringelly Shale) occur in the proposed site. The main geological feature of the site is the Luddenham Dyke which extends north-west through the site.	**Description:** Triassic rocks of the Wianamatta Group (Ashfield Shale), Mittagong Formation and Hawkesbury Sandstone occur in the proposed site. A major structural feature near the site is the Narellan Lineament fault line.	The Badgerys Creek site occurs in a predominantly shale area, while the Wilton site is located in a predominantly sandstone area.
The proposed site contains potentially important clay/shale extractive resources. The economic value of this resource is currently being investigated. Coal resources 40 Mt also exist beneath the site at a depth of about 830 m, but are unlikely to be mined in the foreseeable future.	The predominant economic resource of the region is coal. Low ash hard coking coal which is of regional and national importance is produced from local mines. However there is some evidence to suggest that the quality of some of the coal deteriorates in the area of the proposed site. There is about 50 million tonnes of in situ coal beneath the proposed site which could be economically mined. There are no other known economic extractive resources within the proposed site.	Both sites contain potentially extractable mineral resources. While the coal resources at Wilton are of regional and national significance, it is unlikely that they would be mined for some time. The clay/shale resource at Badgerys Creek may be of regional significance but as yet this has not been determined.
Assessment: A decision to acquire the proposed site could potentially sterilize regionally significant light-firing clay/shale extractive resources. However, if suitable deposits were located within the proposed site, it may be possible to co-ordinate the extraction of the material with the construction of the airport.	**Assessment:** A decision to acquire the proposed site could adversely affect proposals for the extraction of coal from beneath the site and surrounding mining leases; however, it is uncertain at this time whether the development of the airport would totally or partially sterilize the resource.	Both sites could potentially sterilize important mineral resources, although the extent of this is uncertain in both cases.
Seismic data collected to date indicates the general region has a relatively low sensitivity, with most earthquakes in the region having their epicentre around Picton-Robertson and Kurrajong.		The Wilton site is located closer to the likely epicentre of any seismic activity in the region. However, there has been no major structural damage caused by previous earthquakes or tremors at Wilton although there has been some minor damage to old buildings located near the epicentre of the earthquakes.
The site is located about 20 km outside the Modified Mercallie Scale Ground Intensity V which is expected to be exceeded on average once in every 100 years. The vibration effects from such a tremor are likely to be similar to a passing heavy truck.	The site is located between the Modified Mercallie Scale Ground Intensity V and VI, which are expected to be exceeded on average once in every 100 years. Earthquakes with such a ground intensity produce vibration effects that awaken sleepers, frighten people and damage weak structural work.	
SOILS **(Section 10.1.2)**	**(Section 15.1.2)**	
Description: The proposed site contains sandy to silty clay loams, and alluvial clays, loams and sand derived from Bringelly Shale. Their fertility ranges from moderate to low and they have a moderate to high erosion potential. Drainage is poor and soil salinity occurs over a small area of the site.	**Description:** The proposed site contains a range of soil types derived from Ashfield/Bringelly Shales and shale lenses interbedded in sandstone. The fertility of the soils is moderate to poor, and they have a moderate to extreme erosion potential. Soils tend to have good permeability. The shale-derived soils can exhibit salinity problems.	The Wilton site contains a greater variation in soil types and characteristics than the soils at the Badgerys Creek site.
Assessment: The site comprises a large proportion of soils which are moderately or highly erodible. It also contains areas of saline soils which are likely to inhibit revegetation. Special measures would be adopted to control sedimentation and ensure revegetation.	**Assessment:** The site contains soils which are highly erodible and these could potentially cause siltation and sedimentation problems in the surrounding drainage system.	Both sites contain erodible soils, although the Wilton soils are more highly erodible than those at Badgerys Creek. Erosion control procedures would be adopted at Wilton to minimize the risk of sediments entering the water supply system during construction.

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment		Significance of difference
Badgerys Creek	Wilton	
PHYSIOGRAPHY (Section 10.1.3)	(Section 15.1.3)	
Description: The proposed site is located on an elevated portion of the Cumberland Plain at an average elevation of 80 m above sea-level. The site ranges in elevation from 45-118 m. About 95% of the site has a slope of less than 5%.	**Description:** The proposed site is located on the Woronora Plateau at an average elevation of 310 m above sea-level. The site ranges in elevation from 245-333 m. About 75% of the site has a slope of less than 5%.	Badgerys Creek is located in the Cumberland Plain west of Sydney, while the Wilton site is located in the Woronora Plateau, some 230 m higher than the Badgerys Creek site. The Badgerys Creek site is generally flatter than the Wilton site and has a lesser range in elevation. The Wilton site contains a higher proportion of steeper slopes than does the Badgerys Creek site. The Badgerys Creek site would require about 1.69 million m^3 more of earthworks than Wilton in order to prepare the ground surface for airport development.
Reshaping of the ground surface by excavating and filling would be required to obtain the necessary grades for future airport development.		
About 15.754 million m^3 of excavation and 15.823 million m^3 of filling would be required. This would involve up to about 10 m of fill in some locations, mainly to fill creek beds, and up to 20 m of cut where the ridge coincides with the area for the connecting taxiway apron.	About 14.163 million m^3 of excavation and 14.035 million m^3 of filling would be required. This would involve up to 20 m of fill in some locations, mainly to fill creek beds, and up to 10 m of cut would be required where the existing ridge lies across the runways areas.	
Assessment: The above estimates of cut-and-fill are preliminary. However, it would be feasible to obtain a balanced cut-and-fill for earthworks at both sites.		
DRAINAGE AND WATER QUALITY (Section 10.2)	(Section 15.2)	
Description: The proposed site is located in the upper part of the South Creek catchment. Approximately 92% of the site drains into South Creek which enters the Hawkesbury River north of Windsor. The remaining 8% drains into Duncans Creek which enters the Nepean River south of Wallacia.	**Description:** The proposed site is located in the middle to lower part of the Cordeaux and Cataract rivers catchment on the northern edge of the Metropolitan Water Sewerage and Drainage Board's Metropolitan Catchment for water supply. About 86% of the site drains into the Metropolitan Catchment and enters the Sydney water supply system. The remaining 14% drains into Allens Creek which flows into the Nepean River upstream of Douglas Park.	The Wilton site is located downstream of the main Sydney water supply storages but within the area required to protect the water supply system off-takes at Pheasants Nest and Broughtons Pass.
Flooding: Badgerys Creek has the only developed floodplain. Most other creeks draining the site have a sufficiently steep gradient to render flooding unlikely for any duration longer than the particular storm event.	**Flooding:** There are no developed flood plains on the site although streams are subjected to flooding during major storm events but water does not remain longer than the duration of the storm.	A small part of the Badgerys Creek site occurs within a defined flood plain, however, it does not affect the proposed development.
Groundwater: The Wianamatta Group that underlies the site has poor groundwater potential, and the water that is available is brackish to saline and has a low yield thereby limiting extensive use of the resource.	**Groundwater:** The Hawkesbury Sandstone that occurs within the site is the most favourable porous rock in the Sydney Basin. Groundwater is generally obtained from fracture zones but has a low yield and can contain iron. Because of this, its use is limited.	The availability and use of groundwater is limited at both sites, even though the Wilton site occurs in an area of favourable geology for groundwater.

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

<table>
<tr><th colspan="2">Description and assessment</th><th rowspan="2">Significance of difference</th></tr>
<tr><th>Badgerys Creek</th><th>Wilton</th></tr>
<tr><td>DRAINAGE AND WATER QUALITY
(Section 10.2)</td><td>(Section 15.2)</td><td></td></tr>
<tr><td>Water quality: Surface waters draining from the site enter the Hawkesbury-Nepean River system. While these waters are not classified, there are water quality problems due to the level of nutrients present.</td><td>Water quality: Most surface waters draining from the site would be diverted from entering the Metropolitan Catchment. Only run-off from undeveloped parts of the site would be allowed to enter the Metropolitan Catchment area.</td><td>Creeks that receive run-off from the Badgerys Creek site have not been classified. In contrast, all the creeks receiving waters at the Wilton site are classified as either Class 'S' or Class 'P'. These are the highest classifications given to receiving waters in NSW.</td></tr>
<tr><td colspan="2">A number of possible operations that could be conducted at the second airport could be expected to give rise to treated effluent or produce contaminants in site run-off. These would include:

. process wastewater arising from aircraft maintenance
. domestic sewage
. stormwater</td><td>Irrespective of which site is chosen, the Department of Aviation would comply with all statutory requirements relative to wastewater discharges from the site during the course of airport construction and operation.</td></tr>
<tr><td>'Clean' stormwater from developed areas within the site would be diverted into first-flush retention ponds. A total storage capacity of between 200,000 m^3 and 300,000 m^3 would be required to contain the initial flush, and the capacity of the basins would range from about 15,000-70,000 m^3 depending on the size of area draining to them. Stormwater retarding basins would also be provided on the major creeks and would be designed to contain the peak flow so that the present peak flows from a 1:100 year storm event would not be exceeded. Up to 500,000 m^3 of storage capacity would be required, and individual basins would range in size from about 35,000-160,000 m^3.</td><td>A perimeter drainage canal would be constructed around the proposed site together with a stormwater storage and first flush retention basins to control run-off and to direct it out of the Metropolitan Catchment. Preliminary design estimates indicate that the canal would vary in width from 15 m at the top of the catchment to about 100 m at the lower end. A total storage capacity of between 200,000 m^3 and 300,000 m^3 would be required to contain the initial flush. A stormwater retarding basin would also be provided on Allens Creek and would be designed so that the present peak flow from a 1:100 year storm event would not be exceeded. Up to 1.3 million m^3 of storage capacity would be required in this retarding basin.</td><td>Both sites would require about the same overall capacity for the first flush retention system. However, the Wilton site would require a much larger stormwater retarding basin as well as a perimeter canal to ensure that run-off from the developed areas of the site did not enter the water supply system.</td></tr>
<tr><td>Assessment: Possible effects during airport construction and operation include:

. increased potential for flooding along South Creek;

. effects on groundwater;

. effects on water quality during construction and operation.</td><td>Assessment: Possible effects during airport construction and operation include:

. increased potential for flooding along Allens Creek;

. effects on groundwater;

. effects on water quality during construction and operation;

. loss of area of water supply catchment;

. risk of contamination of the Sydney water supply.</td><td>At Wilton, run-off from about 875 ha within the Metropolitan Catchment would be diverted and the Metropolitan Water Sewerage and Drainage Board has estimated the annual cost of water lost to be $23,600

The effects on groundwater at both sites is likely to be low.

Both sites would contribute a similar proportion of nutrients (nitrogen and phosphorus) to the nutrient load of the downstream sections of the drainage systems into which they would discharge treated effluents.</td></tr>
<tr><td colspan="2">The Department of Aviation would adopt design and operational measures at both sites to reduce the attractiveness of the drainage system to birds.</td><td></td></tr>
</table>

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment		Significance of difference
Badgerys Creek	Wilton	

AIR QUALITY
(Section 10.3) (Badgerys Creek) **(Section 15.3)** (Wilton)

Description: Six main sources of pollutants would be associated with the operation of an airport:

- aircraft engine exhausts during aircraft operations
- aircraft fuelling systems
- ground service vehicles and equipment
- aircraft engine emissions during maintenance
- fuel storage systems
- access traffic entering and leaving the airport.

The estimated annual airport related emissions for Badgerys Creek and Wilton are shown below:

Source	Badgerys Creek: Carbon monoxide	Badgerys Creek: Hydro-carbons	Badgerys Creek: Nitrogen oxides	Wilton: Carbon monoxide	Wilton: Hydro-carbons	Wilton: Nitrogen oxides
On site						
. aircraft emissions	1,411	518	798	1,411	518	798
. vehicle emissions	1,743	200	251	1,835	211	264
. other	552	56	30	552	56	30
Off site						
. aircraft emission	2,370	75	1,331	2,370	75	1,331
. vehicle emissions	14,420	1,688	2,077	19,669	2,259	2,833
Total airport related emissions	20,496	2,537	4,487	25,837	3,119	5,256

Significance of difference: While the net additions to total emissions are estimated to be about the same for both airport sites, airport related vehicle emissions, although not additional to the total emissions in the Sydney Region, would have a different pattern of geographic distribution depending on which site was selected. Emissions, from all sources at an airport at Badgerys Creek are likely to contribute to a degradation of air quality in the Hawkesbury Basin to a greater degree than emissions at Wilton, because some emissions at the latter site would not be transported into the Sydney Basin (Hawkesbury or Liverpool basins) by drainage flows.

Assessment: The estimated net addition of airport related air emissions to the forecast total emissions in the Sydney Basin is as follows:

	Badgerys Creek: Carbon monoxide	Badgerys Creek: Hydro-carbons	Badgerys Creek: Nitrogen oxides	Wilton: Carbon monoxide	Wilton: Hydro-carbons	Wilton: Nitrogen oxides
Estimated net addition as a result of airport operations	4,333	649	2,159	4,333	649	2,159
% of total emissions without airport	0.6	0.5	2.1	0.6	0.5	2.1

With regard to the construction of an airport, the dust associated with earthmoving and site preparation would arise mainly from the operation of mobile equipment and to a lesser extent from wind blowing across exposed areas.

Badgerys Creek: Air drainage flows across the site include a local southerly flow towards Richmond, regional drainage flows from the west (Blue Mountains) and south-west (Illawarra escarpment to Lake Burragorang), and a spillover flow into the Parramatta River Valley. These flows affect the transport and dilution of air emissions at Badgerys Creek.

Wilton: The south-west air drainage flow from the Illawarra escarpment—Mittagong ridge—Lake Burragorang region would affect the transport and dilution of air emissions at Wilton. Depending on daily conditions, this air drainage flow could transport emissions to different parts of the Sydney Basin.

Significance of difference: Emissions of dust from site preparation works and airport construction would be minimized by watering and establishing vegetation cover on exposed areas as early as possible. During periods of strong winds, dust deposition could be experienced at some distance from the site (up to 1 km), although the frequency and magnitude of such occurrences are likely to be low. Dust may thus affect nearby residences at Badgerys Creek. Dust pollution of the water supply weirs at Pheasants Nest and Broughtons Pass is unlikely as these weirs are located about 3 km from the site away from the direction of the strong prevailing winds.

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment		Significance of difference
Badgerys Creek	Wilton	
ROAD AND RAIL ACCESS PROPOSALS (Section 10.4)	**(Section 15.4)**	
Description: To cater for 13 million passengers a year, the Hume Highway (The South Western Freeway) east of Liverpool, and Bringelly Road between the freeway and the Northern Road would require upgrading. A new road would also be required along the eastern side of the site connecting north to Erskine Park Road. The Northern Road would need to be relocated west of its present position where it passes through the site.	**Description:** To cater for 13 million passengers a year the Hume Highway (South Western Freeway) would require upgrading from 4 to 6 lanes between Wilton Road and Campbelltown and between Liverpool and Henry Lawson Drive. In addition, sections of Picton Road and Mount Keira Road might require upgrading, a new link would be required from the freeway to the airport entrance, and Mount Keira Road would need to be relocated along the eastern edge of the site.	Assuming rail access were available, the cost of the road works necessary to cater for 13 million passengers a year would be about $159 million at Badgerys Creek and about $154 million at Wilton.
Description: Rail access to an airport at Badgerys Creek could be provided in two ways: . a trunk route via St Marys, in common with a possible freight railway from Glenlee on the Main Southern Line to Werrington on the Main Western Line and from there via the Main Western Line to Sydney; . a trunk route via Glenfield and thence via the East Hills and Illawarra lines to Sydney.	**Description:** Rail access to an airport at Wilton could be provided in two ways: . a trunk route via Wilton Loop and Maldon Junction, in common with the Maldon—Dombarton electrified freight railway currently being constructed, thence via the Main Southern Line to Glenfield, the East Hills Line and the Illawarra Line to Sydney. . A trunk route via a new railway line from the airport through Appin to Menangle Park and thence via the main Southern Line to Glenfield, the East Hills Line and the Illawarra line to Sydney; this line could be developed for suburban as well as airport services.	The capital cost of providing rail access will very much depend on the route selected, the future availability of capacity at critical points on the rail network, and on the extent to which other additions or improvements to the network take place. The probable ranges of costs are $101 million to $217 million at Badgerys Creek and $85 to $237 million at Wilton.

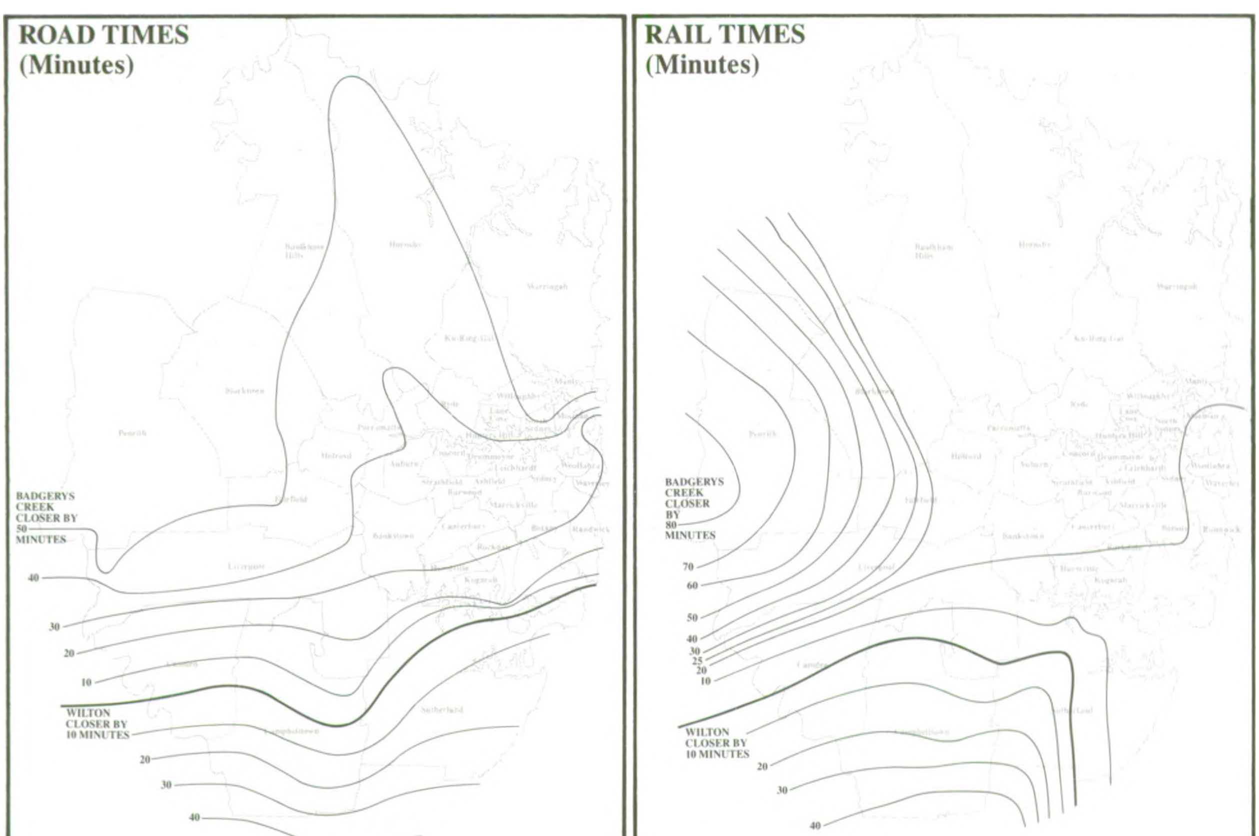


Figure 17.1
COMPARISON OF RAIL AND ROAD ACCESS TIMES

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment: Badgerys Creek	Description and assessment: Wilton	Significance of difference

RELATIVE ACCESSIBILITY

Assessment: The Badgerys Creek and Wilton sites are markedly different in terms of accessibility. The most informative comparison of their relative accessibility is therefore to consider rail and road accessibility separately, and to make area-by-area comparisons. Figure 17.1 shows isochrones (lines of equal time) for the difference in travel time across the metropolitan area to either Badgerys Creek or Wilton. Overall average travel times in peak hour (end-to-end trip duration) for air passengers at Badgerys Creek and Wilton would be as follows:

	Average travel time (minutes) Badgerys Creek	Wilton
By road	69	102
By rail	72 (via St Marys)	88 (via Douglas Park)
By rail	68 (via Glenfield)	84 (via Appin)

The following general conclusions can be drawn on the relative accessibility of the two sites:

- If the future air travel market comprised predominantly visitors, then the rail access time advantage of Badgerys Creek would be much reduced — compared to the rail travel time to Wilton from the city centre (where many visitors begin or end their journey at present) there would be only a 15 minute or 21% saving.
- If the future air travel market comprised predominantly visitors, but no rail access to the airport were available, then the access time advantage of Badgerys Creek would be greater — about a 30 minutes or 29% saving on travel time by road to Wilton from the city centre.
- If the future air travel market comprised predominantly residents, then the travel time advantage of Badgerys Creek would be substantial for large sections of the travel market. For example, for travellers originating from much of the northern half of the city there would be a 40 minute saving when compared with road journeys to Wilton, which would take 80 to 150 minutes or more, according to origin.

Significance of difference: The choice of Wilton would necessarily imply acceptance of some constraints on the second airport's role and its manner of development. These might be as follows:

- the need to provide rail access at the outset, despite the initial low air passenger flows. (Were rail access not provided, total travel times for a bus-based system of public transport would be longer than private vehicle travel times);
- the probability that a large proportion of the Sydney resident travel market could not be persuaded to use the second airport;
- in comparison with Badgerys Creek, Wilton's role would be more restricted to serving:
  - those most willing to trade increased access time for lower air fares (mainly leisure travellers);
  - those least disadvantaged by the remote location (mainly visitors to, and residents living in the south of the city).

It follows from these constraints that the time at which development of a second airport at Wilton would become viable would be later than at Badgerys Creek.

INFRASTRUCTURE AND ENERGY CONSUMPTION

Badgerys Creek (Section 10.5)

Description: Existing local power and telecommunication facilities would be affected, as would a 330 kV transmission line. This line is being investigated for possible upgrading to 500 kV and diversion to Kemps Creek substation. Current plans for this would have to be abandoned in favour of a more expensive and less acceptable southern route if the line were to be upgraded.

Wilton (Section 15.5)

Description: A low voltage line, a 330 kV transmission line, and sections of the gas pipeline to Wollongong and of a pipeline used for dispersing wastewater from the Cordeaux mine pit top facilities all cross the proposed site and would require relocation.

Significance of difference: Both sites would have relatively minor impacts on existing infrastructure. The Badgerys Creek site would affect proposals to upgrade an existing power line and divert it to the Kemps Creek substation. Development of the Wilton site would require more facilities to be relocated.

Both sites are outside the area currently serviced by the Metropolitan Water Sewerage and Drainage Board and there are currently no plans to extend water supply or sewerage services into these areas. Construction of new facilities would be required to meet the needs of the airport and associated development.

Significance of difference: Both sites would require the construction of a new plant to treat sewage effluent.

Assessment: The effects associated with specific infrastructure proposals would require further investigation once the site has been selected and the requirements for relocating facilities and providing services determined.

Table 17.1 Comparison of the Badgerys Creek and Wilton sites (continued)

Description and assessment		Significance of difference
Badgerys Creek	Wilton	
LANDSCAPE AND VISUAL QUALITY (Section 10.6)	**(Section 15.6.)**	
Description: The proposed site is located in the transitional zone between the Cumberland Plain and the Blue Mountains escapment. Less than 10% of the site is still vegetated and 94% of the site is classed as having minimal landscape and scenic quality. The only distinctive landscape feature is the partly vegetated ridge which extends southwards from Luddenham.	**Description:** The proposed site is located within the plateau zone and contains a number of different landform features. Over 90% of the site is vegetated. However 82% of the site has been classed as having a minimal landscape and scenic quality. The only distinctive landscape features occurred along a small part of Cascade Creek and along the gorge bounding the site.	While airport construction at Badgerys Creek would remove a small area of remaining forest vegetation, development at Wilton would require most of the existing forest to be removed. Badgerys Creek has a more varied landscape because of the variety in landcover types. However the landscape and visual quality of the Wilton landscape is higher than at the Badgerys Creek site.
Assessment: Most of the selected site would be cleared and earthworks would level the high ground and fill some of the low depressions. These changes would irreversibly alter the current landscape and visual character of the site.		The landscape and visual appearance of the airport would be similar irrespective of which site were chosen.
FLORA (Section 11.1)	**(Section 16.1)**	
Description: A total of 71 native plant species were recorded during the field surveys of the proposed site. Only remnant stands of native vegetation remain, in clumps ranging in size from 0.5-1 ha in area. Forest or partially cleared forest represents less than 10% of the site.	**Description:** About 350 native plant species were identified during field surveys of the proposed site. Five vegetation types were recognized and include swamps/wet heath; scribbly gum woodland; peppermint woodland; riverine complex; and open forest on shale. These covered about 90% of the site.	The Wilton site contains over 280 more plant species, is floristically more diverse, and contains about 1,120 ha more forest cover than the Badgerys Creek site.
Assessment: None of the areas of vegetation within the proposed site could be described as an authentic remnant of the natural plant cover. Introduced plants are abundant and as a consequence the floristic value of the site is low. Only one plant was identified as having significant conservation value.	**Assessment:** The proposed site contains about 11 significant plant species. The site has considerable floristic value, as it contains an integrated and well preserved example of regional vegetation. Several plant species identified are important because of restricted distribution.	In floristic terms, the Wilton site contains more significant plant species and is generally of greater conservation value than the Badgerys Creek site.
FAUNA (Section 11.2)	**(Section 16.2)**	
Description: The faunal habitats are associated mainly with the cleared farming land, dams and waterbodies, and remnant vegetation, particularly along Badgerys Creek. The site survey recorded 61 birds, 1 native mammal, 14 reptiles, 2 amphibian species. The creek habitat was the most important of the habitats on the proposed site.	**Descripion:** The main habitat types that were identified were associated with the shale and heath vegetation, the cleared area and the creek lines. The site survey recorded 96 birds, 12 native mammals, 9 reptiles and 11 amphibian species. The native vegetation associated with the shale areas supported the highest diversity of wildlife.	A total of 78 and 128 native species respectively were recorded at Badgerys Creek and Wilton.
Assessment: There is a low diversity of fauna within the proposed site and none of the species recorded are regarded as being of high conservation value. The site is of low ecological value and airport construction would have little impact on the status of wildlife species.	**Assessment:** There is a high diversity of fauna within the proposed site and several of the bird and one mammal (the koala) species are considered of conservation importance. The site is considered to have high ecological value. While the loss of habitat from the area would not affect the overall status of most species, the distribution status of some endangered species may be affected.	The Badgerys Creek site is regarded as having a low ecological value whereas the Wilton site is regarded as having a high ecological value. The loss of habitat from either area would not affect the overall status of most species, although the distribution status of some endangered species at Wilton may be affected.

CHAPTER 18

Public Information Programme

18.1 SCOPE OF THE PROGRAMME

During preparation of this Draft Environmental Impact Statement, the Department of Aviation conducted a programme of public information to provide the community both with current information on the process of selecting a site for a second Sydney airport and with a means of commenting on issues related to the second airport. This was necessarily an informal programme, as the formal means of receiving public comment will become available only when this Draft Environmental Impact Statement is placed on public exhibition in accordance with the requirements of the Environment Protection (Impact of Proposals) Act 1974.

The major elements of the Department of Aviation's programme were:

- establishment of a Community Access Centre, where staff provided information and answered enquiries and where a special telephone enquiry service was maintained;
- provision of displays with background information, maps and photographs in the vicinities of Badgerys Creek and Wilton;
- conducting briefings and responding to invitations for departmental officers to attend public meetings;
- releasing information at appropriate stages on progress being made in the selection of a site;
- conducting surveys to ascertain the attitudes of the community to a second airport.

18.2 COMMUNITY ACCESS CENTRE

The Community Access Centre, located in the foyer of the NSW Government Information Centre at 55 Hunter Street, Sydney, was opened on 22 June 1984 and will remain open until at least the end of the period of public exhibition of this Draft Environmental Impact Statement. The centre is open during normal business hours and is staffed by an information officer from the Department of Aviation.

Visual displays

A large display provides information about the site selection process and a description of the two short-listed sites, including sample layouts of runways. There are also descriptions of the analyses of surface access requirements, the local environment, and principles of airport master planning. The site selection programme stages are illustrated and details of consultancy assistance are shown. Interspersed with the information panels are photographs of various aviation activities plus photographs and relief maps of the proposed site locations. There is also information about community access, and questionnaires are provided for visitors to use for their comments.

In the period from 22 June 1984 to the end of February 1985, approximately 5,000 people visited the centre.

Telephone Enquiry Service

As it was expected that many who could not visit the Community Access Centre would nevertheless wish to receive information or make further enquiries, two telephone numbers were provided and widely advertised. From 18 September 1984 one of these was an 008 area code number, so that residents outside the 02 area code district could telephone the Access Centre for the cost of a local call. Enquirers calling after hours could record a message for the information officer to follow up.

A total of 2,360 telephone calls were received between 22 June 1984 and 11 January 1985. In about 300 cases, the enquirers called after hours and left no message, so it was not possible to respond in those instances.

As well as attending to the concerns of telephone callers the information officers noted them down, and they are summarized in Figure 18.1. The main emphasis in the enquiries was on the uncertainty and inconvenience caused by the proposals: there were many enquiries about the location of the site boundaries, about acquisition of land and compensation, and about other issues involving community disruption. People often discussed more than one issue; for instance some began by stating their complete opposition to the proposal and then, in elaborating on this, would bring forward a number of issues.

18.3 LOCAL DISPLAYS

Display panels were erected in local shops, council chambers or post offices in or near both the areas short-listed as a potential location for a second airport. For the Wilton site, display panels were located at Wilton and Picton and, for the Badgerys Creek site, they were located at Badgerys Creek, Luddenham, St Clair and Liverpool. Like the display in the Community Access Centre, these panels carried information about the Site Selection Programme and the possible airport sites. There was a letter-box beside each for the receipt of comments and for answers to the questionnaires that had been widely distributed in the regions affected by the site proposals.

As no officer was in attendance at any of these displays, it is not known how many people saw them. However, the many references to them in telephone enquiries to the Community Access Centre indicated that they had increased public awareness and interest.

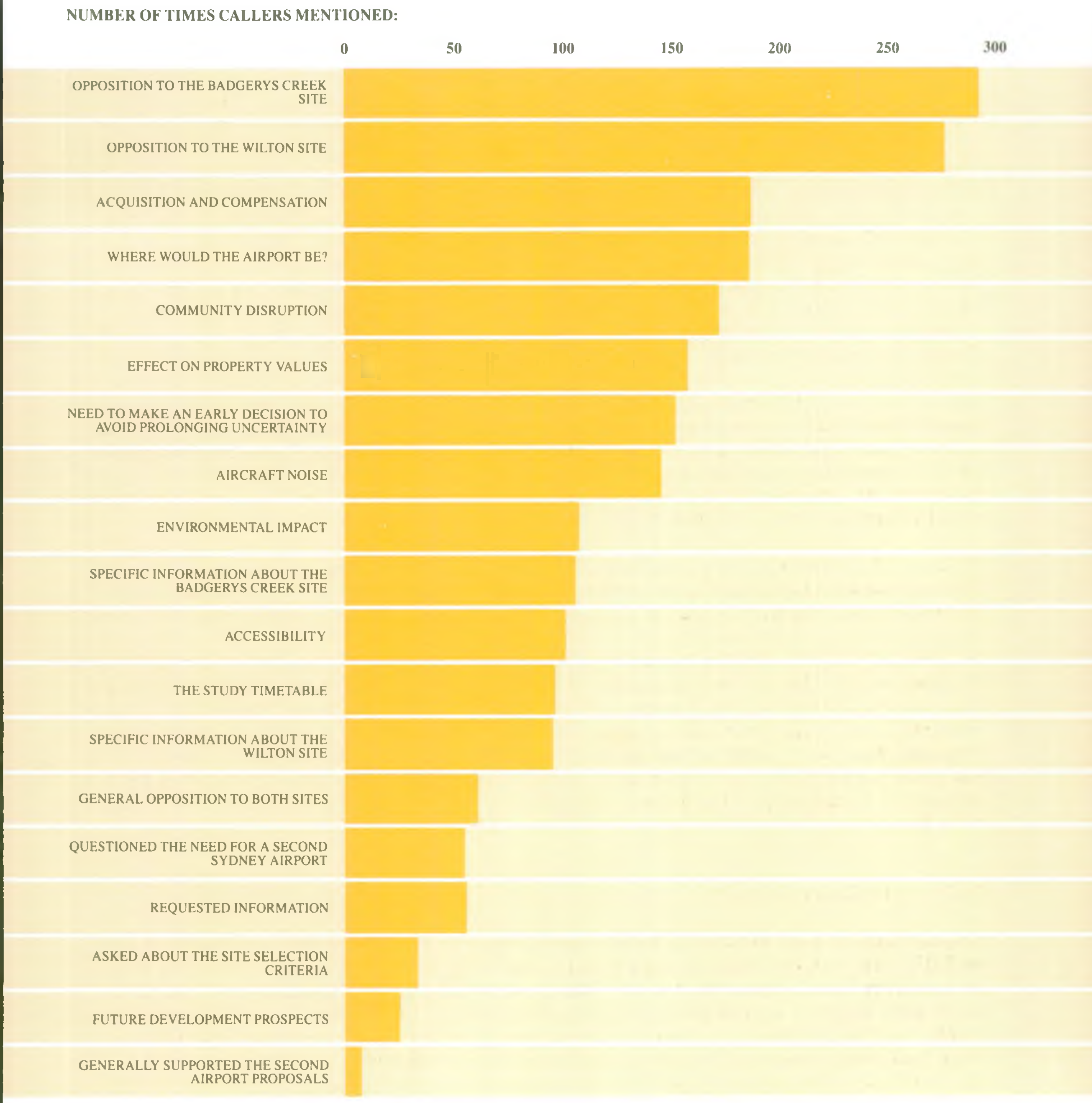


Figure 18.1
ISSUES RAISED IN TELEPHONE CALLS TO THE ACCESS CENTRE

18.4 BRIEFINGS AND MEETINGS

Officers from the Department of Aviation attended the following meetings:

Date	Organizing group	Nature of meeting
July 1984	Local Government Association of New South Wales	Briefing on progress of the selection programme
September 1984	Warnervale Progress Association	Public meeting about the Warnervale site
October 1984	Wilton Airport Resistance	Public meeting about a proposal for a second airport site at Wilton
October 1984	Badgerys Creek Anti-Airport Committee	Committee meeting about a proposal for a second airport site at Badgerys Creek
November 1984	Department of Aviation	Briefings to Liverpool Council
December 1984	Department of Aviation	Briefing to Penrith, Liverpool and Wollondilly councils
January 1985	Department of Aviation	Briefings to Penrith, Blue Mountains and Liverpool councils
January 1985	Department of Aviation	Briefing to Wollongong Council giving latest information on the selection of a site
January 1985	Department of Aviation	Briefing to Wollondilly Council giving latest information on the selection of a site
March 1985	Hawkesbury/Nepean/Georges River Basin Anti-Airport Committee	Briefing giving latest information on the selection of a site

These meetings have given community groups opportunities to obtain information directly from officers of the Department of Aviation, and to convey their views.

Many local councils from New South Wales country districts sent representatives to a meeting of the Local Government Association on 25 July 1984 to voice their strong concern about their need for continuing access to Kingsford-Smith Airport by regular air transport. They feared that, if their intrastate and commuter flights were directed to a second Sydney airport, they would lose the advantage of the easier access provided by Kingsford-Smith Airport to the city centre, which for their short-haul flights they saw as being of vital importance.

Following meetings between the Minister for Aviation and delegations led by councils from potentially affected areas, ways of improving liaison at officer level were agreed on, to ensure that councils and community groups were kept informed of developments in the programme and given adequate opportunity to contribute. Arrangements were made with Liverpool and Wollondilly councils that provided for the involvement not only of Department of Aviation and council officers but also of nominated representatives of community groups.

In addition, speakers were provided at meetings of the following service clubs:

- Penrith Rotary Club on 18 June 1984
- Sutherland Rotary Club on 10 October 1984
- Engadine Lions Club on 21 November 1984.

18.5 INFORMATION ON PROGRESS

At appropriate stages in the Second Sydney Airport Site Selection Programme, the Department of Aviation released information about progress. The topics and dates of these releases are listed below:

Date	Subject	Form of release
July 1984	Appointment of major consultants	Departmental news release
6 July 1984	Minister opens Community Access Centre	Minister's speech
6 July 1984	Description of Second Sydney Airport Site Selection Programme	Brochures, display panels in Community Access Centre
25 July 1984	Site selection procedures	Paper presented to meeting of Local Government Association of NSW
29 August 1984	Second Sydney Airport Site Selection	Ministerial news release
18 September 1984	Short-listing announcement	Ministerial news release
September 1984	Wilton or Badgerys Creek?	Brochure
September 1984	Information on short-listed sites	Latest information added to Community Access Centre panels
September 1984	Information on short-listed sites	Minister's letter to residents possibly affected
October 1984	Information on short-listed sites	Display panels in local centres
25 October 1984	Clarification of procedures for acquisition and compensation	Departmental news release

An address list was compiled of interested people who had indicated that they wished to be informed when major developments occurred in the Site Selection Programme. The list had grown to over 700 by the time of publication of this Draft Environmental Impact Statement.

18.6 SURVEYS OF COMMUNITY ATTITUDES

Two surveys were conducted during the Site Selection Programme to ascertain community attitudes towards a second Sydney airport. The first was a statistically controlled telephone survey carried out in January 1984, and the second was based on a questionnaire available at the Access Centre and local displays. Distribution of the questionnaire began in June 1984 when the Access Centre opened. An amended questionnaire was issued following announcement in September 1984 of Wilton and Badgerys Creek as locations for further study. The results of both surveys are summarized below.

Telephone survey

A total of 1,350 people were interviewed (Burke 1984). The sample was drawn from the 02, 042, 043, 045, 046, and 047 STD areas. A random quota technique was employed so that the demographic characteristics of the people who responded would reflect those of the community as a whole.

The results of this survey indicated in general that the community was very much aware of the proposal to acquire a site for a second airport and, more importantly, endorsed its construction. Over eight of every ten respondents knew such a facility was currently being planned, and more than half of these were aware that a site had not yet been selected. A clear majority of people — seven of every ten respondents — expressed the view that a second airport was necessary.

While a second airport was seen as creating certain problems, especially for local residents, the advantages it would bring were regarded as clearly outweighing the disadvantages. People felt that Kingsford-Smith Airport was inadequate because, for example, it was subject to air and road traffic congestion, and because the expected growth of the urban population would require further airport capacity than could currently be provided there. The principal advantages of a second airport were seen as being in the relief of air traffic congestion at Mascot, and in its job creation potential. The major disadvantages people referred to were the general disruption to residents living in the area and the increased noise levels. Apart from the feeling that the current Sydney facility was inadequate, many people also saw a second airport as contributing positively to the whole of Australia.

When asked to state their preferences regarding the broad area where the second airport should be built, people clearly indicated that the Sydney Metropolitan Area was not strongly favoured. Rather the preference was for a site somewhere on the outskirts of Sydney or, failing that, a site removed from the Sydney area altogether.

Specific preferences for seven sites nominated as possible were, in rank order from the site most preferred to that least preferred:

- Darkes Forest
- Holsworthy
- Londonderry
- Scheyville
- Badgerys Creek
- Somersby
- Gundary Plains (Goulburn).

A second Sydney airport was seen as serving both international and domestic air traffic, and as potentially making a broad contribution to the country and/or the State of New South Wales, rather than primarily contributing to Sydney only.

Community Access Centre questionnaire

A two-page questionnaire was developed and made available at the Community Access Centre and local displays. From September 1984 a total of 9,000 copies of the amended questionnaire were placed with the various displays and approximately 670 responses were received.

As responses to the questionnaire were voluntary and unsupervised, the 670 responses represented only the views of those people who were interested enough to complete questionnaires and return them. Examination of the questionnaires returned showed that of the 670, 198 came from the Wilton area, including Picton, Douglas Park and Tahmoor, and 228 from the Badgerys Creek area, including Luddenham, Bringelly and St Clair. A further 111 came from areas adjacent to potentially affected communities. Thus 80% of all responses came from people living in or near areas that could be affected by the proposal.

Of the people returning the questionnaires, 46% considered that the most important factor in siting an airport was the effect on the local community, while the second most important was the effect on the local environment. After that, 'operational and safety aspects' and 'user convenience and accessibility' were the overwhelming choices as next in importance. 'Cost factors' was selected as the least important. 'Effect on the local community' was the most important factor for groups in all areas of Sydney except the north, where operational and safety aspects were considered even more important. However, the sample size for the groups from the north was low, with only thirty-two questionnaires being returned.

With regard to the choice of a site, 51% of the respondents chose Wilton, 21% chose Badgerys Creek and 28% selected neither of these sites. However, as the amended questionnaire did not provide an alternative choice of sites other than the two that had been short-listed, the number preferring the 'neither' option may be significant. The proportion of respondents from the Wilton area who preferred the Badgerys Creek site was only 36%, while 54% chose neither as their preference. In contrast, the proportion of respondents from Badgerys Creek preferring Wilton was a high 76% compared with a 'neither' vote of 17%. The major reason given for a preference for Wilton was 'the effect on the local community' — presumably because there are fewer people there than at Badgerys Creek. Those who preferred Badgerys Creek gave accessibility as the most important reason for their choice.

Sixty-five per cent of respondents considered that an airport would be a disadvantage rather than a benefit to an area, and gave as the most important reasons the adverse effects on the environment and on the local community. The highest number of people holding this view came from the Wilton and Badgerys Creek areas (75% and 82% respectively). Of the 35% of respondents who considered a second airport as a benefit to the area selected for the site, 80% gave employment as the main reason.

When asked in what ways the community would want to be kept informed about development, by far the greater number of respondents favoured 'publications mailed to respondents' and 'staffed information office being temporarily located in area'. To satisfy these needs, information is being sent out under the Community Access Programme to all those whose names are included on the centre's extensive address list, and also to any one else who makes a request. In addition, the Community Access Bus, which is fitted out as a mobile information centre, will visit many communities in or near the two short-listed sites during the period when the Draft Environmental Impact Statement is on public exhibition.

In relation to the preparation of submissions on the Draft Environmental Impact Statement, the questionnaire asked 'In what ways can we assist you?'. However, respondents appeared to take this question as an opportunity to air their overall views. The great majority of people said that there should be no second Sydney airport and that Kingsford-Smith Airport should be expanded. They also clearly stated the view that residents should be kept well informed and that there needed to be a quick decision on a site for the new airport.

18.7 LETTERS TO THE MINISTER

Since commencement of the Site Selection Programme, letters to government ministers (principally to the Minister for Aviation) from members of the public and organizations have totalled approximately 2,800. This total included a mass mailing of approximately 1,900 pro forma letters to the Minister for Aviation objecting to one location, Scheyville. Over the same period, letters to ministers that were not merely pro forma totalled 867, and related to all sites under consideration.

Since the public announcement on 18 September 1984 by the Minister for Aviation that the Government had short-listed two locations, Badgerys Creek and Wilton, for closer study, almost all correspondence received by the Minister for Aviation concerning the second airport has related to these two sites.

18.8 MAJOR SUBMISSIONS

During the course of preparation of this Draft Environmental Impact Statement, submissions were received from the Badgerys Creek Anti-Airport Action Group and the Wilton Airport Resistance Group. Both submissions raised a large number of issues which are summarized below.

Badgerys Creek Anti-Airport Action Group

The major issues identified in this submission were that:

- it was fifteen years too late to contemplate building an airport at Badgerys Creek;
- too many people would be affected by noise and pollution;
- local councils have allowed housing applications to be processed over the years, without warning the applicants of a possible airport being sited there;
- it would be necessary to acquire over 210 dwellings, two churches, a public school, a public hall, two shops, a post office and a cemetery, as well as one of the largest milk producing properties in New South Wales;
- employees and owners of businesses within the affected area might not be able to relocate in circumstances comparable to those now enjoyed;
- people with properties affected by noise would have to sell cheaply and would not be compensated for any losses incurred;
- all land within the 25 ANEF noise contour should be acquired;
- the residents of Kemps Creek and those living in the flight paths on the heights of Mount Vernon and Horsley Park would be adversely affected;

- the prime objective in site selection must be people, and in particular consideration must be given to the number of people who would be affected by site selection and acquisition;

- the second Sydney airport should be located on public land.

This submission also stated that there had been a lack of communication between the Department of Aviation and the general public and that questions were yet to be answered (by the Department) on such matters as:

- the type of airport to be built
- the use of the airport
- the type of aircraft to use the airport
- the direction of flight paths
- the time when provisional site maps would become available.

This submission stated that 24,000 signatures had been obtained for a petition entitled 'No Airport for Badgerys Creek'.

Wilton Airport Resistance Group

The Wilton Airport Resistance Group prepared two major documents in the form of reports on the environmental impacts of locating an airport at Wilton, and specifically within the water catchment area. The first report (18 January 1985) was approximately 110 pages in length, and the second (30 January 1985) was 86 pages. This second document contains a summary of the effects of the proposed siting of the second airport in the Wilton area and/or the catchment. This summary is reproduced below without alteration (except for omission of reference to appendices in that document).

In giving permission for the summary to be reproduced, the Wilton Airport Resistance Group notes that its submission is a draft only and is not to be taken as a submission on the Draft Environmental Impact Statement.

SUMMARY OF EFFECTS OF THE PROPOSED SITING OF SSA IN WILTON/CATCHMENT

Topographical effects

The proposed site has been systematically analysed by a trained geographer familiar with the local area and its impact on local topography is now discussed in detail:

Cut and fill
In terms of longitudinal gradient, the two strips would require cut and fill averaging 10 m. Much of the site would need to be filled with imported material. The fill needed in many areas would exceed 20 m, which, of course, was the reason for rejection of other sites during the original selection of the SSA. In view of the natural topographical features, this would mean blasting and the use of heavy capital equipment to remove overburden. It is highly likely to cause earth tremors from blasting which will accelerate otherwise long-term natural earth movements such as sandstone floaters within the site and outside it at the Cordeaux Gorge which border the site. Blasting in general could affect the stability of landforms some distance from the site as was the case when the F5 was constructed.

Mine subsidence
The site is surrounded by mine subsidence regions that were mined without recourse to such an extensive surface development like an airport. The additional costs of construction due to possible subsidence must be considered.

Restriction of further expansion

The location of the runways within the proximity of the major gorges (850 m and 650 m) will obviously restrict future expansion and the development of the airport as a stand alone facility. South of runway 1 the Cordeaux river bank is as close as 500 m. In the North East, the runways are bounded by Cascade and Wallandoola Creeks forming part of the feeder system for Sydney's water supply. Expansion to the North West encounters two major problems. The first is the necessity to cut and fill 30 m since the fall of land is 60 m. The second is the location of Allen's Creek an integral part of the catchment drainage system, where heavy flows into Allen's Creek are likely to filter through the overburden into the sandstone lined Nepean Tunnel. This drainage into Allen's Creek is highly likely to deposit pollutants into the Sydney water supply.

Clearing of bushland

Construction of an airport in Water Catchment would require the removal of at least 16 square kilometres of natural bushland to be replaced by the non-natural cover of asphalt. This would result in various cross-sectoral effects:

- *increased run-off and siltation of rivers;*
- *accelerated erosion and soil loss;*
- *increased wind erosion;*
- *increased evaporation/transpiration rates leading to less effective utilization of the water storage in the existing dams;*
- *deterioration of water quality;*
- *damage to fish and breeding grounds;*
- *destruction and disruption of the natural habitats of native birds and animals.*

It is therefore crucial that these cross-sectoral effects, where activities in one sector affect other seemingly unconnected sectors are anticipated prior to any airport development within the catchment area.

Social costs

a. *Resumption costs will be minimal due to the use of predominately Crown Land.*

b. *Apart from runway construction, the major costs would result from the re-location of:*

   - *Mt. Keira Road;*
   - *a natural gas pipe line;*
   - *electricity transmission lines;*
   - *telephone lines; and*
   - *control of drainage/run-off into tributaries of Wallandoola Creek, and the Cordeaux and Cataract Rivers.*

c. *The social costs, resulting from the loss of our national heritage, would be great. These would include:*

   - *removal of buffer zones;*
   - *destruction of fauna and flora;*

- *sterilization of valuable coal resources; and*
- *pollution of Sydney's water supply.*

d. *Over 200 Wilton families will lose their lifestyles, the psychological effect of which is difficult to assess.*

e. *The cost of development of concurrent infrastructures such as railway link, hospitals, etc. would be astronomical.*

f. *The complaints of citizens of New South Wales were disregarded while the decision was made by government to construct the Maldon-Dombarton rail link. In addition, Wilton residents have still not been paid by the State government for land resumed for this railway. This project has now been put in cold storage. Like the airport proposal it was meant to provide employment. Can you blame Wilton residents for being cynical?*

g. *Cross runways will directly affect many other villages, e.g. Appin, Bargo, Tahmoor, Thirlmere and Picton, etc.*

h. *Television reception, which is marginal in the Picton area, will be greatly affected as aircraft fly between Picton and the Sydney transmitters.*

i. *The noise from airport maintenance and on-ground warm-ups, from planes landing or taking off, from planes in the circuit and on approach will greatly reduce the quality of life in surrounding areas.*

j. *The effect of noise spreads further in rural areas because of the lower absorption background levels and lack of barriers to baffle sound. The Galston estimate was that noise would be very loud 20 km from the airport.*

k. *The hills around Wilton and around Picton will cause the sound to reverberate. Picton will suffer an amphitheatre effect.*

l. *The Water Catchment is a very important wildlife refuge. It acts as a de facto National Park. An airport will destroy this habitat.*

m. *Wilton's picturesque brick church, St Lukes, could be damaged (e.g. Hansard reports on church roofs being displaced when located in the vicinity of flight/glide paths.*

n. *St Mary's Towers and Wilton Park, both listed by the National Trust and the National Estate and important in the history of the area, will be severely affected.*

o. *Aboriginal sites will be destroyed.*

p. *The area is subject to mine subsidence and earthquake activity which adds to building costs should industrial development follow the airport.*

q. *If development of the area does occur, water will have to be released from the water storage dams to flush the nutrient laden water down the river. We cannot afford to squander our water reserves in this manner.*

r. *The natural gas pipeline to Sydney runs through Wilton Catchment and has a major offshoot to Wollongong. This pipeline will have to be relocated as a result of the proposed airport, and the present regular checks on this line conducted by McIver Aviation will have to terminate at great risk to a leakage.*

s. *Those properties not resumed will drop in value and will be very difficult to sell.*

The effect of Wilton weather on the proposed SSA

Weather phenomena occurring in the Wilton area would pose the following problems for aviation:

a. strong winter SW winds funnelling through the valley and turbulence about Razorback Range;

b. high incidence of fogs, and mists accentuated by the rivers and dams;

c. winter frosts and cold temperatures;

d. for light general aviation, it is desirable to land and take-off into the wind. Camden airport is well aligned for the prevailing wind pattern. Camden Airport runway is 06-24 (i.e. 60°-240°) which approximates North East to South West. However, in Mr Beazley's news release September 18, 1984, it showed a possible runway configuration NW-SE facing Razorback Range superimposed over the township of Wilton. This runway alignment is totally inappropriate for the prevailing winds.

The effect on airline users of locating SSA at Wilton

a. Wilton is too far away from Sydney for a second airport - a taxi fare to Sydney costs over $50 (if one can be obtained).

b. Depending on the final location of the proposed site, Sydney's second airport could be 87-100 km from the City.

c. The location of a second airport in such a remote site would be recorded in the Guinness Book of Records for the city with the most remote airport (the average distance of an airport from the city it serves is 15 km).

d. Most air commuters come from the northern or eastern suburbs of Sydney and will have to travel through Sydney, mostly at peak hour.

e. It would take twice as long to get to the airport as it would to fly to Melbourne.

f. You're halfway to Canberra by the time you've arrived at Wilton!

g. A phone call from Wilton to Sydney is STD.

h. Imagine a 26 hour flight from Europe, 1 hour through customs and then 2 hours drive from Wilton airport to Sydney. It's enough to send you to Melbourne or Brisbane.

i. Is it conceivable that the State Rail Authority can run a fast train from Wilton Catchment area to the city for international visitors, when present commuters from Campbelltown are not catered for.

j. How would the SRA schedule trains from Wilton/Catchment to cope with the periodic influxes of jumbo jet passengers when they can't even carry the area's coal?

k. What happens if you fly into Wilton and your connection is from Mascot?

l. NSW residents do not want to use Wilton.

m. What if an accident was tragically to occur? There are not the facilities in the Wilton region to cope with such a crisis.

Pollution

General comments

a. *The SSA proposal raises the possibility of the need for a quarantine centre. This would have a disastrous effect in water catchment area.*

b. *The pollutants from an airport include carbon monoxide, mercury and lead, the severe effects of which have been noted in this report.*

c. *Representatives of the MWS&DB have expressed concern at the prospect of typhoid carriers using toilets in the middle of the catchment area.*

d. *The area planned for the airport at Wilton is surrounded by rivers and creeks that are classified Class S (specially protected waters) under the Clean Waters Act. No effluent of any kind may be discharged into these waters.*

e. *It is possible to treat human wastes and make them fit to drink. But what happens when the Water Board goes on strike (such as happened in Sydney recently)? It's bad enough on the beaches and in our rivers, but, in our drinking water!*

f. *A major water supply tunnel passes through Wilton. This was built last century through porous sandstone and is unlined. It is known to fill with water draining from the land above.*

g. *Cascade Creek, which drains the area of the proposed airport, leads directly to Broughton's Pass Weir which is the start of the water supply canal to Prospect reservoir. This is an integral part of Sydney's Water Supply System.*

h. *Water treatment costs will be substantial at Wilton (approximately $80 million, at 1984 prices).*

i. *The area is inappropriate for substantial industrial or residential development because of the difficulties with sewerage and drainage disposal in the upper reaches of the Nepean system due to low flow rates in the river below the dams, and the inappropriate terrain.*

j. *Pollution of the Nepean system will be detrimental to communities using the Nepean system for drinking (e.g. Menangle) or for agriculture.*

k. *To be consistent with its role and history, the MWS&DB must resist and veto any proposal to introduce an airport into their sacred environ.*

l. *The Sydney sprawl needs a buffer zone to safeguard its water supply. At present, this buffer zone is the catchment area. There is nowhere else to guarantee the purity of the sources of their water supply. For future generations, preservation of this area will be crucial to the maintenance of a potable supply.*

m. *How would Schweppes react to having their mineral waters polluted by an airport?*

Questions to be answered regarding pollution of water and air

a. *Since a sewerage treatment plant doesn't remove all traces of micro-biological activity, how does the MWS&DB intend to guarantee that dangerous bacteria will not enter water system, especially under conditions as experienced in recent rains? During these recent incidences of heavy rainfall in this region, the open canal was polluted at Broughton's Pass, highlighting the sensitivity of our water supply and vulnerability of man-made systems.*

b. *The siting of an airport could be seen as fulfilling a need in the transport industry (although totally discredited in other sections of the two submissions presented by*

WAR). The Department of Home Affairs and Environment puts the case succinctly in its discussion paper titled 'Living Resource Conservation and Sustainable Development': 'Ecological processes essential for food production, health and human survival must be maintained, for without healthy life support systems the very concept of development is redundant. The life support system soil, air, water and natural living communities' (1982, p. 13). Interference in the water catchment area, to the degree requiring siting of a SSA and concurrent relocations of roads, transmission lines etc. will guarantee massive deterioration in the life support system for the Sydney population. Is it therefore ethical, to introduce such a potential polluter like an airport into such a sensitive natural environment as the upper unpolluted reaches of the Water Catchment Area?

c. *The MWS&DB currently closely monitor some effluent from Mascot discharged to sewer. We have been informed by the MWS&DB that these details will not be made available because they are confidential. Surely the public have the right to such information because of its effect on their lives. What does the MWS&DB fear about the effluent discharge from KSA? Would they have the same fear about effluent discharged from the SSA particularly if it was situated in its most sacred of domains (i.e. water catchment area).*

d. *The policy on conservation issues in respect of disposal of crown land, conversion of leases etc. states that 'crown land will not be disposed of by way of sale if it meets any of the requirements regarding land acquired to be retained for scenic or catchment area protection and/or protection and preservation of the habitat of native flora. Further, it states that it will not be allocated by way of lease or permissible occupancy if these requirements are adversely affected.' The MWS&DB have been very possessive about their land and consistently followed a policy of buying up any holdings that became available particularly if in the vicinity of any streams. Will the MWS&DB remain consistent with past policy and government be consistent with respect to crown lands and effectively veto any suggestion of siting SSA in water catchment area?*

e. *As argued in the two submissions, the siting of SSA in water catchment is likely to have unplanned, insidious and undesirable effects on the water cycle, flora, fauna and the population that rely on pure water. Can our society afford the additional costs incurred in curbing pollution, treatments aimed at removing pollutants, and the social costs associated with diseases and environmental damage?*

f. *The Water Resources Conference held at Macquarie University in 1983, resolved that no natural resource or physical commodity is more important to the country than water. Water resources are irreproducible. How can a government justify siting SSA in a locality that will pollute the Cordeaux, Cascade, Allens, and Wallandoola drainage system and hence make unacceptable and unsuitable for domestic purposes the water currently regarded as one of the most pure in the world?*

g. *Is the Department of Aviation presently investigating legislation which will allow for compensation for residents in areas affected by the noise of aircraft?*

h. *When will the House of Representatives Standing Committee on Environment and Conservation complete the enquiry into aircraft noise.*

18.9 RESPONSE OF THE DEPARTMENT OF AVIATION

Throughout the course of the Second Sydney Airport Site Selection Programme, the Department of Aviation has made every effort to ensure that residents in potentially affected areas have been kept informed on the progress of the study.

Within the limits of the timetable set by the Commonwealth Government, the Department of Aviation has, through the work of its Consultant, provided as comprehensive and as detailed a Draft Environmental Impact Statement as possible.

Recognizing the scope and complexity of the subject matter of this Draft Environmental Impact Statement, a ten-week public exhibition period has been set. During the course of this exhibition period the Department of Aviation will continue to maintain the Community Access Centre in Sydney. In addition, the Department has a Community Access Bus which will be located at advertised centres in the vicinity of Badgerys Creek and Wilton throughout the period of exhibition of this Draft Environmental Impact Statement.

APPENDICES

APPENDIX A: CONDUCT OF THE STUDY AND GUIDELINES FOR ENVIRONMENTAL IMPACT STATEMENT PREPARATION

CONDUCT OF THE STUDY

This Draft Environmental Impact Statement was prepared over an eleven month period by the Consultant, Kinhill Stearns, under the direction of the Department of Aviation. The scope of the Draft Environmental Impact Statement was established by the guidelines prepared jointly by the Department of Arts, Heritage and Environment and the NSW Department of Environment and Planning, which are included in this Appendix.

Three reference groups were established to oversee the conduct of the study. The Environmental Reference Group comprised representatives of the Commonwealth departments of Aviation, and Arts, Heritage and Environment, and the NSW Department of Environment and Planning. This group provided guidance in the interpretation of the Environmental Impact Statement guidelines and advice on the structure of the Draft Environmental Impact Statement and reviewed the Draft Environmental Impact Statement text prior to publication.

The Land Use Working Group comprised representatives of the Department of Aviation and the NSW Department of Environment and Planning. This group provided guidance on the application of the NSW Government's regional planning policies and specific planning controls which will be gazetted to coincide with the announcement of the selected site.

The Access Working Group comprised representatives of the Commonwealth departments of Aviation and Transport, and the NSW departments of Main Roads and Environment and Planning, the State Transport Study Group, the Urban Transit Authority and the State Rail Authority. This group provided guidance on appropriate study procedures and on NSW transport policies and plans, and provided data.

SECOND SYDNEY AIRPORT SITE SELECTION PROGRAMME: GUIDELINES FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT

1 INTRODUCTION

The main text of the Draft Environmental Impact Statement should be a straightforward document treating its subject in terms which are clear and readily intelligible to the general reader. Supporting technical detail should be included as appendices so that the Draft Environmental Impact Statement forms a complete and self-contained entity.

These guidelines are based on the requirements of paragraph 4.1 of the Environment Protection Administrative Procedures. These guidelines also recognize the requirements of the NSW Environmental Planning and Assessment Act, 1979, and the Environmental Planning and Assessment Regulation, 1980, in so far as the proposal comes within the scope of the Agreement between the Commonwealth Minister for Arts, Heritage and Environment and the NSW Minister for Planning and Environment concerning procedural guidelines for environmental assessment involving the Commonwealth and New South Wales.

In broad terms the provisions of this agreement require:

- consultation with a view to reaching agreement on the environmental information each department will require, and matters that should be covered, in a Draft Environmental Impact Statement;

- the Draft Environmental Impact Statement being made public in accordance with the specific requirements of each department;

- exchange of written comments received on the Draft Environmental Impact Statement;

- consultation with respect to any inquiry contemplated;

- independent assessment and preparation of reports to Ministers by the two departments but with appropriate consultation; and

- reference to Ministers where the departments are unable to reach agreement.

The NSW environmental legislation requires that the person preparing a Draft Environmental Impact Statement shall consult with the Director, Department of Environment and Planning, to ascertain the Director's requirements with regard to its form and content. As there has been liaison between the Commonwealth and State with regard to these guidelines, it may be regarded as meeting the Director's requirements.

An essential element of the Draft Environmental Impact Statement is the discussion of alternatives, their environmental impacts and the reasons for the choice of the proposal. In discussions between the departments of Arts, Heritage and Environment and Aviation it has been agreed that the Draft Environmental Impact Statement will be the basis for arriving at a short list of alternative sites, rather than one preferred site. It is envisaged that detailed discussion in the Draft Environmental Impact Statement will concentrate on the key sites on this short list. However, it is also essential that there is adequate coverage of the reasons, environmental or other, for the elimination of all other possible alternative sites and courses of action, including continued reliance solely on Kingsford-Smith Airport.

It will be necessary to set out early in the document the nature of the site selection task and consequently the scope of the Draft Environmental Impact Statement. The aim of the exercise is to select and acquire land for a second Sydney airport against a possible shortfall in capacity at Kingsford-Smith Airport. The Draft Environmental Impact Statement will discuss in detail the impacts associated with the selection and acquisition process and will cover as far as possible the impacts of possible developments at the various sites. However, as there is no commitment at this stage to any development at the selected site, this discussion can only be in broad terms with regard to airport design. However, as noise is a key issue in the environmental assessment of the proposal it would be essential for the Draft Environmental Impact Statement to show the location and alignment of the runways and to provide ANEF contours for consideration in relation to adjacent and anticipated urban development.

The Draft Environmental Impact Statement should also include an analysis of access requirements in relation to anticipated metropolitan urban development. As the role of the second Sydney airport may not be determined at the time of the preparation of the Draft Environmental Impact Statement, the assessment will need to be based on the 'worst possible case' for each site under consideration.

The document should include sufficient information and technical data to enable interested parties to examine the basis of the environmental implications of decisions. Relevant maps should also be included but their preparation and reproduction should be such as to minimize, as far as convenient, the cost of printing the Draft Environmental Impact Statement, and of making it available to the public.

The following guidelines indicate the aspects which should be considered in the preparation of the Draft Environmental Impact Statement. Each aspect should be dealt with only to the extent considered appropriate to the development under consideration, with a view to concentration on the more significant impacts. It is also essential that close contact be maintained with this Department during the preparation of the Draft Environmental Impact Statement. The Department of Arts, Heritage and Environment will in turn facilitate the necessary liaison with the NSW Department of Environment and Planning with respect to the State's requirements on the form and content of the Draft Environmental Impact Statement. These guidelines are not necessarily exhaustive.

2 CONTENTS OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

2.1 Introduction

Title of the proposal; name of the proponent; place of the Draft Environmental Impact Statement in the planning, design and decision-making process for the second Sydney airport; application of Environment Protection Administrative Procedures to the proposal and relationship with State environment assessment procedures; scope of the Draft Environmental Impact Statement in that it covers as far as possible the effects of a developed, operational second Sydney airport as well as site identification and acquisition effects; immediate steps following the Environmental Impact Statement, particularly site announcement and acquisition procedures.

2.2 Summary

The Draft Environmental Impact Statement should include a concise summary of relevant information to enable the reader to obtain a quick but thorough understanding of the proposal and the resulting environmental impact.

2.3 Background to and need for the proposal

Need for new runway capacity in the Sydney Region in the long term. Analysis of aviation demands for Sydney Region and discussion of Kingsford-Smith airport site limitations.

Description of the Commonwealth Government's decision relating to Master Planning Kingsford-Smith airport.

Outline of ultimate constraints at Kingsford-Smith airport.

History of investigations for new runway capacity in recent years and summary of information made publicly available in recent years on this issue through the Major Airport Needs of Sydney exercise.

Relationship of proposal to planning for other airports in the Sydney Region and for all forms of aviation in the Region, including general aviation.

Consequences of taking no action, the planning risk involved in not reserving a site now.

State Government views and regional planning considerations regarding Kingsford-Smith airport and new airport development for a second Sydney airport as formally conveyed to the Commonwealth Government.

2.4 Role of and requirements in general for a typical second Sydney airport

Range of possible roles for the second Sydney airport when fully operational in long-term. Additional second Sydney airport measures which are desirable to keep options open for ultimate developments beyond forecast period.

The Draft Environmental Impact Statement to be based on assumptions relating to the fully operational second Sydney airport (worst-case scenario for the configuration that has been adopted).

In general terms the locational requirements, area needs and site requirements for a typical second Sydney airport, with reference to airport operational criteria.

In general terms the levels of air traffic that will be generated by such a fully operational second Sydney airport, its investment requirements, the surface traffic likely to be generated, likely pressures for urban development in nearby areas, and the likely extent of noise-affected areas under flight paths.

2.5 Elimination of unsuitable alternative second Sydney airport sites

Summarise the process of short-listing to the current alternative sites, which was undertaken in earlier studies and has been adopted in current planning.

In summary form provide the environmental reasons relating to both the natural and the social environment for the reduction of the current list of sites to a short list of two or three.

Provide other reasons for the elimination of alternative sites: operational, topographical, site suitability, economic, financial, accessibility, and any others.

Give the State Government's views, particularly on the relationship of alternatives to Sydney's regional planning, as made available to the Commonwealth Government.

The above analysis should be in sufficient detail to justify beyond doubt to the public the elimination of unsuitable sites from further consideration.

Nominate the remaining feasible and prudent alternative sites for a second Sydney airport, which will be discussed in the Draft Environmental Impact Statement - the short list.

2.6 Description of the environments of the remaining alternatives

A description of the existing and anticipated future environments on the short-list sites and related areas is required to provide baseline environmental data for the evaluation of the impact of the proposals, development of safeguards and subsequent management and monitoring programmes. Any detailed technical information should be provided in an appendix.

The environment of the sites and related areas should be described, to an appropriate level of detail for each site, including the following:

Natural environment

- geomorphology - land forms, terrain analysis
- topography as regards airport suitability
- soils - soil types, including erosion potential
- geology, including seismic stability, mineralisation, materials that could be used for construction or which could become sterilized
- hydrology - details of surface and underground water systems including flood potential, water quality
- climate - particularly wind, fogs and temperature inversions
- air quality - dust, smoke, particulates, and relationship of site to Sydney's air drainage basin

- flora vegetation associations
- fauna, habitats
- ecological relationships, including conservation status of species or associations to be disturbed by project
- visual aspects of the site - immediate and from vantage points
- areas of special significance.

Socio-economic environment

- population distribution and structure (numbers, demographic characteristics and trends, ethnic and social structure)
- workforce and occupations, employment opportunities, regional unemployment (numbers and skills)
- description of existing primary, secondary and service industries in the locality
- social factors (cultural or lifestyle characteristics, existing trends and social problems)
- land tenure, subdivision, and easements through sites
- land use - existing and proposed uses (especially those imposing constraints on the proposal), government land, forests, water resources, infrastructure corridors, rural, industrial, residential, commercial, recreational, mining, town planning or zoning considerations
- feature and sites of historical, scenic, recreational, cultural or scientific interest - including national parks or reserves, places on the Register of the National Estate
- sites or relics of Aboriginal anthropological or archaeological significance
- description of adjacent urban areas and relevant existing local and regional services, social facilities and infrastructure
- noise environment at the site, under prospective flight paths and near possible access routes and other works.

2.7 Description of alternative proposals at the short-listed sites

Describe the salient features of the proposal for each site as regards acquisition and any altered land use. In addition, describe as far as possible airport developments at each site. The technical, social and broad economic characteristics of the project, flight path and its associated facilities, both public and private, should be discussed. Provide appropriate maps, figures and diagrams.

Specific aspects on which information should be included, as appropriate, are:

- site boundaries, site earthworks, possible material requirements and sources of supply;
- extent of acquisitions for the site, associated works and flight paths (if applicable);
- flight paths, and likely frequency of flights on each runway and generalised description of aircraft types making flights;

- facilities of all types to be provided within site;
- number of employees, travellers, others who will visit site;
- location of access roads or other transport facilities;
- description of likely traffic volumes by transport modes;
- provision of utility services to the site and demands on those services;
- outline of essential or likely off-site infrastructure and community developments which will be necessary for the support and servicing of an airport in the vicinity of each site;
- desirable zoning and land-use requirements adjacent to site and under flight paths.

2.8 Potential environmental impact

The potential impact on the environment of the alternatives should be assessed by examining and discussing the predicted effects of all facets of the proposed development at each of the short-listed sites on the existing and likely future environment at the local, regional and (if appropriate) State or national levels.

Impacts should be considered for the acquisition, construction, and operational phases. The impacts may be direct or indirect, adverse or beneficial, short or long-term and temporary or irreversible. Emphasis should be given to major impacts. Impacts should cover the airport itself, related and adjacent areas and access routes.

Some examples of the more obvious types of impacts that need to be considered are listed below:

Acquisition phase

- any effects on the natural environment arising from acquisition
- severance effects
- effects of acquisition of residences, commercial and industrial activities, institutions, and others
- effects of acquisition on recreation areas, sites of archaeological or heritage value
- compensation measures for compulsory acquisition
- timing, procedures for acquisition.

Construction phase

Describe as far as practicable the likely impacts of construction works associatd with any future developments as they affect the various sites. These impacts may arise from:

- earthworks, soil erosion, hydrological effects, materials required for construction and possible sources of supply;
- extent of clearing (if any) of native vegetation plus effects on native fauna, especially rare or endangered species or significant habitats;
- effects on natural environment of new infrastructure works, e.g. roads, access tracks, power lines, water pipelines, sewerage disposal or solid waste disposal sites;

- social impacts of construction workforce on nearby areas.

Operational phase

Describe as far as practicable the likely impacts of an operational airport at each of the proposed sites including possible cumulative effects with associated development. Impacts which might be considered include:

- noise impacts

  - aircraft in flight, in terms of ANEF contours, and on ground
  - surface traffic generated;

- electro-magnetic interference from flights;

- air pollution

  - aircraft
  - surface traffic
  - associated urban development;

- effects of alteration to run-off and drainage patterns;

- safety - aircraft and surface traffic;

- visual impacts at the site and from vantage points;

- effects of waste disposal, particularly sewerage;

- effects on local and regional economy;

- demands on community facilities and utilities;

- effects on surrounding land uses and zonings at the announcement stage, in the long term.

2.9 Analysis of alternative sites

Since it would be inappropriate to publicly nominate a preferred site before a Ministerial decision, the Draft Environmental Impact Statement could indicate, by employing some form of analytical matrix, the range of environmental considerations which would need to be taken into account in coming to decision on a site. This might include a weighting of the environmental impacts discussed above for each site, which would need to be balanced against other (non-environmental) factors in final decision making. This should involve the separate listing of tangible and intangible (subjective) matters.

2.10 Environmental safeguards and monitoring

Describe and assess all safeguards and remedial measures proposed for the amelioration of the potential impacts identified. This should be done in a separate chapter in the Draft Environmental Impact Statement, and should include details of any monitoring programmes undertaken following acquisition. Aspects to be covered should include:

- compensaton for acquisition;

- monitoring programmes and any procedures to be implemented to avoid 'planning blight' following acquisition;

- compensation (if applicable), standards and flight path procedures relating to the minimising of aircraft noise nuisance;

- extent of acquisition of land rezoning options or other measures that may be possible to minimize effects outside site;

- provision for long-term leaseback for non-residential uses;

- ongoing liaison with State, local government as regards regional planning, environmental standards.

2.11 Sources of information

The sources of information (e.g., reference documents, literature sources, research projects, authorities consulted) should be cited.

2.12 Appendices

Additional information relevant to the Draft Environmental Impact Statement that is not included elsewhere should be set out in appendices (e.g., maps, graphs, tables, photographs, reports etc).

Environment Assessment Branch

Department of Arts, Heritage and
Environment February 1984

APPENDIX B ASSESSMENT AND COMPARISON OF CAPITAL COSTS FOR ALL SITES

In order to compare the capital costs required for construction and support of airport facilities at each of the ten nominated sites under the worst case assumptions used for site ranking, estimates were obtained for the following:

- land acquisition costs
- relocation of any Commonwealth facilities on the site
- relocation of existing infrastructure on the site
- site preparation costs
- access related costs to support the site
- costs for new infrastructure at the site.

These cost estimates are set out in Table B.1 in terms of constant (1984) dollars. It should be noted that site preparation costs include only the costs of preparing the site for construction (obstacle clearing, earthworks of various types); the costs of the 'superstructure' at the airport site (runways, taxiways, terminal buildings, maintenance facilities, etc.) were not included because, for the purposes of site comparison, superstructure costs were assumed to be essentially identical for all sites.

Table B.1 Cost estimates - 25 million passenger worst case ($millions, 1984 prices)

Site	Site acquisition	Relocation of Commonwealth facilities	Relocation of existing infrastructure	Site preparation	Access			New infrastructure
					Road	Rail	Total	
Badgerys Creek	76.7	50.0	10.8	94.6	218.0	104.0	322.0	49.0
Bringelly	116.0	0	12.25	84.6	187.0	132.0	319.0	44.0
Holsworthy	17.3	360.0	9.5	375.3	137.0	106.0	243.0	55.0
Londonderry	59.8	90.0	0	84.5	226.0	123.0	349.0	56.0
Scheyville	174.4	51.0	11.6	79.2	232.0	76.0	308.0	49.0
Darkes Forest	3.9	0	0	169.4	192.0	70.0	262.0	49.0
Somersby	32.0	0	10.5	135.0	250.0	145.0	395.0	100.0
Warnervale	51.0	0	3.5	88.0	313.0	114.0	427.0	50.0
Wilton	10.9	0	4.2	103.4	184.0	134.0	318.0	104.0
Goulburn	15.9	0	4.6	135.0	370.0	368.0	738.0	75.0

Sites were then ranked on the basis of the 'savings' relative to the most expensive site. Table B.2 indicates the savings for each airport site with respect to the six cost items in Table B.1. These savings were computed by subtracting the estimate for each capital cost item from the highest estimate for that item, with the most expensive site on each capital cost item having a saving of $0. The following assumptions were made regarding discounting of future costs:

- A discount rate of 10% was used.

- Future disbursements except acquisition were assumed to take place in fifteen years' time (1999). The reasoning behind this assumption was that, if the second airport were to begin operations in twenty years' time (2004), works on site and off site would take place during the ten year period preceding that, with 1999 being the mid-point of that period. It was then assumed that all future payments would take place in one lump sum in 1999. Thus, the savings related to these costs were multiplied by 0.239 $[=1/(1.1)^{15}]$. It was felt that, for the purposes of this preliminary analysis and in view of the lack of a specific timetable for the second airport works and opening date, this assumption was adequate.

Therefore, of the six capital cost items under consideration, land acquisition costs were assumed to be incurred immediately (1984-85) but all other costs were postponed to 1999.

Table B.2 Calculation of savings

Calculation for each site		$million
Badgerys Creek		
97.7 + (310 + 1.45 + 280.7 + 416 + 55) (.239)	=	352
Bringelly		
58.4 + (360 + 0 + 290.7 + 419 + 60) (.239)	=	328
Holsworthy		
157.1 + (0 + 2.8 + 0 + 495 + 49) (.239)	=	288
Londonderry		
114.6 + (270 + 12.25 + 290.8 + 389 + 48) (.239)	=	356
Scheyville		
0 + (309 + 0.7 + 296.1 + 430 + 55) (.239)	=	261
Darkes Forest		
170.5 + (360 + 12.25 + 205.9 + 476 + 55) (.239)	=	436
Somersby		
142.4 + (360 + 1.75 + 240.3 + 343 + 4) (.239)	=	369
Warnervale		
123.4 + (360 + 8.75 + 287.3 + 311 + 54) (.239)	=	367
Wilton		
163.5 + (360 + 8.05 + 271.9 + 420 + 0) (.239)	=	417
Goulburn		
158.5 + (360 + 7.7 + 240.3 + 0 + 29) (.239)	=	311

Table B.2 was subsequently converted into Table B.3, which shows the savings and scores assigned to each site on a 0 to 10 scale. The most expensive site on each of the capital cost items in Table B.1 (i.e. the site with a savings of $0 for that item) receives a score of 0, and the least expensive site (i.e. the site with the highest savings) a score of 10, with the values in between assigned on a linear scale. The scores shown in Table B.3 are the ones used in the site ranking matrix.

It will be seen from Table B.3 that Scheyville is the most expensive site overall (i.e. it has a net savings of $0). The net savings for each of the other sites have been computed by subtracting $261 million (the aggregated savings for Scheyville calculated in Table B.2) from the aggregated savings computed for each site. For instance, Badgerys Creek has a net savings of $91 million ($352 million minus $261 million), while Wilton has a net savings of $156 million ($417 million minus $261 million).

Table B.3 Present value of savings relative to the most expensive site for the 25 million passenger worst case (1984 dollars; 10% discount rate; 15 years)

Site	Savings ($million)	Score
Scheyville	0	0
Holsworthy	27	1.5
Goulburn	50	2.9
Bringelly	67	3.8
Badgerys Creek	91	5.2
Londonderry	95	5.4
Warnervale	106	6.1
Somersby	108	6.2
Wilton	156	8.9
Darkes Forest	175	10.0

APPENDIX C THE AUSTRALIAN NOISE EXPOSURE FORECAST SYSTEM AND ASSOCIATED LAND USE COMPATIBILITY ADVICE FOR AREAS IN THE VICINITY OF AIRPORTS

The aircraft Noise Exposure Forecast (NEF) technique was first developed in the United States of America in the late 1960s. It was subsequently refined in Australia in 1982.

The NEF system is a scientific measure of the noise exposure levels around airports. It can also be used for assessing average community response to aircraft noise and for land-use planning around airports. In the Australian NEF system, noise exposure levels are calculated in Australian Noise Exposure Forecast (ANEF) units, which take into account the following factors of aircraft noise:

- the intensity, duration, tonal content and spectrum of audible frequencies of the noise of aircraft takeoffs, approaches to landing, and reverse thrust after landing. (For practical reasons, that noise generated on the airport from aircraft taxiing movements, and engine running during ground maintenance, is not included);

- the forecast frequency of aircraft types and movements on the various flight paths;

- the average daily distribution of aircraft take-off and landing movements in both daytime and night-time hours (daytime defined as 7 a.m. to 7 p.m., night-time as 7 p.m. to 7 a.m.).

ANEF charts are produced by the Department of Aviation for most airports throughout Australia. The charts are simply plans of the airport and the surrounding localities on which noise exposure contours of 20, 25, 30 and 40 ANEF units have been drawn. These four contours define land areas around the airport which are affected by aircraft noise, increasingly so with increasing ANEF value.

In the areas outside 20 ANEF it is generally accepted that noise exposure is not of significant concern. Within the area from 20 to 25 ANEF, aircraft noise exposure starts to emerge as an environmental problem, whilst above 25 ANEF the noise exposure becomes progressively more severe.

The land-use compatibility recommendations made in this paper are by reference to the above ANEF contours (see Table C.1).

In 1979, the then Department of Transport together with the Department of Defence jointly sponsored the National Acoustic Laboratories of the Department of Health to undertake a major socio-acoustic investigation to assess the impact of aircraft noise on residential communities in Australia. In the social survey, personal interviews were conducted with 3,575 residents around the commercial airports in Sydney, Adelaide, Perth and Melbourne and the RAAF base at Richmond, NSW. From the responses to the questionnaire, subjective reaction to aircraft noise was measured in terms of GR (General Reaction), a composite of a number of ratings of dissatisfaction, annoyance and fear, as well as reports of activity disturbance and complaint disposition. A high score of GR was used to define whether or not respondents were 'seriously affected' by aircraft noise. Noise measurements were made at several sites around each airport either by tape-recording of flights or by the unmanned logging of noise levels over periods of two weeks. The noise exposure at each of the dwellings in the social survey was estimated in terms of twenty different noise indices.

Analysis by the National Acoustic Laboratories showed that 'equal-energy' indices such as NEF were more highly correlated with community reaction than other types of index, including 'peak-level' indices. However, it was found that the standard weighting given to night flights was too high, and that there should be a weighting applied to flights during evening hours. Attitudes towards the aviation industry, personal sensitivity to noise, and fear of aircraft crashing were found to be important in modifying the extent to which a person will be affected by a given amount of aircraft noise. Demographic variables such as age, sex, occupation and education were found to be of generally minor importance in explaining subjective reaction.

The report of the National Acoustic Laboratories extensive and definitive study was published in mid 1982*. As a result of the National Acoustic Laboratories finding, the Department of Aviation decided to revise its existing American based NEF to reflect the specific Australian findings. The system was renamed the ANEF system.

The following changes were included in the new system:

- The 'night-time' period was changed from between 10 p.m. and 7 a.m. to between 7 p.m. and 7 a.m. The weighting of noise in the 'night' hours was lowered from 12 decibels to 6 decibels.

- the 20 ANEF contour was included on all newly issued ANEF charts (despite the low degree of confidence in its location);

- tabulation of aircraft movements and runway usages were included on ANEF charts.

The findings of the National Acoustic Laboratories survey also provided information on the percentage of residents living around airports who are either moderately or seriously affected, or unaffected by the noise. Such information, which is called a dose/response relationship, provides the basic information necessary for formulating appropriate recommendations on compatible land use around Australian airports.

Prior to 1982, Australian land use recommendations were essentially similar to the criteria used in the US NEF system. However, with the availability of an Australian dose/response function derived from the National Acoustic Laboratories social survey, the US criteria were revised to take into account the general reaction of Australian communities to aircraft noise.

In essence, this revision was limited to a firmer definition of the criterion for residential land use compatibility. In the NEF system as originally adopted in Australia, the United States criterion of 30 NEF was adhered to, but, in accordance with a recommendation of the House of Representatives Select Committee on Aircraft Noise made in 1970, cautious restraint was urged to be applied by land zoning authorities when applying the system to Australian conditions. In effect, this meant that, where possible, the 25 NEF contour should be used rather than the 30 NEF as a conservative safeguard until the system was validated in Australia.

The National Acoustic Laboratories Report now provides substantial evidence to support the use of 25 ANEF as the appropriate criterion for residential land usage. The only qualification which arises from the findings of the National Acoustic Laboratories Report is that some people having a higher sensitivity to noise may find that the noise exposure at 25 NEF is still unacceptable (refer to dose/response relationship in Figure C.1 for percentage of people still affected in 20-25 ANEF zone).

Accordingly, the Department of Aviation enters the 20 ANEF contour on all ANEF charts for that purpose. It is to be stressed, however that the actual location of the 20 ANEF contour is difficult to define accurately because of variations in aircraft flight paths, pilot operating techniques, and the effect of meteorological conditions on noise propagation. For that reason, the 20 ANEF contour is shown as a broken line on ANEF plans.

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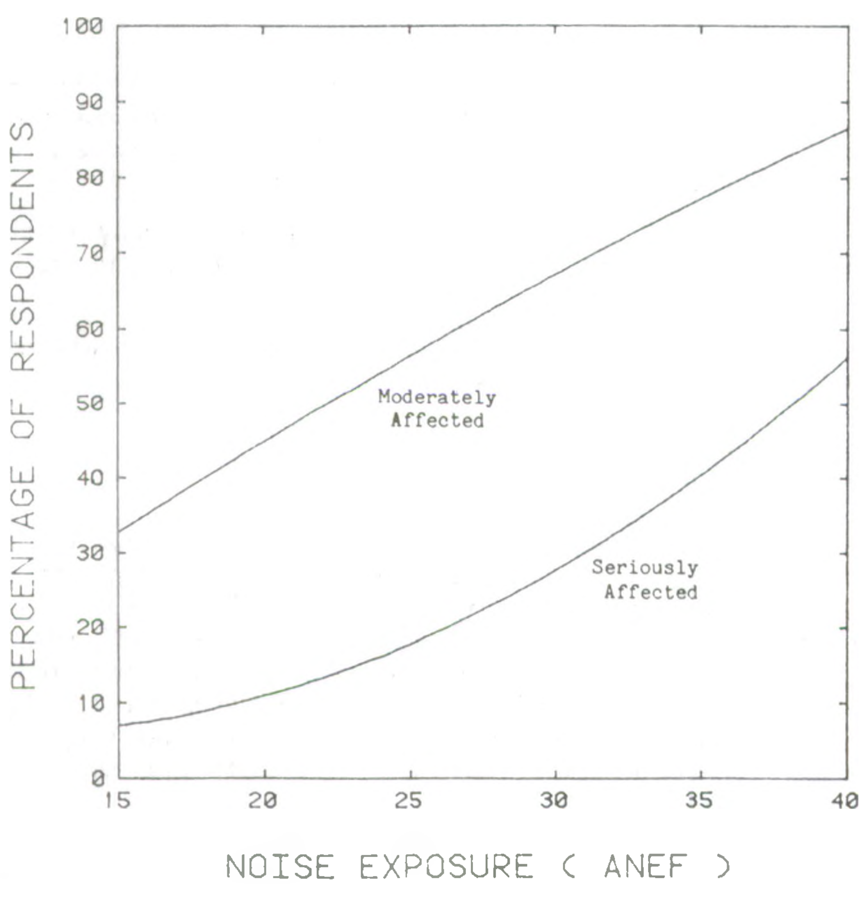
* National Acoustic Laboratories: Commonwealth Department of Health, Report No. 88 'Aircraft Noise in Australia: A Survey of Community Reaction' Australian Government Publishing Service, February 1982.

Land-use planning is a function carried out by State or Local Government authorities in all but the Commonwealth Territories. It is realized that many unrelated, non-aviation factors have to be taken into account and could influence decisions taken in specific land-use considerations. However, the Department of Aviation considers that the public interest is best protected by ensuring that the long-term viability of the airport is preserved wherever possible by planning in accordance with the guidance material contained in this document. The land-use recommendations in Table C.1 are, of course, mainly applicable to new development on undeveloped land around airports. In those areas around some of the major Australian airports where established residential development has existed for some considerable time, it is generally not feasible to apply appropriate land-use recommendations unless the opportunity for rezoning of individual properties arises.

Figure C.1 shows the dose/response relationship between aircraft noise and community reaction. Table C.1 is the Department of Aviation's land-use recommendations in the ANEF system. A technical description of the ANEF formulation follows.

Figure C.1 Dose/response relationship between noise exposure forecast level and community reaction



Source: National Acoustic Laboratories Report No. 88, "Aircraft Noise in Australia : A Survey of Community Reaction" February 1982.

Table C.1 Land use compatibility advice for areas in the vicinity of Australian airports

Land use	ANEF range			
	Less than 20 ANEF+	20-25 ANEF	25-30 ANEF	Above 30 ANEF
Residential	Yes	Yes*	No	No
Hotel, motel, offices, public buildings	Yes	Yes	**	No
Schools, churches	Yes	No	No	No
Hospitals, theatres	Yes	Yes**	No	No
Commercial, industrial	Yes	Yes	Yes	**
Outdoor recreational (non spectator)	Yes	Yes	Yes	Yes

* Within 20 to 25 ANEF, some people may find that the land is not compatible with residential use. Land use authorities may consider that the incorporation of noise control features in the construction of residences is appropriate.

** An analysis of building noise reduction requirements by an acoustic consultant should be made and any necessary noise control features included in the design of the building.

\+ The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variations in aircraft flight paths.

The ANEF Formulation

The ANEF system is firmly based on survey evidence of the reaction of Australian communities to aircraft noise. The ANEF unit incorporates, in a single formula, the noise levels produced by the various aircraft operating at an airport, plus a logarithmic function of the daily average number of aircraft noise events, with a weighting included if they occur during the evening or night-time hours when the sensitivity of people to noise is increased. The forecast frequency of aircraft movements on various flight paths (either take-off or landing), and the proportion of aircraft movements by day and by night, provide the input to determine this aircraft number weighting factor.

The basis for combining aircraft noise levels with a logarithmic function of frequency of occurrences is called the principle of energy equivalence. Briefly, this principle holds that people respond to a number of noise events in the same way as they react to their loudness, and therefore the number of noise events should also be expressed in logarithmic form. This implies that a loud noise perceived only a few times per day produces similar subjective response to a moderate noise perceived many times. Most social surveys, including the Australia survey by the National Acoustic Laboratories, have confirmed that 'equal energy' units of aircraft noise exposure are better correlated with community reaction than are other units known as peak level indices which have also been postulated for aircraft noise exposure measurement.

The ANEF combines the above two factors of aircraft noise (i.e. noise level and frequency of operations) by a reasonably simple mathematical formulation. Noise of evening/night operations (defined as 7 p.m. to 7 a.m. in the ANEF system) of aircraft is weighted to account for the increased sensitivity of communities to noise during periods of relaxation or sleep. The actual aircraft noise level measurement used in the ANEF formulation is the complex Effective Perceived Noise Level (EPNL) which takes into account all known annoying aspects in the temporal and frequency domain. (This EPNL unit is also used for the international noise certification of new aircraft). Its calculation is complex but its principles are fairly basic:

> The three basic physical properties of noise are measured; level, frequency distribution and time variation. Specifically, the instantaneous sound pressure level in each of 24 one-third octave bands of the noise is gathered for each one half-second increment of time during the aircraft flyover. The following steps are then computed:

- the instantaneous one-third octave levels are converted to perceived noisiness by reference to a subjective annoyance table (NOY table);
- a tone correction factor is calculated to account for spectral irregularities;
- a duration correction factor is calculated;
- the EPNL is the algebraic addition of the maximum perceived noise level at any instant plus the tone and duration corrections.

Aircraft noise levels, measured in terms of EPNdB, of most civil regular public transport aircraft, military aircraft and a representative sampling of light aircraft now operating in Australia, are now known with a reasonable degree of accuracy. These data have been collected over the years from the Department of Aviation's noise monitoring system at Sydney Airport, and from measurements of light and military aircraft noise. Additionally, aircraft manufacturers in USA and Europe provide accurate noise definitions of the existing and new aircraft. All this information, together with the profiles describing each aircraft's take-off and landing operations are stored in data arrays in the Department of Aviation's airport noise model computer system.

If the flight path of an aircraft is known, the average noise level at any point along and to the side of the flight path can be determined with good accuracy. If the aircraft flies that operation on the same flight path Nday times in daytime hours and Nnite times in evening/night-time hours, the partial NEF value due to that aircraft type on that particular flight path can be calculatd from the formula:

$$ANEF_{ij} = EPNdB_{ij} + 10 \log (Nday + 4\ Nnite) - 88$$

Where $ANEF_{ij}$ = noise exposure due to aircraft type i on flight path j.

$EPNdB_{ij}$ = noise level of aircraft type i on flight path j.

Nday, Nnite = number of flights during the day and night respectively, of aircraft type i on flight path j.

It can be seen from the above formula that if there is only one aircraft flight in daytime hours only, then the partial NEF value is directly proportional to the noise level of the aircraft. Also it is clear that the NEF increases as the logarithm of the number of operations increases. The total NEF at any point on the ground around an airport is composed of all individual noise exposures (summed logarithmically) produced by each aircraft type operating on each flight path over the period of one day, i.e.

$$ANEFt = 10 \log \sum_{i=1}^{i=I} \sum_{j=1}^{j=J} \text{antilog} \left(\frac{ANEF_{ij}}{10} \right)$$

Where I = total number of aircraft types
J = total number of flight tracks
ANEFt = total noise exposure forecast.

The original definition of the NEF formula and the derivation of the constants in the original works by the consultants to the US FAA are detailed in US Federal Aviation Administration Report No. 70-9. Subsequent revision of the system in Australia was made in 1982 following the social survey of aircraft noise around Australia airports by the National Acoustic Laboratories of the Commonwealth Department of Health (reference National Acoustic Laboratories Report No. 88: 'Aircraft Noise in Australia: A Survey of Community Reaction'/Australian Government Publishing Service February 1982).

The ANEF method is sensitive to the forecast of air traffic movements and to the allocation of such air traffic to the flight paths on which departing and arriving aircraft are routed. Every attempt is made to ensure that the traffic forecast and flight paths are as accurate as possible. However, at major airports particularly, accurate definition of flight paths to the extent of the 20 ANEF contour is difficult to achieve. For that reason, the confidence in the location of the 20 ANEF will be significantly less than for the 25, 30 and 40 ANEF contours.

The ANEF computation is based on forecasts of air traffic movements on an average day. Allocations of the forecast movements to runways and flight path are on an average basis and take into account the existing anf forecast air traffic control procedures at the airport which nominate preferred runways and preferred flight paths for noise abatement purposes (ref. Aeronautical Information Publication Terminal Area Procedures). Aircraft movements are categorized by:

- night or day
- type of aircraft
- take-off or landing
- range/route
- runway used
- flight path.

Department of Aviation
Canberra, November 1982

APPENDIX D NATIVE PLANT SPECIES OCCURRING ON THE PROPOSED AIRPORT SITE AT BADGERYS CREEK*

Acacia falcata
A. parramattensis
A. ulicifolia
Ajuga australis
Amyema gaudichaudii
Angophora floribunda
Astroloma humifusum
Brachychiton populneus
Bursaria spinosa
Calystegia sepium
Cassinia uncata
Casuarina glauca
C. littoralis
Cheilanthes sieberi
Convolvulus erubescens
Daviesia ulicifolia
Dianella laevis
Dichelachne sp.
Dichondra repens
Dillwynia juniperina
Dodonaea cuneata
D. viscosa
Echinopogon caespitosus
Entolasia stricta
Eucalyptus amplifolia
E. bosistoana
E. crebra
E. eugenioides
E. fibrosa
E. moluccana
E. tereticornis
Euphorbia drummondii
Exocarpos cupressiformis
Galium sp.
Geranium sp.
Glycine clandestina
Goodenia hederacea
Helichrysum apiculatum
H. scorpioides
Hardenbergia violacea
Hibbertia diffusa?
Indigofera australis
Juncus usitatus
Kennedia rubicunda
Lepidosperma laterale
Lomandra filiformis
L. longifolia
Melaleuca decora
M. linariifolia
M. styphelioides
Oplismenus sp.
Oxalis corniculata
Parsonsia straminea
Phragmites australis
Plantago debilis
Polymeria calycina
Potamogeton tricarinatus
Pseuderanthemum variabile
Pultenaea parviflora
Schoenus moorei
Senecio lautus
S. linearifolius
Solanum pungetium
Themeda australis
Trachymene procumbens
Tricoryne elatior
Triglochin procera
Typha orientalis
Vittadinia triloba
Wahlenbergia gracilis
Wahlenbergia sp.

* Nomenclature is consistent with Jacobs and Pickard (1981).

APPENDIX E MAMMALS RECORDED FROM THE PROPOSED AIRPORT SITE AT BADGERYS CREEK

Scientific name	Common name	Status
Native mammals		
Petaurus breviceps	Sugar glider	C
Pseudocheirus peregrinus	Common ringtail possum	C
Trichosorus vulpecula*	Common brushtail possum	C
Introduced mammals		
Bos taurus*	Cattle	
Canis familiaris*	Dog	
Capra hircus*	Goat	
Equus asinus*	Donkey	
Equus caballus*	Horse	
Felis catus*	Cat	
Mus musculus	House mouse	
Oryctolagus cuniculus*	European rabbit	
Rattus rattus	Black rat	
Vulpes vulpes	Fox	

* Observed during present survey.
C Common

APPENDIX F FREQUENCY OF OCCURRENCE AND STATUS OF AVIFAUNA LOCATED AT THE PROPOSED AIRPORT SITE AT BADGERYS CREEK

Species	Habitat				Status		
	Creek	Woodland	Paddock	Dam	County of Cumberland	New South Wales	Australia
Acanthiza nana, yellow thornbill	X	X			C	A	C
A. pusilla, brown thornbill		X			C	A	C
Accipiter fasciatus, brown goshawk			X			MC	MC
Acridotheres tristis, common mynah	X	X	X	I/O	C	A	C
Acrocephalus stentoreus, clamorous reed-warbler				I/O	C	A	C
Anas castanea, chestnut teal					C	MC	C
A. gibberifrons, grey teal				I/O	C	A	A
A. platyrhynchos, mallard				O	U	U	
A. superciliosa, Pacific black duck				I/O	C	A	A
Anhinga melanogaster, darter				O	R	MC	MC
Anthochaera chrysoptera, little wattlebird	X				C	C	MC
Anthus novaeseelandiae, Richard's pipit			X		C	A	A
Ardea novaehollandiae, white-faced heron	X			I/O	C	A	C
Artamus cyanopterus, dusky woodswallow			X		C	A	C
Cacatua galerita, sulphur-crested cockatoo		X			MC	C	C
C. roseicapilla, galah			X		U	A	A
Cecropis ariel, fairy martin			X	O	C	A	C
Charadrius melanops, black-fronted plover				O	C	C	C
Chenonetta jubata, maned duck	X			I	C	A	C
Cinclorhamphus cruralis, brown songlark		X			C	A	C
Cisticola exilis, golden-headed cisticola			X			A	C
Coracina novaehollandiae, black-faced cuckoo-shrike	X	X			C	A	C
Corvus coronoides, Australian raven	X	X	X		C	A	C
Cracticus torquatus, grey butcherbird	X		X		MC	A	C
Cygnus atratus, black swan				I	C	A	A
Dacelo novaeguineae, laughing kookaburra		X			C	A	A
Egretta alba, great egret				O	C	C	C
Falco cenchroides, Australian kestrel				O	C	C	A
Fulica atra, Eurasian coot				I/O	C	A	C
Gallinula tenebrosa, dusky moorhen				I/O	C	A	C
Grallina cyanoleuca, Australian magpie-lark	X	X	X	I	A	A	C
Gymnorhina tibicen, Australian magpie	X	X	X	O	C	A	A
Halcyon sancta, sacred kingfisher	X				C	A	C
Himantopus himantopus, black-winged stilt				O	U	C	MC
Hirundo neoxena, welcome swallow			X	O	C	A	C
Malurus cyaneus, superb fairy-wren	X				C	A	MC
Manorina melanocephala, noisy miner	X	X			C	A	C
Megalurus gramineus, little grassbird			X	O		C	MC
Microeca leucophaea, jacky winter	X				C	A	A
Nycticorax caledonicus, rufous night heron	X				U	MC	MC
Ocyphaps lophotes, crested pigeon	X	X			S	A	A
Oriolus sagittatus, olive-backed oriole	X				MC	C	MC
Pachycephala rufiventris, rufous whistler	X				C	A	C
Passer domesticus, house sparrow				O	C	A	A
Phalacrocorax melanoleucos, little pied cormorant				O	C	A	C
P. sulcirostris, little black cormorant				I/O	C	A	C
Platalea flavipes, yellow-billed spoonbill				I	C	MC	MC
P. regia, royal spoonbill				I/O	U	MC	MC
Platycercus eximius, eastern rosella		X	X		C	A	A
Poephila bichenovii, double-barred finch		X			C	A	C
Porphyrio porphyrio, purple swamphen				I/O	C	A	MC
Psephotus haematonotus, red-rumped parrot			X	O	C	A	C
Rhipidura fuliginosa, grey fantail	X	X			C	A	C
R. leucophrys, willie wagtail	X	X		I/O	C	A	A
Smicrornis brevirostris, weebill	X	X				A	C
Streptopelia chinensis, spotted turtle-dove	X	X	X		C	A	C
Sturnus vulgaris, common starling	X	X	X	O	A	A	A
Tachybaptus novaehollandiae, Australasian grebe				I/O	C	A	C
Threskiornis aethiopica, sacred ibis				I	C	A	C
T. spinicollis, straw-necked ibis				I	C	A	A
Vanellus miles, masked lapwing				I/O	C	A	C

Notes: Scientific and common names from Royal Australasian Ornithologists Union (1978)

X Observed in habitat
I Observed at dam inside proposed site
O Observed at dam outside proposed site
A Abundant
C Common
MC Moderately common
U Uncommon
R Rare
S Scarce

Status for County of Cumberland from Hindwood and McGill (1958)
Status for New South Wales from Morris et al. (1981)
Status for Australia from MacDonald (1973)

APPENDIX G HERPETOFAUNA RECORDED FROM THE PROPOSED AIRPORT SITE AT BADGERYS CREEK

Scientific name	Common name
Amphibians	
Litoria caerulea	Green tree frog
L.fallax*	Eastern dwarf tree frog
Reptiles	
Lampropholis delicata	Eastern grass skink
L. guichenoti*	Garden skink
Leiolopisma platynota	Red-throated skink
Morelia spilotes	Carpet python
Oedura lesueurii	Lesueur's velvet gecko
Phyllurus platurus	Southern leaf-tailed gecko
Physignathus lesueurii*	Eastern water dragon
Pseudonaja textilis	Eastern brown snake
Pygopus lepidopodus	Common scaly-foot
Ramphotyphlops nigrescens	Blind snake
Sphenomorphus quoyii*	Eastern water skink
S. tenuis	Wall skink
Tiliqua casuarinae	Oak skink
Varanus varius*	Lace monitor

* Observed during present survey.

Note: No conservation status ascribed in the current literature.

APPENDIX H DRAFT SCHEDULE OF CONDITIONS, PROVIDED BY THE METROPOLITAN WATER SEWERAGE AND DRAINAGE BOARD, APPLICABLE TO THE CONSTRUCTION, OPERATION AND MAINTENANCE OF AN AIRPORT AT WILTON

In this Schedule the word/s

- 'Board', wherever appearing, shall mean Metropolitan Water Sewerage and Drainage Board.
- 'Catchment Area', wherever appearing, shall mean that area known as the Metropolitan Catchment Area as defined in Gazette No. 79 of 13th July, 1923, as amended in Gazette No. 79 of 26th May, 1933. The proclamation will not be amended as a result of the construction of the airport.
- 'Department', wherever appearing, shall mean the Department of Aviation of the Australian Government.
- 'Manager Headworks', wherever appearing, shall mean the person occupying that position in the Board's employ or any person to whom the authority of that position has been delegated relative to this operation.
- 'Perimeter canal', wherever appearing, shall mean the perimeter canal system to be constructed around the airport to intercept drainage flows and shall include any detention ponds constructed as part of the system.
- 'Inside the canal', wherever appearing, shall mean the area of land bounded by the perimeter canal system, from which liquids are to be drained to Allens Creek.
- 'Outside the canal', wherever appearing, shall mean the area from which liquids drain to the Catchment Area.

NOTE:
Any direction given to any person in relation to the observance of the requirements of this Schedule of Conditions may be given verbally, in which case it will be confirmed in writing within ten (10) working days of the giving of the direction, or may be given in writing.

a) The Department shall carry out the Works in such a way as to conform strictly to all provisions of the Metopolitan Water, Sewerage and Drainage Act, 1924, applying to the prevention of pollution of any Catchment Area or the preservation of the purity of the water supply provided thereby or derived therefrom, or for the protection of the property of the Board on any Catchment Area under the said Act or any of the by-laws thereunder for the time being in force.

b) If the Department shall at any time be using or about to use any process in the construction, operation, maintenance or use of the Works or any part of them which in the opinion of the Manager Headworks is likely to pollute any Catchment Area or the water supply or to endanger any property of the Board on any Catchment Area the Department upon being so directed by the Board's Manager Headworks so to do, shall:

    (i) discontinue the use of such process forthwith

    or

    (ii) thereafter refrain from adopting such process at any time

    as the case may require.

c) The Department shall make such provision for sanitation as may be directed by the Manager Headworks and shall at all times observe and perform any requirements of the Board respecting sanitation.

d) The Department shall provide and maintain to the satisfaction of the Manager Headworks efficient means to prevent the contamination, pollution or siltation of any stream or watercourse or catchment area by the Department or any contractor, agent, servant or employee of the Department and shall observe any instruction given by the Manager Headworks with a view to preventing or minimising the contamination, pollution or siltation of any stream, watercourse or catchment area.

e) The Department shall not establish any camps of habitation or other buildings within the Catchment Area, prior to the construction and commissioning of the perimeter canal.

f) The Department hereby covenants with the Board that the Department shall at all times hereafter save harmless and keep the Board indemnified from payment of compensation and from and against all actions proceedings claims and demands in respect of any injury loss or damage arising out of or in any way connected with any interference with or deprivation or loss of access to the land and premises hereby demised which may occur by reason of any works or operations undertaken or carried out by the Board or arising out of or in any way connected with any discontinuance or alteration of any process consequent upon the service of a notice in pursuance of the provisions of subclause (b) of this clause or arising out of or in any way connected with the operation of any by-laws relating to a Catchment Area in force at the date hereof or made by the Board at any time hereafter.

g) The Department shall not erect install or use within any area outside the canal any structure or facility whatsoever without the prior approval of the Board, and then only in accordance with such conditions as may be specified by the Board.

h) The Department shall at all times properly operate, maintain and drain at its own expense to the satisfaction of the Board the perimeter canal and appurtenant works authorised by this demise within the Catchment Area and shall ensure that no activity is permitted which might affect the efficient operation of the perimeter canal.

i) The Department shall observe any requirements of the Manager Headworks as to the order and method of constructing the Works so as to prevent erosion or siltation of any Catchment Area, or pollution of any watercourse, creek or the stored water of any dam, and in particular shall construct and commission the perimeter canal prior to executing any works inside the canal.

j) The Department shall carry out to the satisfaction of the Manager Headworks any structural works considered necessary by the Manager Headworks for the protection of the purity of the water supply.

k) The Department shall carry out the establishment of vegetation on any part of the works authorised by this demise within the Catchment Area as may be determined by the Manager Headworks as to the location of such works, the timing and order of execution of such works, the methods, materials and species to be used in such works and the maintenance thereof, to the satisfaction of the determining officer.

l) The Department shall ensure that the following requirements are complied with in regard to the method of construction and location of the perimeter canal within the Catchment Area:

(i) cutting and filling of the formation shall be kept to a minimum;

(ii) all material cut and not required for fill purposes shall be removed from the Catchment Area if so directed by the Manager Headworks;

(iii) all embankments shall be stabilised by such processes as may be approved by the Manager Headworks;

(iv) the perimeter canal shall be provided with suitable concrete-lined drains, silt traps, culverts, dwarf walls or other facility to prevent erosion which shall be of sufficient capacity to permit of cleaning without putting them simultaneously out of commission;

(v) the perimeter canal shall be designed, constructed and maintained in such a manner as will prevent liquids flowing onto the area outside the canal. (Liquids to include all surface drainage from the developed airport site e.g. rainfall from maximum rainfall possible, liquids used for fuels, cleaning and maintenance, which may be spilled on the area, and the like.)

m) The Department shall submit to the Board for its approval, full sets of the survey and design plans of the proposed perimeter canal and appurtenant works, well in advance of the time intended to commence construction thereof, and no work shall commence until the Board's approval is given thereto.

The Department shall comply with any restrictions and/or requirements by the Board as to ground surface disturbance, scrub or tree cutting and removal, clearing, burning off, and other related activities.

n) The Department shall not leave deposited on the surface outside the canal any material or refuse without specific approval from the Manager Headworks.

o) The Department shall keep all parts of the land hereby demised within the Catchment Area in a clean condition.

p) The Department shall strictly limit its operations within the Catchment Area to the area approved by the Board to be used for the perimeter canal, its appurtenant works and the area inside the canal. The parking of plant, or stockpiling of materials beyond this area, shall be prohibited except in the sites specifically approved, in advance, by the Manager Headworks. Proposals for the provision of access tracks within any Catchment Area to the Department's facilities must also be approved in advance by the Manager Headworks before construction of any such track is commenced. Use of such tracks shall be as approved by the Manager Headworks.

q) The Department shall limit the use and storage of petrol, diesel fuel, grease, oil and similar materials to the minimum essential for the carrying out of the Works, and shall arrange for the use and storage of these materials only in such parts of the Catchment Area as are approved by the Manager Headworks.

r) The Department shall design and construct in a manner approved by the Manager Headworks alternative roads as replacements for any roads or fireroads as may be affected by the works.

s) The use of any amenities, facilities or other sites on the Catchment Area by personnel shall be subjected to satisfactory hygiene arrangements including the provision of treatment works designed and constructed to the requirements of the Board. The effluent, any other sullage, including bathroom wastes, trade wastes and the like, shall be disposed of in a manner satisfactory to the Board, clear of the Catchment Area.

t) (i) The Department shall not permit any fire place to be constructed within any Catchment Area unless protected by stone wallings and fires lit therein shall not be left unattended.

(ii) The Department shall take adequate precautions for the prevention of fire to the satisfaction of the Manager Headworks, and in the event of any fire caused by the operation of the Department within the Catchment Area the Department shall be held responsible for the cost of fire supression activities incurred by the Board;

(iii) No fires shall be lit within the Catchment Area for the purposes of clearing vegetation or other materials without the prior approval of and to such conditions as may be stipulated by the Manager Headworks.

u) The Department shall accept responsibility for the control and conduct of its employees or other persons engaged in business with the Department at all times while they are on the Catchment Area whether actually working or not. If any person in the employ of the Department is guilty of an offence under any of the Board's by-laws governing the control or use of any Catchment Area, the Department shall agree upon the request of the Board to transfer that employee to work outside the Catchment Area.

v) The Department shall erect and maintain fences and locked gates where determined by the Manager Headworks to prevent the entry from the area demised of unauthorised persons on to any immediately adjacent part of the Catchment Area.

w) The Department shall permit free and uninterrupted access to officers or employees of the Board at any time for the purposes of their official duties and production of an 'Authority to Enter' card issued by the Board or other official badge shall be accepted by the Department as sufficient proof of identity.

x) The Department shall provide and maintain suitable signs at sites determined by the Board, warning all persons that trespassing on the Catchment Area is strictly prohibited.

y)* The Department shall make contribution towards the Board's costs for supervision of the investigation, design and construction of the various installations authorized by the agreement, of Fifty Thousand Dollars ($50,000) 1984 costs, per calendar year for the construction phases.

The ongoing annual fee for the operational phase shall be Ten Thousand Dollars ($10,000) 1984 costs.

Such fees to commence at a date to be determined by the Board.

The quantum of such fee shall be reviewed every three years, from the date of commencement of the fee.

The annual cost of water lost to the Board is estimated (in 1984 dollars) to be $23,600. This amount shall be paid by the Department of Aviation as compensation, and shall be reviewed annually.

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* Subject to negotiation between the Department of Aviation and the Metropolitan Water Sewerage and Drainage Board.

APPENDIX J WATER QUALITY CRITERIA FOR CLASS 'S' AND 'P' WATERS

Regulation 8 under the Clean Waters Act, 1970,
Prescribed Classes of Waters

For the purpose of Section 11(1) of the Act, waters shall be classified as follows:

Class S: Specially protected waters: waters into which:
- (a) no wastes are to be discharged; and
- (b) only Class P waters flow.

Class P: Protected waters: waters into which:
- (a) wastes are not to be discharged except as provided in respect of this classification;
- (b) where sewerage is available, wastes which are of a type acceptable to the sewerage authority are not to be discharged otherwise than by way of sewer;
- (c) overflows from sewers, wastes pumping stations, treatment works or other parts of a sewerage system are not to be discharged;
- (d) organic wastes are not to be discharged unless they are so treated that the resulting effluent has —
  - (i) where the relative proportion of water to the wastes is 19:1 or more — a biochemical oxygen demand of not more than 20 mg/L and a non-filtrable residue of not more than 30 mg/L; or
  - (ii) where the relative proportion of water to the wastes is less than 19:1 and the oxygen content of the waters is, or is likely to be, reduced as a result of the discharge — such a lower biochemical oxygen demand and non-filtrable residue as may be approved;
- (e) wastes are not to be discharged unless the concentration of plant nutrients in the wastes is controlled so as to prevent excessive plant growth in, abnormal variation in dissolved oxygen or pH levels in, or degradation of the appearance of, the waters;
- (f) infectious wastes or wastes in which faecal coliforms are likely to be present are not to be discharged unless:
  - (i) the wastes are treated in an approved manner; and
  - (ii) in the case of waters likely to be used for bathing — the faecal coliform density as determined in an approved manner after sampling at an approved location does not exceed 200 per 100 millilitres;
- (g) wastes are not to be discharged unless they are visually free of grease, oil, solids and unnatural discolouration and free of settleable matter;
- (h) wastes are not to be discharged if the resulting concentration of the wastes in the waters:
  - (i) is or is likely to be harmful, whether directly or indirectly, to aquatic life or water-associated wildlife;
  - (ii) gives rise to or is likely to give rise to abnormal concentrations of the wastes in plants or animals; or
  - (iii) in the case of fresh water, is likely to affect the use of the waters for human consumption, domestic or industrial purposes, watering of stock or the irrigation of land;
- (i) wastes are not to be discharged if the concentration of any restricted substance in the water exceeds the concentration specified opposite that substance in Schedule 2;
- (j) wastes are not to be discharged into the waters if the pH value of the wastes is less than 6.5 or more than 8.5 or if the discharge induces a variation in the pH value of the water of more than 0.2;
- (k) wastes are not to be discharged if the radioactivity level of the wastes exceeds the levels specified in Schedule 3;
- (l) thermal wastes are not to be discharged into the waters.

Schedules 2 and 3 of the Regulations under the Clean Waters Act, 1970.

Schedule 2: Restricted substances

Substance	Not in excess of (mg/L)
Arsenic	0.05
Barium	1.0
Boron*	1.0
Cadmium	0.01
Chloride*	250.0
Chromium (hexavalent)	0.05
Copper	1.0
Cyanide	0.05
Fluoride*	1.5
Iron (filtrable)	0.3
Lead	0.05
Manganese (filtrable)	0.05
Mercury	0.001
Methylene blue active substances	0.5
Nitrogen (ammonia)	0.5
Nitrogen (nitrate plus nitrite)	10.0
Pesticides (individual or total in group)	
Endrin, chlordane, toxaphene	0.001
Other organochlorides	0.01
Organophosphates	0.05
Carbamates	0.1
Fluorinated hydrocarbons	0.001
Substituted phenols and cresols	0.001
Weedicides including 2,4-D (including salts and esters), 2,4,5 - T(including salts and esters), Phenylureas, Triazines, Amides, Quaternary salts, Dipyridyls, Acrolein	0.1
Phenolic compounds	0.001
Selenium	0.01
Silver	0.05
Sulphate*	250.0
Uranyl ion	5.0
Zinc	5.0

* Limits indicated do not apply to these substances in regard to tidal waters.

Schedule 3: Radioactive substances

Gross alpha activity: not to exceed 3 picocuries per litre.
Gross beta activity: not to exceed 30 picocuries per litre.

APPENDIX K FREQUENCY OF OCCURRENCE OF PLANT SPECIES IN THE VEGETATION TYPES (1-5), AND IN THE ALLENS CREEK VALLEY AT THE PROPOSED AIRPORT SITE AT WILTON**

Plant species	Vegetation type					Allens Creek Valley
	1	2	3	4	5	
Acacia elata	0	0	1	4	0	0
A. elongata	0	1	0	0	0	0
A. floribunda	0	1	0	4	0	0
A. implexa	0	0	1	2	1	0
A. linifolia	6	6	6	0	2	0
A. longifolia	2	1	6	4	0	10
A. myrtifolia	4	5	1	0	0	0
A. oxycedrus	0	0	1	0	0	0
A. parramattensis	0	1	1	4	4	10
A. suaveolens	0	3	1	0	1	0
A. terminalis	0	1	8	2	3	10
A. ulicifolia	0	4	4	0	0	0
Acrotriche divaricata	0	0	1	0	0	0
Actinotus helianthi	0	1	4	0	0	0
A. minor	0	3	2	0	0	0
Adiantum aethiopicum	0	0	1	2	2	0
Amperea xiphoclada	0	3	3	4	0	0
Amyema pendulum	0	1	2	2	0	0
Anagallis arvensis*	0	0	0	0	1	0
Angophora bakeri	0	0	0	0	0	5
Anisopogon avenaceus	6	5	1	0	2	0
Aristida ramosa	0	1	0	0	4	0
Asplenium flabellifolium	0	0	1	2	0	0
Aster subulatus	0	0	0	0	0	5
Astroloma humifusum	0	1	0	0	2	5
A. pinifolium	0	0	1	0	0	0
Astrotricha longifolia	0	1	3	4	0	0
Austromyrtus tenuifolia	0	0	0	2	0	0
Backhousia myrtifolia	0	0	0	4	0	0
Baeckea diosmifolia	10	0	0	0	0	0
B. linifolia	2	0	3	2	0	0
B. ramosissima	0	1	0	0	0	0
Banksia ericifolia	0	0	1	0	0	0
B. marginata	0	1	3	0	0	0
B. oblongifolia	4	1	0	0	0	0
B. paludosa	2	1	0	0	0	0
B. robur	2	0	0	0	0	0
B. serrata	0	2	7	0	0	0
B. spinulosa	4	7	7	0	3	0
Bauera rubioides	2	0	4	2	0	0
Baumea rubiginosa	2	0	0	0	0	0
Billardiera scandens	0	2	4	0	4	5
Blechnum ambiguum	0	0	0	2	0	0
B. cartilagineum	0	0	2	6	0	5
B. nudum	0	0	0	2	0	0
Boronia ledifolia	0	3	3	2	0	10
B. parviflora	2	0	0	0	0	0
B. polygalifolia	0	1	0	0	1	0
Bossiaea heterophylla	0	5	1	0	0	0
B. neo-anglica	0	0	1	0	0	0
B. obcordata	0	7	3	0	2	0
B. scolopendria	0	1	0	0	0	0
Brachycome angustifolia?	0	0	0	0	1	0
B. scapiformis	0	1	0	0	1	0
Brachycome sp.	0	0	0	0	2	0
Brachyloma daphnoides	0	1	0	0	0	0
Burchardia umbellata	8	2	1	0	1	0
Bursaria spinosa	0	0	0	6	3	5
Caladenia carnea	0	0	1	0	2	0
Callicoma serratifolia	0	0	0	2	0	0
Callistemon citrinus	2	1	2	0	0	0
C. linearis	2	1	1	0	1	0
Callitris muelleri	0	0	1	4	0	0
Calochilus campestris	4	1	1	0	2	0
Calytrix tetragona	0	1	1	0	0	0
Cassia coluteoides*	0	0	0	0	1	0
Cassinia longifolia	0	2	2	2	0	0
Cassytha glabella	4	1	1	4	1	0
C. pubescens	0	3	5	2	2	5
Casuarina littoralis	0	3	4	4	1	0
C. torulosa	0	1	0	0	6	5
Caustis flexuosa	0	2	4	0	0	0
Centaurium erythraea	0	0	0	0	1	0

APPENDIX K FREQUENCY OF OCCURRENCE OF PLANT SPECIES IN THE VEGETATION TYPES (1-5), AND IN THE ALLENS CREEK VALLEY AT THE PROPOSED AIRPORT SITE AT WILTON (continued)

Plant species	Vegetation type					Allens Creek Valley
	1	2	3	4	5	
Ceratopetalum apetalum	0	0	0	8	0	0
C. gummiferum	0	1	3	0	0	5
Cheilanthes distans	0	0	1	0	0	0
C. sieberi	0	0	0	0	3	5
Chloanthes stoechadis	0	1	4	0	0	0
Choretrum candollei	0	0	1	0	0	0
Chorizandra cymbaria	2	0	1	0	0	0
Cirsium vulgare*	0	0	0	0	1	0
Clematis aristata	0	0	1	4	5	5
Comesperma ericinum	0	0	0	2	0	0
Conospermum longifolium	2	3	1	0	0	0
C. taxifolium	0	1	0	0	0	0
C. tenuifolium	2	1	3	0	0	0
Conyza albida	0	0	0	2	1	0
Correa reflexa	0	1	2	2	0	10
Crassula sieberana	0	0	1	0	0	10
Culcita dubia	0	0	3	4	0	5
Cyathea australis	0	0	0	4	0	0
Cyathochaeta diandra	4	7	3	0	3	0
Cynodon dactylon	0	0	0	2	0	0
Dampiera purpurea	0	2	3	4	1	10
D. stricta	4	4	1	0	0	0
Darwinia grandiflora	0	0	2	0	0	0
Daviesia corymbosa	2	0	0	0	0	0
D. latifolia	0	1	0	0	0	0
D. ulicifolia	0	0	0	0	1	0
Dendrobium pugioniforme	0	0	0	2	0	0
D. speciosum	0	0	0	2	0	0
Desmodium varians	0	1	0	0	1	0
Dianella caerulea	0	1	3	2	4	5
D. revoluta	2	3	0	0	6	0
Dichondra repens	0	0	1	0	5	0
Dillwynia floribunda	6	4	1	0	0	0
D. retorta	0	5	5	0	0	0
Diuris sulphurea	0	1	1	0	0	0
Dodonaea camfieldii	0	0	1	0	0	0
D. falcata J.G. West	0	1	0	0	0	0
D. pinnata?	0	0	1	4	0	0
D. triquetra	0	0	3	0	0	10
Doodia aspera	0	0	0	0	0	5
Drosera binata	0	0	0	2	0	0
D. peltata	6	3	2	0	1	0
D. pygmaea	4	0	0	0	0	0
D. spathulata	4	1	1	0	0	0
Echinopogon caespitosus	0	0	0	0	4	0
Elaeocarpus reticulatus	0	0	2	4	0	5
Eleocharis sphacelata	0	1	0	0	0	0
Empodisma minus	4	0	1	0	0	0
Entolasia stricta	6	8	3	6	6	10
Epacris coriacea	0	1	1	0	0	0
E. crassifolia	0	0	0	2	0	0
E. microphylla	6	3	4	0	0	0
E. obtusifolia	4	0	2	0	0	0
E. pulchella	2	3	5	0	1	5
Eriocaulon scariosum	0	0	1	0	0	0
Eriostemon australasius	0	8	5	0	2	0
E. myoporoides	0	0	0	4	0	0
Eucalyptus agglomerata	0	0	3	0	0	0
E. crebra	0	0	0	0	1	0
E. elata	0	0	0	4	0	0
E. globoidea	0	1	0	0	8	0
E. gummifera	0	9	2	0	4	0
E. haemastoma	2	1	0	0	0	0
E. longifolia	0	1	0	0	5	0
E. oblonga	0	6	2	0	0	0
E. paniculata	0	0	0	0	5	0
E. pilularis	0	1	0	0	2	10
E. piperita	0	0	10	2	0	0
E. punctata	0	1	2	0	3	10
E. resinifera	0	3	0	0	5	0
E. saligna	0	0	0	6	0	0
E. sclerophylla	2	9	5	0	1	0
E. sieberi	0	4	4	0	1	0
Exocarpos cupressiformis	0	0	1	4	2	0
E. stricta	0	1	0	0	0	5

APPENDIX K FREQUENCY OF OCCURRENCE OF PLANT SPECIES IN THE VEGETATION TYPES (1-5), AND IN THE ALLENS CREEK VALLEY AT THE PROPOSED AIRPORT SITE AT WILTON (continued)

Plant species	Vegetation type					Allens Creek Valley
	1	2	3	4	5	
Gahnia clarkei	0	1	3	4	1	0
G. microstachya	0	0	1	0	0	0
Galium binifolium	0	0	0	0	0	5
Gastrodia sesamoides	0	0	0	0	1	0
Gleichenia dicarpa	0	0	2	0	0	0
G. rupestris	0	0	3	2	0	0
Glycine clandestina	0	0	0	0	7	0
Gnaphalium sphaericum	0	0	0	0	2	0
Gompholobium glabratum	0	2	0	0	1	0
G. grandiflorum	0	5	4	0	1	0
G. latifolium	0	0	4	0	0	0
G. minus	0	0	0	0	1	0
Gonocarpus micranthus	2	1	2	0	0	0
G. teucrioides	4	4	7	6	4	10
Goodenia bellidifolia	0	2	1	0	3	0
G. hederacea	2	3	0	0	3	0
G. heterophylla	4	0	3	4	0	5
G. ovata	0	0	0	2	0	5
G. stelligera	4	1	0	0	0	0
Grammitis billardieri	0	0	0	2	0	0
Grevillea capitellata	2	2	2	0	0	0
G. longifolia	0	0	2	0	0	0
G. mucronulata	0	8	8	2	2	0
G. oleoides	0	0	2	2	0	0
G. parviflora	0	1	0	0	0	0
G. sphacelata	0	3	1	0	0	0
Haemodorum corymbosum	6	0	1	0	0	0
H. planifolium	0	1	0	0	0	0
Hakea dactyloides	2	7	3	2	0	0
H. sericea	4	5	5	0	2	0
H. teretifolia	4	0	0	0	1	0
Hardenbergia violacea	0	1	4	0	2	0
Helichrysum collinum	0	1	0	0	2	0
H. elatum	0	0	0	0	2	0
H. scorpioides	0	1	0	0	5	0
Hemigenia purpurea	0	0	1	0	0	0
Hibbertia aspera	0	1	3	0	6	0
H. diffusa	0	0	0	0	4	0
H. monogyna	0	1	2	0	0	0
H. nitida	0	0	3	4	0	0
H. riparia	0	1	0	0	0	0
H. serpyllifolia	8	5	0	0	0	0
Hovea linearis	0	1	1	0	0	0
H. pannosa	0	1	0	0	0	0
Hybanthus monopetalus	0	4	0	0	0	10
Hydrocotyle sp.	0	0	1	2	5	0
Hymenophyllum cupressiforme	0	0	0	4	0	0
Hypericum gramineum	0	1	1	0	0	0
Hypochoeris radicata	0	2	3	0	2	5
Hypoxis hygrometrica	2	0	0	0	0	0
Imperata cylindrica	0	1	0	0	4	0
Indigofera australis	0	1	0	0	4	0
Isopogon anemonifolius	4	7	7	0	1	0
I. anethifolius	0	0	0	0	1	0
Juncus planifolius	2	1	1	0	0	0
J. usitatus	2	1	0	0	0	0
Kennedia rubicunda	0	0	2	2	0	5
Kunzea ambigua	0	4	1	0	0	0
Lambertia formosa	2	7	5	0	1	0
Lasiopetalum ferrugineum	0	1	2	2	0	0
L. rufum	0	1	0	0	0	0
Laxmannia gracilis	0	1	1	0	0	0
Lepidosperma filiforme	0	1	2	0	0	5
L. laterale	0	3	5	6	2	10
Leptocarpus tenax	4	1	1	0	0	0
Leptomeria acida	0	2	4	0	2	0
Leptospermum arachnoides	4	1	1	0	0	0
L. attenuatum	0	8	7	2	1	5
L. flavescens	6	2	3	0	1	10
L. juniperinum	2	0	1	0	0	0
L. lanigerum?	0	0	2	0	0	0
L. parvifolium	0	1	0	0	0	0
Lepyrodia scariosa	2	5	4	0	1	0

APPENDIX K FREQUENCY OF OCCURRENCE OF PLANT SPECIES IN THE VEGETATION TYPES (1-5), AND IN THE ALLENS CREEK VALLEY AT THE PROPOSED AIRPORT SITE AT WILTON (continued)

Plant species	Vegetation type					Allens Creek Valley
	1	2	3	4	5	
Leucopogon amplexicaulis	0	0	2	0	0	0
L. juniperinus	0	1	0	0	2	0
L. lanceolatus	0	1	0	2	0	0
L. setiger	0	0	2	0	0	0
L. virgatus	0	0	0	0	1	0
Lindsaea linearis	6	2	2	0	0	5
L. microphylla	0	0	1	2	2	5
Lissanthe strigosa	0	1	0	0	3	0
Logania albiflora	0	1	3	2	0	0
Lomandra confertifolia ssp. rubiginosa	0	1	2	0	0	10
L. cylindrica	2	1	1	0	1	0
L. filiformis	2	1	1	0	4	0
L. filiformis ssp. coriacea	0	0	0	0	1	0
L. filiformis ssp. filiformis	0	1	2	0	0	5
L. fluviatilis	0	0	1	0	0	0
L. glauca	0	1	0	0	0	0
L. longifolia	2	1	6	8	4	10
L. multiflora	0	0	0	0	4	0
L. obliqua	2	7	4	2	2	5
Lomatia myricoides	0	0	3	2	0	0
L. silaifolia	2	5	4	0	1	5
Lycopodium deuterodensum	0	0	1	0	0	0
Marsdenia suaveolens	0	1	1	2	1	5
Melaleuca linariifolia	6	1	4	0	1	5
M. squarrosa	0	0	1	0	0	0
M. styphelioides	0	0	0	0	0	5
M. thymifolia	10	0	0	0	1	0
Micrantheum ericoides	8	1	0	0	0	0
Microtis sp.	0	0	0	0	1	0
Mirbelia rubiifolia	2	5	3	0	0	0
Mitrasacme polymorpha	6	7	3	0	1	0
Monotoca scoparia	0	4	0	0	2	5
Morinda jasminoides	0	0	0	2	0	0
Myriophyllum pedunculatum	0	0	1	0	0	0
Notelaea sp.	0	0	0	8	0	5
Olax stricta	0	1	2	0	0	0
Olearia microphylla	0	0	0	0	0	10
O. viscidula	0	0	0	0	1	0
Omphacomeria acerba	0	1	1	0	1	0
Opercularia aspera	2	1	3	4	3	10
O. varia	0	1	0	0	2	0
Oxalis corniculata	0	0	1	0	4	0
Oxylobium ilicifolium	0	0	1	0	0	5
Patersonia glabrata	4	7	7	2	2	5
Persoonia hybrids	0	1	0	0	0	0
P. lanceolata	0	1	0	0	0	0
P. levis	0	8	8	0	3	0
P. linearis	0	3	3	4	5	10
P. pinifolia	0	1	3	0	0	0
Petrophile sessilis	8	7	5	0	2	0
Phebalium squameum	0	0	0	6	0	0
Phyllanthus gasstroemii	0	0	0	6	0	0
P. thymoides	0	5	3	0	5	0
Phyllota phylicoides	2	0	0	0	0	0
Pimelea linifolia	4	8	4	0	3	0
Pittosporum revolutum	0	0	0	0	1	5
Plantago debilis	0	0	0	0	1	0
Platysace ericoides	0	3	2	0	0	0
P. lanceolata	0	0	0	2	0	0
P. linearifolia	0	3	5	0	1	0
Poa sp.	0	3	2	0	4	0
Podolepis jaceoides	0	1	0	0	4	0
Pomaderris ferruginea	0	0	0	0	0	5
P. lanigera	0	0	0	0	0	5
P. ligustrina	0	0	0	2	0	0
P. multiflora	0	0	2	0	0	10
Pomax umbellata	0	2	4	0	1	0
Poranthera corymbosa	0	2	2	0	0	0
P. ericifolia	0	1	2	0	1	0
P. microphylla	0	1	2	4	4	0
Potamogeton tricarinatus	0	0	0	0	0	5
Pratia sp.	0	0	1	2	5	0
Prostanthera lasianthos	0	0	0	6	0	0
P. linearis	0	0	2	6	0	0

APPENDIX K FREQUENCY OF OCCURRENCE OF PLANT SPECIES IN THE VEGETATION TYPES (1-5), AND IN THE ALLENS CREEK VALLEY AT THE PROPOSED AIRPORT SITE AT WILTON (continued)

Plant species	Vegetation type					Allens Creek Valley
	1	2	3	4	5	
Pseudanthus pimeleoides	0	0	0	2	0	0
Pseuderanthemum variabile	0	1	0	0	0	5
Pteridium esculentum	0	1	4	8	1	10
Ptilanthelium deustum	2	0	0	0	0	0
Pultenaea daphnoides	0	0	1	2	0	0
P. elliptica	2	1	0	0	0	0
P. flexilis	0	0	0	4	0	5
P. retusa	0	1	1	0	0	5
P. scabra	0	1	0	0	0	0
P. villosa	0	1	1	0	4	0
Rapanea variabilis	0	0	0	0	0	5
Restio gracilis	6	1	0	0	0	0
Ricinocarpos pinifolius	0	0	1	0	0	0
Rubus sp.	0	0	1	0	0	0
Scaevola ramosissima	0	1	1	0	0	5
Schoenus ericetorum	0	1	1	0	0	0
S. imberbis	0	0	1	0	0	0
S. maschalinus?	0	1	2	0	0	0
S. melanostachys	4	1	6	2	0	10
S. moorei	0	0	0	0	1	0
Scirpus cernuus?	0	0	1	0	0	0
Selaginella uliginosa	4	0	3	0	0	0
Senecio lautus	0	1	1	0	2	5
S. linearifolius	0	0	0	0	1	0
S. minimus	0	0	0	0	0	5
S. vagus	0	0	0	0	0	5
Smilax glyciphylla	0	0	3	0	0	5
Solanum pungetium	0	0	1	0	3	0
Sphaerolobium vimineum	4	3	0	0	1	0
Sprengelia incarnata	4	0	0	0	0	0
Stackhousia viminea	0	0	1	0	0	0
Stenocarpus salignus	0	0	1	6	0	0
Sticherus flabellatus	0	0	3	6	0	0
Stipa pubescens	2	1	0	0	3	0
Stylidium graminifolium	0	1	3	0	0	0
S. laricifolium	0	1	2	2	0	5
Styphelia triflora	0	0	0	0	1	0
Symphionema paludosum	2	0	0	0	0	0
Telopea speciosissima	0	0	2	0	1	0
Tetratheca ericifolia	0	1	0	0	0	0
Themeda australis	0	2	0	0	4	0
Todea barbara	0	0	3	6	0	0
Triglochin procera	0	0	1	0	0	0
Tristania laurina	0	0	1	8	0	5
T. neriifolia	0	0	3	4	0	0
Typha latifolia*	2	0	0	0	0	0
Vallisneria gigantea	0	0	1	0	0	0
Vernonia cinerea	0	0	0	0	3	0
Veronica calycina	0	0	1	0	4	5
Viminaria juncea	6	1	1	2	0	0
Viola betonicifolia	0	1	0	0	3	0
V. hederacea	2	1	0	2	1	5
Wahlenbergia sp.	0	0	0	2	7	5
Xanthorrhoea resinosa	0	4	1	0	1	0
Xanthosia pilosa	0	1	5	2	0	0
X. tridentata	2	3	4	0	1	0
Xylomelum pyriforme	0	1	1	0	1	5
Xyris sp.	2	0	0	0	0	0
Zieria pilosa	0	0	2	0	0	0

* Introduced species.
** Nomenclature is consistent with Jacobs and Pickard (1981).
? Precise identification not confirmed.

Note: Scale used is 0 (absent) to 10 (common).

APPENDIX L METHODS USED FOR FAUNAL SURVEY AT THE PROPOSED AIRPORT SITE AT WILTON

The methods used in carrying out the faunal survey at the proposed airport site at Wilton are briefly described below; for more details see Denny (1984).

Mammals

The following techniques were used to locate and identify mammals:

- **Elliott live traps:** Small traps (30 x 10 x 10 cm) were set 10 m apart in lines through different habitats. A total of 700 trap days was completed. The traps were baited with rolled oats, peanut butter and bacon fat, and a small wad of dacron filling was placed inside each trap to provide trapped animals with protection from the cold. At each trap site, a brief description of the groundcover in the immediate vicinity was made in order to provide information about the microhabitat. Microhabitats are smaller in area than habitats and yield more detail about habitat preferences of the trapped animals. Table 16.2.1 lists microhabitats sampled, together with the percentage of traps laid in each.

- **Cage traps:** Six 'bandicoot' and two 'possum' wire traps were laid within each survey area and baited with meat and apple.

- **Spotlighting:** Spotlighting transects were undertaken on foot along all tracks within the survey area. Selected areas of bushland were also inspected by spotlight.

- **Mist netting for bats:** One 18 m mist net was set up across a flyway in the south-western part of the survey area. The net was used at night and checked at hourly intervals.

- **General observations:** Evidence of occupation of the study area by mammals came also from indirect sources. Identification of droppings, characteristic scratchings and diggings and calls were used to locate mammal species.

Table L.1 Percentage distribution of Elliott traps within the microhabitats

Microhabitats	Category	Percentage of traps laid	
		Shale vegetation	Heath
Upper strata	Trees	42	18
	No trees	58	82
Middle strata	Tall grass	13	0
	Shrubs	2	95
	Nil	85	5
Lower strata	Grass	88	85
	Fern	3	0
	Vine	1	0
	Nil	8	15
Ground cover	Litter	99	97
	Nil	1	3
Vicinity of logs	Beside log	3	8
	Under log	0	1
	No log near	97	91

Avifauna

Birds were observed during walking transects in the survey area, which were undertaken each morning and coincided with the inspection of Elliott traps. Other sightings of birds were obtained during spotlighting transects and by general observation. All birds sighted were counted, thus obtaining a quantitative estimate of the density of each bird species in the study area, and these estimates were used to establish a status ranking for each bird. Records of birds were also obtained from indirect evidence such as calls and nests.

Herpetofauna

Reptiles and amphibians were caught by hand during walking transects through the study area. Indirect identification of frogs was undertaken by recording their calls and comparing them with reference recordings (Grigg and Barker, University of Sydney 1983).

Habitat analysis

Information on various physical parameters associated with some of the habitat types is important in assessing the value of a particular habitat for fauna. The following parameters were measured:

- **Upper and middle strata vegetation density:** During a walking transect, the number of trees (upper strata) and shrubs (middle strata) were counted within a strip 50 x 2 m. The shrub category also included emergent saplings and small trees. The density of the trees and shrubs was calculated in terms of numbers per hectare.

- **Tree and shrub height:** Any trees or shrubs located during each transect were measured for height. Trees were measured to the nearest metre and shrubs to the nearest 20 cm. Mean heights were calculated from these measurements.

- **Lower strata vegetation density:** At ten points along each transect, a 0.25 m^2 quadrat was laid upon the ground. Visual estimates were made of the relative proportions of groundcover contributed by grass, forbs, moss, vines, rocks, ferns, litter and logs. These were measured as a percentage of the cover, using canopy cover as the parameter for grass, forbs and ferns. The total percentage cover within some quadrats was more than 100% because of the overlapping nature of some of the components.

- **Grass and forb height:** The average height of the grasses and forbs within each quadrat was measured to the nearest 1 cm when the plants were less than 10 cm tall and in 5 cm intervals if taller than 10 cm.

- **Litter mass:** All leaf litter was cleared from each quadrat, placed in a plastic bag, and weighed on a spring balance to the nearest 10 g.

- **Soil penetrability:** After clearing away the litter, the soil was tested in four places for penetrability. Soil penetrability can be used as a measure of how easy the soil is to dig. Thus a high value for soil penetrability (measured in kg/cm) indicates a hard soil and therefore difficulty in digging. This parameter was measured using a 'Soil-test' pocket penetrometer.

APPENDIX M HABITAT CHARACTERISTICS OF MAJOR NATIVE VEGETATION TYPES AT THE PROPOSED AIRPORT SITE AT WILTON

Parameter	Sample areas		Unit
	Open forest on shale	Scribbly gum woodland	
Grass cover	21.6 ± 6.82*	32.5 ± 4.34*	%
Forb cover	7 ± 1.12*	0.5 ± 0.5*	%
Litter cover	83 ± 5.2*	82.5 ± 4.07*	%
Rock cover	0	1.5 ± 1.07*	%
Log cover	2 ± 0.82*	9 ± 2.2*	%
Grass height	27.1 ± 4.2*	36.2 ± 2.4*	cm
Forb height	6 ± 1.8*	10 ± 10*	cm
Litter mass	208 ± 28.8*	182 ± 30.6*	g
Soil penetrability	0.6 ± 0.07*	0.77 ± 0.08*	kg/cm^2
Tree density	1,000	1,400	per ha
Tree height	12.5	4.6	m
Shrub density	100	11,200	per ha
Shrub height	0.6	0.7	m

* Means ± standard error (n=10); n = number of samples.

APPENDIX N MAMMALS RECORDED FROM THE PROPOSED AIRPORT SITE AT WILTON

Scientific name	Common name	Status
Carnivora		
Canis familiaris	Dog	C
Felis catus	Feral cat	C
Vulpes vulpes	Fox	C
Largomorpha		
Oryctolagus cuniculus	European rabbit	A
Marsupialia		
Antechinus stuartii	Brown antechinus	A
Macropus rufogriseus	Red-necked wallaby	C
M. giganteus	Eastern grey kangaroo	A
Perameles nasuta	Long-nosed bandicoot	C
Petauroides volans	Greater glider	A
Phascolarctos cinereus	Koala	C
Pseudocheirus peregrinus	Common ringtail possum	C
Trichosaurus vulpecula	Common brushtail possum	A
Vombatus ursinus	Common wombat	C
Wallabia bicolor	Swamp wallaby	C
Monotremata		
Tachyglossus aculeatus	Short-beaked echidna	C
Rodentia		
Mus musculus	House mouse	A
Rattus fuscipes	Bush rat	C

Note: Scientific and common names and status from Strahan (1983).
A Abundant
C Common

APPENDIX O FREQUENCY OF OCCURRENCE AND STATUS OF AVIFAUNA RECORDED AT THE PROPOSED AIRPORT SITE AT WILTON

Species	Habitat				Status		
	Open forest on shale	Scribbly gum woodland	Cleared land	Creek-line woodland	Illawarra	New South Wales	Australia
Acanthiza chrysorrhoa, yellow-rumped thornbill	X	X			C	A	A
A. lineata, striated thornbill	X		X		C	A	MC
A. pusilla, brown thornbill		X			A	A	C
A. reguloides, buff-rumped thornbill		X			MC	A	C
Acanthorhynchus tenuirostris, eastern spinebill	X	X			A	A	C
Accipiter fasciatus, brown goshawk		X	X		U	MC	MC
Acridotheres tristis, common mynah			X		MC	A	C
Alisterus scapularis, Australian king-parrot					MC	C	C
Anas gibberifrons, grey teal			X		MC	A	A
A. superciliosa, Pacific black duck			X		C	A	C
Anthochaera chrysoptera, little wattlebird	X	X	X		A	C	MC
Anthus novaeseelandiae, Richard's pipit			X		C	A	A
Aquila audax, wedge-tailed eagle					MC	MC	MC
Ardea novaehollandiae, white-faced heron					C	A	C
Artamus cyanopterus, dusky woodswallow			X	X	MC	A	C
Cacatua galerita, sulphur-crested cockatoo	X				U	C	C
C. roseicapilla, galah					MC	A	A
Callocephalon fimbriatum, gang-gang cockatoo	X				U	MC	C
Calyptorhynchus funereus, yellow-tailed black-cockatoo	X				U	MC	MC
Carduelis carduelis, European goldfinch					MC	A	C
Cecropis ariel, fairy martin			X		MC	A	C
C. nigricans, tree martin					MC	A	A
Ceyx azurea, azure kingfisher	X	X			U	MC	MC
Chenonetta jubata, maned duck			X		MC	A	C
Cinclosoma punctatum, spotted quail-thrush					U	MC	MC
Climacteris leucophaea, white-throated treecreeper	X	X			C	A	MC
C. picumnus, brown treecreeper	X				U	A	C
Coracina novaehollandiae, black-faced cuckoo-shrike	X	X		X	A	A	C
Corcorax melanorhamphos, white-winged chough	X	X			U	C	MC
Corvus coronoides, Australian raven	X	X	X		A	A	C
Cracticus torquatus, grey butcherbird	X			X	MC	A	C
Cuculus pyrrhophanus, fan-tailed cuckoo	X	X	X		C	C	C
Dacelo novaeguineae, laughing kookaburra	X	X			A	A	A
Daphoenositta chrysoptera, varied sittella	X		X		U	C	C
Dasyornis brachypterus, eastern bristlebird		X			S	U	R
Dicaeum hirundinaceum, mistletoebird					C	A	MC
Elanus notatus, black-shouldered kite					MC	MC	MC
Emblema guttata, diamond firetail			X		A	C	MC
E. temporalis, red-browed firetail	X				A	A	C
Eopsaltria australis, eastern yellow robin	X	X			C	A	C
Falco cenchroides, Australian kestrel			X		C	C	A
F. longipennis, Australian hobby					U	MC	MC
Fulica atra, Eurasian coot					C	A	C
Geopelia placida, peaceful dove					MC	A	C
Grallina cyanoleuca, Australian magpie-lark			X		A	A	C
Gymnorhina tibicen, Australian magpie	X	X	X	X	A	A	A
Halcyon sancta, sacred kingfisher				X	C	A	C
Hirundo neoxena, welcome swallow			X		A	A	C
Leucosarcia melanoleuca, wonga pigeon					MC	MC	MC
Lichenostomus chrysops, yellow-faced honeyeater	X	X		X	A	A	C
L. leucotis, white-eared honeyeater		X			MC	A	MC

APPENDIX O FREQUENCY OF OCCURRENCE AND STATUS OF AVIFAUNA RECORDED AT THE PROPOSED AIRPORT SITE AT WILTON (continued)

Species	Habitat				Status		
	Open forest on shale	Scribbly gum woodland	Cleared land	Creek-line woodland	Illawarra	New South Wales	Australia
L. melanops, yellow-tufted honeyeater	X		X		MC	A	MC
Malurus cyaneus, superb fairy-wren	X	X	X	X	A	A	MC
M. lamberti, variegated fairy-wren		X			MC	C	MC
Manorina melanocephala, noisy miner	X	X	X	X	MC	A	C
Melanodryas cucullata, hooded robin	X				S	C	C
Meliphaga lewinii, Lewin's honeyeater					A	A	C
Melithreptus lunatus, white-naped honeyeater					MC	A	C
Menura novaehollandiae, superb lyrebird					MC	C	MC
Microeca leucophaea, jacky winter	X	X	X		MC	A	A
Neophema pulchella, turquoise parrot					R	U	MC
Ninox novaeseelandiae, southern boobook					MC	C	C
Ocyphaps lophotes, crested pigeon					A	A	A
Origma solitaria, origma	X				MC	MC	MC
Oriolus sagittatus, olive-backed oriole	X		X		MC	C	MC
Pachycephala pectoralis, golden whistler					MC	A	C
P. rufiventris, rufous whistler	X	X	X	X	C	A	C
Pardalotus punctatus, spotted pardalote	X	X			C	A	C
P. striatus, striated pardalote					C	A	C
Petroica multicolor, scarlet robin		X			U	C	MC
Phalacrocorax carbo, great cormorant			X		C	C	C
Phaps chalcoptera, common bronzewing	X	X	X		U	A	C
P. elegans, brush bronzewing			X		MC	MC	MC
Philemon corniculatus, noisy friarbird	X	X			U	A	C
Phylidonyris novaehollandiae, New Holland honeyeater			X		A	A	C
Platycercus elegans, crimson rosella		X			C	A	C
P. eximius, eastern rosella	X	X	X	X	C	A	A
Podargus strigoides, tawny frogmouth					MC	A	C
Poephila bichenovii, double-barred finch					MC	A	C
P. guttata, zebra finch					U	A	A
Psephotus haematonotus, red-rumped parrot					R	A	C
Psophodes olivaceus, eastern whipbird	X				C	A	C
Ptilonorhynchus violaceus, satin bowerbird					C	C	C
Rhipidura fuliginosa, grey fantail	X	X	X		A	A	C
R. leucophrys, willie wagtail	X		X		A	A	A
R. rufifrons, rufous fantail					MC	C	MC
Sericornis frontalis, white-browed scrub wren	X	X			C	A	C
Stipiturus malachurus, southern emu-wren		X			U	MC	MC
Strepera graculina, pied currawong	X	X			A	A	C
Streptopelia chinensis, spotted turtle-dove					C	A	C
Sturnus vulgaris, common starling			X		A	A	A
Tachybaptus novaehollandiae, Australasian grebe			X		C	A	C
Turnix varia, painted button-quail					MC	MC	MC
Tyto alba, barn owl					MC	MC	C
Vanellus miles, masked lapwing			X		C	A	C
Zosterops lateralis, silvereye					A	A	A
Species richness	38	33	34	10			

Notes: Scientific and common names from Royal Australasian Ornithologists Union (1978)

X Observed in habitat
A Abundant
C Common
MC Moderately common
U Uncommon
S Scarce
R Rare

Status for Illawarra region from Gibson (1977)
Status for New South Wales from Morris et al. (1981)
Status for Australia from MacDonald (1973)

APPENDIX P HERPETOFAUNA RECORDED FROM THE PROPOSED AIRPORT SITE AT WILTON

Scientific name	Common name
Amphibians	
Limnodynastes peronii	Brown striped frog
Litoria caerulea	Green tree frog
L. citropa	Blue Mountains tree frog
L. ewingii	Brown tree frog
L. fallax	Eastern dwarf tree frog*
L. peronii	Peron's tree frog*
L. phyllochroa	Leaf green tree frog
L. verreauxii	Verreaux tree frog
Pseudophryne bibronii	Brown toadlet
Ranidella signifera	Common eastern froglet*
Uperoleia laevigata	Eastern spotted toadlet*
Reptiles	
Amphibolurus muricatus	Jacky lizard
Chelodina longicollis	Eastern long-necked tortoise*
Lampropholis guichenoti	Garden skink
L. mustelina	Weasel skink*
Physignathus lesueurii	Eastern water dragon*
Pseudechis porphyriacus	Red-bellied black snake*
Pseudonaja textilis	Eastern brown snake
Sphenomorphus quoyii	Eastern water skink*
Varanus varius	Lace monitor*

* Observed during present survey.

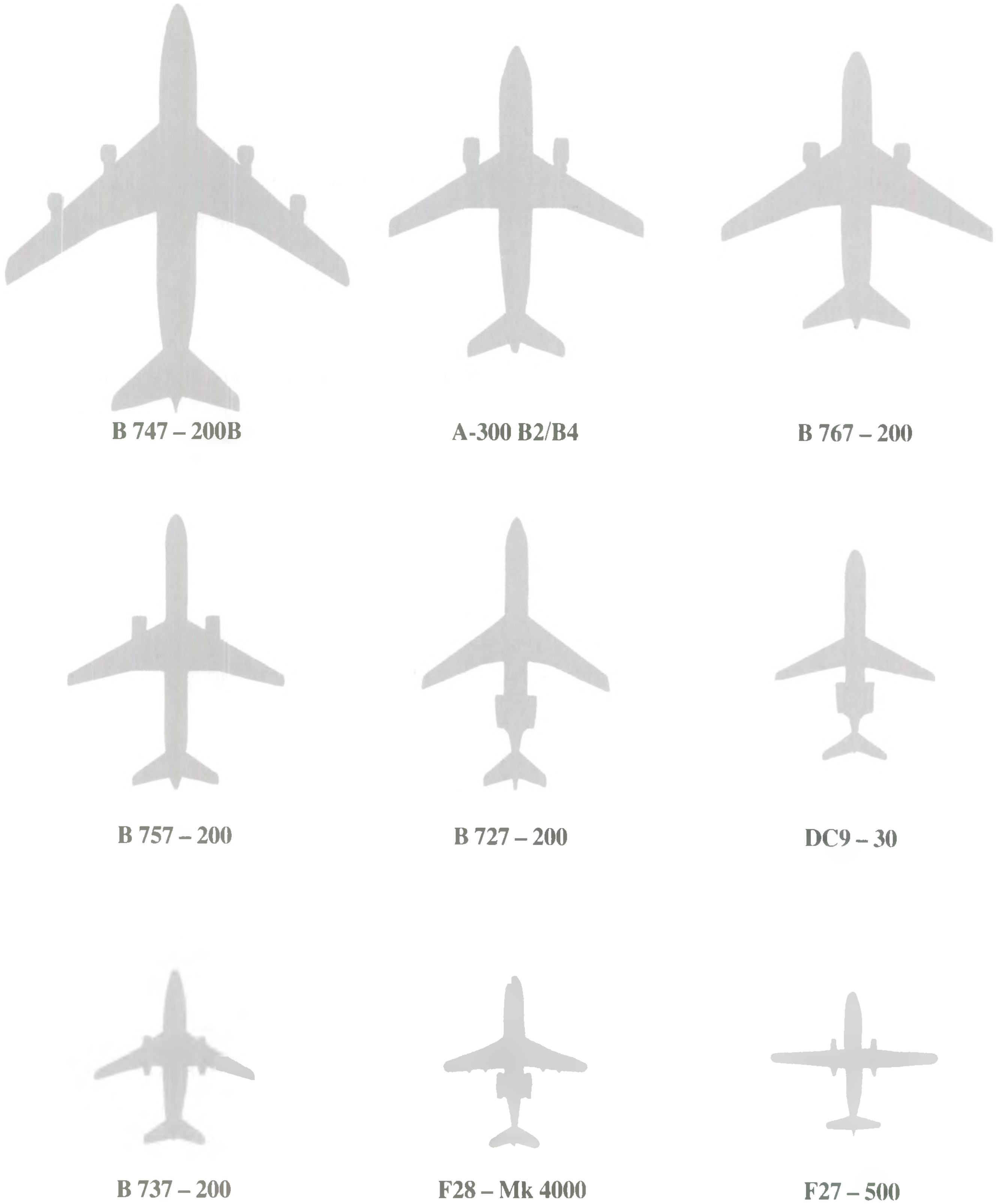
Note: No conservation status ascribed in the current literature.

APPENDIX Q GLOSSARY

Aircraft movement	a landing or take-off of an aircraft
At-grade	(of a road intersection) having the intersecting roads on the same level
Authigenic	(of minerals) formed in situ, during or after deposition
B horizon	the middle layer of soil, lying between the topsoil and the originating material; the subsoil
Channel sandstone	sandstone formed from a bed of sand deposited in a stream bed or some other channel eroded into the underlying bed
Forb	any herbaceous plant which is not a grass
Glide slope	an electronic navigation facility providing vertical guidance for aircraft during approach and landing
Gross margin	the gross return from an enterprise less variable costs
Groundside	of that part of a journey which is made on land, not in the air
Hubbing	the designation of selected airports for the collection and distribution of an airline's passengers making intermediate stops
Laminite	a series of sedimentary beds made up of individual units that show a regular vertical pattern of changing grain size of the sediments comprising the bed
Lithosol	surface rock without soil
Localizer	a directional radio beacon which guides an aircraft during approach and landing
Pedal	(of soil) having a structure that includes natural aggregates
Picrite	an igneous rock consisting principally of ferromagnesian minerals
Pisolithic	(of sedimentary rock) built of round concretions 2 mm or more in diameter
Point bar	a bank of sand or gravel deposited on the inner side of a river meander
Propagule	a part of a plant, such as a seed or cutting, capable of forming a new plant
Provenance terrain	the parent rock from which the fragments of a sediment are formed
Quartzose sandstone	a sandstone composed of at least 90% silica
Silcrete	a compacted subsoil cemented with silica

Swale	a depression or marshy place in the ground
Terminal passenger	a passenger who joins or leaves an aircraft at an airport
Touch-and-go training flights	a landing followed immediately by a take-off without stopping
Understorey	the lower layer of trees in a forest
Wind shear	a change of wind speed with height

Note: The Concise Oxford Dictionary may be consulted for definitions of any terms not listed in this glossary.



AIRCRAFT SILHOUETTES (to scale)

APPENDIX R ABBREVIATIONS

ANEF	Australian Noise Exposure Forecast
CSPR	two closely spaced parallel runways with a cross-wind runway
d	day(s)
dB	decibel(s)
DSE	dry sheep equivalent
DWSPR	two double widely spaced parallel runways with a pair of cross-wind runways
h	hour(s)
ha	hectare(s)
L	litre(s)
m	metre(s)
MJ	megajoule(s)
MM	Modified Mercallie scale (followed by roman numeral)
Mt	megatonne(s)
MV	megavolt(s)
NA	not applicable
NEF	Noise Exposure Forecast
pphm	parts per hundred million
ppm	parts per million
R	right
RPT	regular public transport (scheduled airline and commuter services)
SR	single runway
WSPR	two widely spaced parallel runways with a cross-wind runway

APPENDIX S   REFERENCES

Ames, D.R. 1974. Sound stress and meat animals. In Proceedings of the International Livestock Environment Symposium. American Society of Agricultural Engineers.

Andrews, G.D., and F.A. Bodkin-Andrews. 1984. Dharana: The people of this land. Mimeo.

Attenbrow, V., and G. Happ. 1983. Proposed Maldon—Dombarton rail route: report on archaeological survey for Aboriginal sites. Unpublished report to Dames and Moore.

Australian Bureau of Statistics. 1983. Estimated resident population and components of change in population of local government areas (final), New South Wales, 1976-1981.

—— 1978-83. Computer printouts, Agricultural Census.

Australian Museum. 1979. Faunal Survey of the Newnes Plateau/Colo River Area. Sydney: Australian Museum.

Beadle, N.C.W., O.D. Evans and R.C. Carolin. 1982. Flora of the Sydney Region. Sydney: A.H. and A.W. Reed.

Beca Orr Pty Ltd. March 1984. Sydney region general aviation aerodrome study. Working paper No. 4: Demand forecasts.

Bell, H.L. 1966. A population study of heathland birds. The Emu 65: 295-304.

Benson, D.H. 1980. Explanatory notes for the Sydney 1:100,000 vegetation map sheet. Sydney: National Herbarium of New South Wales.

Bergin, T.J. 1978. The koala. In Proceedings of the Taronga Symposium. Sydney: Zoological Parks Board of New South Wales.

Bowman, H.N. 1974. Geology of the Wollongong, Kiama and Robertson 1:50,000 sheets. Sydney: NSW Geological Survey.

Bowman, H.N., and B. Mulland. In press. Geology of the Wollongong—Port Hacking 1:100,000 Sheet. Sydney: Department of Mineral Resources.

Brayshaw, H. 1983. Archaeological investigations of proposed clay/shale quarry in Housing Commission site 7770, Mulgoa, New South Wales. Unpublished report to Gutteridge Haskins and Davey Pty Ltd.

—— 1982. Archaeological investigation of Lot 1 in the Mulgoa District of the City of Penrith, New South Wales. Unpublished report to R.W. Corkery and Zacuba Pty Ltd.

Bunny, M.R. 1972. Geology and coal resources of the Southern Catchment coal reserve, southern Sydney Basin, New South Wales. NSW Geological Survey Bulletin 22.

Bureau of Meteorology, Department of Science and Technology, NSW Regional Office. 1984. A report on meteorological conditions at Gundary Plains, Darkes Forest and Wilton.

Bureau of Meteorology, Department of Science and Technology, Melbourne. 1982. Estimation of probable maximum precipitation Avon, Cataract, Cordeaux, Nepean and Woronora catchments of the Metropolitan Water Sewerage and Drainage Board, Sydney, New South Wales.

Burke Marketing Research, 1984. A survey of public attitudes towards a second Sydney airport. Research report for the Department of Aviation.

Charman, P.E.V. ed. 1978. Soils of New South Wales. Their characterisation, classification and conservation. Technical Handbook No. 1. Sydney: Soil Conservation Service of New South Wales.

Chesnut, W.S. In press. Engineering Geology from Geology of the Penrith 1:100,000 Sheet Sydney: NSW Geological Survey.

—— 1981a. Penrith 1:1000,000 sheet. Engineering geological considerations and environmental geological hazards. Sydney: NSW Geological Survey.

—— 1981b. Wollongong-Port Hacking 1:100,000 map sheets. Engineering geological considerations and environmental geological hazards. Sydney: NSW Geological Survey.

Clark, N.R. In press. Penrith 1:100,000 Geological Sheet 9030. Sydney: NSW Geological Survey.

—— ed. In press. Geology of Penrith 1:100,000 sheet. Sydney: NSW Geological Survey.

Cogger, H.G. 1962. Snakes, lizards and chelonians. In The Natural History of Sydney. Sydney: Australian Museum.

Colquhoun, J.R. 1983. Lower atmospheric temperature inversions in the eastern part of the Sydney Basin. In The urban atmosphere — Sydney: a case study, ed. J.N. Carras and G.M. Johnson, 31-8. Sydney: CSIRO.

Corkery, R.W., C.J. Baker and C. Herbert. 1980. Management of Clay/Shale Resources in the Sydney Region. Sydney: NSW Geological Survey.

Cotton, L.A. 1921. The Kurrajong earthquake of August 15, 1919. Royal Society of New South Wales Journal and Proceedings 55: 83-104

Cramsie, J.N. 1964. Sedimentation and structure in the Illawarra coal measures. M.Sc. thesis, University of Sydney.

Crawford, E.A. et al. 1980. Diatremes in the Sydney Basin. NSW Geological Survey Bulletin 26: 294-323.

Dallas, M. 1981a. Investigation report on an Aboriginal site at West St Clair. Unpublished report to the Lands Commission of New South Wales.

—— 1981b. An archaeological survey of the South Penrith Development site. Unpublished report to the Housing Commissio of New South Wales.

Dames & Moore. 1983. Maldon—Dombarton—Port Kembla railway. Environmental impact statement.

—— 1975. Supplemental report Environmental impact investigation washery refuse disposal, proposed West Bellambi colliery.

Denham, D. 1980. The 1961 Robertson earthquake — more evidence for compressive stress in south-east Australia. Journal of Australian Geology and Geophysics 5: 153-6.

Denham, D. et al. 1975. Australian earthquakes. Search 6 (1-2).

Denny, M.J.S. 1984. Rapid surveys of fauna and their habitats. In Survey methods for nature conservation Vol. 1, ed. K. Myers, C.R. Margules and I. Musto. Canberra: CSIRO.

—— 1982. Faunal survey of development areas associated with the Mount Piper power station. Report to the Electricity Commission of New South Wales.

Department of Aviation. February 1984. Assignment No. 5: Selection and evaluation of airport locations. Canberra: Department of Aviation.

—— November 1983. Second Sydney airport site selection programme. Paper No. 110: Areas for site evaluation. Canberra: Department of Aviation.

Department of Environment and Planning. 1984a. Sydney region — north-west sector. Regional Environmental Study. 2 vols. Sydney: Department of Environment and Planning.

—— 1984b. Sydney extractive industries. Regional environmental study. Sydney: Department of Environment and Planning.

—— 1984c. Population Projections for New South Wales 1981-2011. Prepared for the New South Wales Population Projections Group. Annexed to Research and Services Division report 1984. Sydney: Department of Environment and Planning.

—— 1983. NSW urban development programme. Sydney: Department of Environment and Planning.

—— 1981. Rural land evaluation manual. Sydney: Department of Environment and Planning.

Department of Mineral Resources. 1984. Second Sydney airport site selection programme. Submission by the Department of Mineral Resources for the preparation of the Draft Environmental Impact Study. Sydney: Department of Mineral Resources.

Doyle, H.A., J.R. Cleary, and N.M. Gray. 1968. The seismicity of the Sydney Basin. Geological Society of Australia Journal 15(2): 175-81.

Drake, L. 1974. The seismicity of New South Wales. Royal Society of New South Wales Journal and Proceedings 107:35-40.

Eades, D.K. 1976. The Dharawal and Dhurga languages of the South Coast of New South Wales. Canberra: Institute of Aboriginal Studies.

Eiser, C.R., F. Koo, and J.D. Court. 1983. Emission trends in hydrocarbons and nitrogen oxides from stationary services in Sydney for the years 1976, 1980 and 1986. In The urban atmosphere — Sydney: a case study, ed. J.N. Carras and G.M. Johnson, 455-71. Sydney: CSIRO.

Espmark, Y., L. Falt, and B. Falt. 1974. Behavioural responses in cattle and sheep exposed to sonic booms and low altitude subsonic flight noise. Veterinary Record 94:106-13.

Ewbank, R. 1976. The effects of sonic booms on farm animals. The Veterinary Annual 17:296-306.

Ewer, R.F. 1968. Ethology of mammals. London: Elek Sciences.

Findlay, C. et al. 1984. Changes in the air? Issues in domestic aviation policy. Sydney: The Centre for Independent Studies.

Fordham, R.C. 1970. Airport planning in the context of the third London airport. Economic Journal.

Fox, B.J., M.D. Fox, and G.M. McKay, 1979. Litter accumulation after fire in a eucalypt forest. Australian Journal of Botany 27: 157-65

Gaull, B.A. 1984. Seismic risk in the Illawarra Region. In Proceedings of the Eighteenth Australian Engineering Conference.

Gibson, J.D. 1977. The birds of the County of Camden. Australian Birds 11: 41-80.

Grandin, T. 1983. Livestock handling from farm to slaughter. Canberra: Australian Government Publishing Service.

Green, R.J. 1984. Native and exotic birds in a suburban habitat. Australian Wildlife Research 11:181-90.

Greer, S., and H. Brayshaw. 1983. An archaeological survey of Lot 1 DP541090 at Mulgoa, New South Wales. Unpublished report to Resource Planning Pty Ltd.

Haglund, L. 1982. Archaeological investigations in the Wilton area. Unpublished report to Longworth and McKenzie, Sydney.

—— 1979. Archaeological survey of area affected by the proposed Kemps Creek substation. Unpublished report to National Parks and Wildlife Service, Sydney.

—— 1978. Archaeological survey of an area considered for second airport, South-western Zone. Unpublished report to the State Pollution Control Commission, Sydney.

—— 1974. Survey along the natural gas pipeline from Wilton to Horsley Park. In Archaeological survey of natural gas pipeline Moomba—Sydney, unpublished report to National Parks and Wildlife Service, Sydney.

Herbert, C. 1979. The geology and resource potential of the Wianamatta Group. NSW Geological Survey Bulletin 25: 203.

Hindwood, K.A., and A.R. McGill. 1958. The Birds of Sydney. Sydney: The Royal Ecological Society of New South Wales.

Hoare, A.G. 1974. International airports as growth poles: a case study of Heathrow Airport. Transactions of the Institute of British Geographers 63:75-96.

Hoskens, E.S. 1979. The birds of the Cumberland State Forest. Unpublished report.

Hyde, R., A. Heggie, and H. Malfroy. 1980. The Western Basin experiment. School of Earth Sciences, Macquarie University, Sydney.

Institution of Engineers, Australia. 1979. Report of the National Committee of Earthquake Engineering.

Institution of Engineers, Australia. 1977. Australian rainfall and runoff: flood analysis and design.

Jacobs, S.W.L., and J. Pickard. 1981. Plants of New South Wales. Sydney: National Herbarium of New South Wales.

Jensen, R.C., R. Powell, et al. 1985. Unpublished report, University of New England, Armidale.

Kamminga, J. 1983. The proposed Maldon—Port Kembla rail route. Unpublished report to Dames and Moore.

Keith, D.A. 1984. Report on the conservation status of O'Hares Creek catchment. Sydney: National Herbarium of New South Wales.

Key, K.H.L. 1978. The conservation status of Australia's insect fauna. Australian National Parks and Wildlife Service Occasional Paper No. 1. Canberra: Australian Government Publishing Service

Kikkawa, J., G.J. Ingram, and P.D. Dwyer. 1979. The vertebrate fauna of Australian heathlands. In Heathlands and related shrublands, ed. R.L. Specht. Oxford: Elsevier Scientific Publishing.

Kilgour, R., and C. Dalton. 1984. Livestock behaviour: a practical guide. Sydney: University of New South Wales Press.

Kinhill Stearns. 1984. South Creek wetland study. Prepared for Hawkesbury Shire Council.

Koettig, M. 1981. West St Clair — archaeological survey for historical and Aboriginal sites. Unpublished report to the Lands Commission of New South Wales.

Laut, P., D. Firth, and T.A. Paine. 1981. Local government areas. Vol. 2 of Provisional environmental regions of Australia. Melbourne: CSIRO.

Leigh, J., J. Briggs and W. Hartley. 1981. Rare or threatened Australian plants. Australian National Parks and Wildlife Service Special Publication No. 7. Canberra: Australian National Parks and Wildlife Service.

MacDonald, J.D. 1973. Birds of Australia. Sydney: A.H. & A.W. Reed.

Macquarie University Centre for Environmental Studies. 1983. Fauna and flora. Vol. 2 of Penrith Lakes Scheme working papers. Penrith Lakes Development Corporation Ltd.

Major Airport Needs of Sydney Study Committee. December 1979. Abstract report.

—— February 1979. Site selection process.

—— March 1978a. Ranking of second Sydney airport alternative sites on the basis of environmental impact.

—— March 1978b. Ranking of alternative second Sydney airport sites on basis of minimum economic cost.

—— November 1977. Report on siting of second Sydney airport in the southern zone. Information Bulletin No.2.

—— June 1977. Second Sydney airport layouts.

Mills, J.M., and T.J. Fitch. 1977. Thrust faulting and crust—upper mantle structure in east Australia. Geophysics 48: 351-84.

Minister for Aviation. 1984. News release 18 September.

Morris, A.K, A.R. McGill, and G.Holmes. 1981. Handlist of birds in New South Wales. Sydney: NSW Field Ornithologists' Club.

Mulgoa Quarries Pty Ltd. 1983. Environmental impact statement for extraction of materials for brick manufacturing and road making, Mulgoa.

Mulgoa Quarries Pty Ltd. 1982. Proposed quarry on Lot 28, Mulgoa. Environmental impact statement.

Nelson, J.P. 1980. Airports and property values. A survey of recent experience. Journal of Transport Economics and Policy: 37-52.

de Neufville, R. 1976. Airport systems planning. London: Macmillan.

Northcote, K.H. 1974. A factual key for the recognition of Australian soils. 4th ed. Adelaide: Rellim Technical Publications.

NSW Planning and Environment Commission. 1980. Sydney Region Outline Plan Review.

Pearse, R.J., and I.H. Eberhard. 1978. The koala. In Conservation of Koalas, ed. T.J. Bergin. Sydney: Zoological Parks Board of New South Wales.

Planning Workshop 1978. Industry incidence survey undertaken for Major Airport Needs of Sydney Study Committee.

Poole, G. 1982. Sound Advice. Poultry Notes July:9-16.

Quilty, J.A., J.S. Hunt, and R.W. Hicke, eds. 1978. Urban erosion and sediment control. Technical handbook No. 2. Sydney: Soil Conservation Service of New South Wales.

Reader's Digest. 1976. Complete book of Australian birds. Sydney: Reader's Digest Services.

Royal Australasian Ornithologists Union. 1978. Recommended English names for Australian birds. The Emu 77: Supplement.

Shaw, S. 1982. Air transport: a marketing perspective. London: Pitman.

Sherwin, L., and G.C. Holmes, eds. In press. Geology of the Wollongong-Port Hacking 1:100,000 sheet. Sydney: NSW Geological Survey.

Sim, I.M. 1964. Aboriginal drawings near Wilton, NSW. Oceania 35:57-65

Smalls, I.C. 1983. Environmental implications of stormwater. Master of Environmental Studies thesis, Macquarie University, Sydney.

Stadelman, W.J. 1958a. The effect of sounds of varying intensity on hatchability of chicken egg. Poultry Science 37:166-9.

—— 1958b. Observations with growing chickens on the effects of sounds of varying intensities. Poultry Science 37:776-8.

State Planning Authority of New South Wales. 1973. The new cities of Campbelltown, Camden, Appin. Structure Plan.

—— 1968. Sydney Region: outline plan 1970-2000 A.D. A strategy for development.

State Pollution Control Commission. 1984. 1982-83 Annual report.

—— 1983. Water quality in the Hawkesbury-Nepean River.

—— 1980. An atlas of classified water in New South Wales.

Stewart, A.C., M.R. Pengilley, R. Brain, J.J. Haley, and M.G. Mole. 1983. Motor vehicle emissions into the Sydney air basin. In The urban atmosphere — Sydney: a case study, ed. J.N. Carras and G.M. Johnson, 485-502. Sydney: CSIRO.

Strahan, R., ed. 1983. Complete book of Australian mammals. Sydney: Angus and Robertson.

Stroud, W.J. 1974. The geology and low-cost extractive resources of the Camden, Campbelltown and Port Hacking 1:50,000 sheets. Unpublished report to NSW Geological Survey.

Stroud, W.J., L. Sherwin, H.N. Ray, and C.J. Baker. In press. Wollongong-Port Hacking 1:100,000 sheet. Sydney: NSW Geological Survey.

Taylor, S. 1984. Expressway threatens Sydney's Wolli Creek Valley. Habitat 12:34-5.

R. Travers Morgan and Partners. May 1974. Benefit/cost study for second Sydney airport. Annex to Handover paper No. 9.

—— May 1974. Benefit/cost study for second Sydney airport. Handover paper No. 9.

—— May 1974. Benefit/cost study for second Sydney airport. Handover paper No. 15. 2 vols.

Tyndale-Biscoe, C.H., and J.H. Calaby. 1975. Eucalypt forests as refuge for wildlife. Australian Forestry 38:117-33.

US Department of Housing and Urban Development. 1974. Major airports and their effects on regional planning. US Government Printing Office.

US Forest Service. 1974. The visual management system. National Forest Landscape Management 2(1). US Department of Agriculture.

Van Tets, G.F. 1969a. Diurnal movement patterns of the silver gull, Larus novaehollandiae, at Sydney Airport. Australian Wildlife Research 14:129-51.

—— 1969b. Quantitative and qualitative changes in habitat and avifauna at Sydney Airport. Australian Wildlife Research 14: 117-28.

—— 1966. Birds and aircraft. Wildlife in Australia 3: 116-18

Van Tets, G.F., W.J.M. Vestjens, and E.Slater. 1969. Orange runway lighting as a method for reducing bird strike damage to aircraft. Australian Wildlife Research 14: 129-51.

Walker, P.H. 1960. A soil survey of the County of Cumberland, Sydney region, New South Wales. Soil Survey Unit No. 2. Sydney: NSW Department of Agriculture.

Water Resources Commission. 1984. Groundwater in New South Wales. Sydney: Water Resources Commission.

Webb, T.F. 1966. Feasibility tests of selected stimuli and devices to drive livestock. Beltsville, MD: Agricultural Research Service, US Department of Agriculture.

Zacuba Pty Ltd. 1983. Environmental impact statement for the extraction of clay-shale at Mulgoa, New South Wales.

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This Draft Environmental Impact Statement was prepared for the Department of Aviation by the Study Team listed below. Liaison with the Department of Aviation was through Mr J.W. Lade, the Department's Project Director for the Second Sydney Airport Site Selection Programme.

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APPENDIX U
BADGERYS CREEK
AUSTRALIAN NOISE EXPOSURE FORECAST (ANEF)
PROPOSED ALIGNMENT
WORST CASE ASSUMPTIONS
Scale 1:25,000
NOTE: This figure to be read in conjunction with Section 9.2 and Appendix C

APPENDIX U

WILTON

AUSTRALIAN NOISE EXPOSURE FORECAST (ANEF)
PROPOSED ALIGNMENT
WORST CASE ASSUMPTIONS

Scale 1:25,000

NOTE: This figure to be read in conjunction with Section 14.2 and Appendix C