Brisbane Airport: Economic Evaluation of Alternative Development Strategies

Report

This Report presents the results of an economic comparison of alternative strategies for the development of Brisbane Airport.

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BUREAU OF TRANSPORT ECONOMICS

BRISBANE AIRPORT:

ECONOMIC EVALUATION OF ALTERNATIVE

DEVELOPMENT STRATEGIES

AUSTRALIAN GOVERNMENT PUBLISHING SERVICE
CANBERRA 1975

ISBN 0 642 01794 8

FOREWORD

Because air traffic is growing rapidly, it is necessary to make periodic decisions on the development of airports. Only recently has airport investment become the subject of systematic analysis and evaluation.

The approach taken in this report has been to look at various development strategies and to recognise that it is important to achieve flexibility when the future is uncertain. Environmental issues, particularly noise, are significant in the evaluation. In the case of Brisbane, it has been possible to set an upper limit to the value of noise nuisance so that a clear conclusion could be reached.

The report is the work of the Economic Evaluation Branch of the BTE, under the direction of G.K.R. Reid. The study was carried out by A.J. Shaw, with forecasting assistance from G.R. Carr. In preparing this report, the BTE acknowledges the considerable assistance received from the Ground Facilities Division of the Department of Transport and from the Department of Housing and Construction in providing technical advice, cost estimates and plans for alternative strategies.

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July, 1975

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SUMMARY

This report presents the results of an economic comparison of alternative strategies for the development of Brisbane Airport.

An earlier study by the Commonwealth-State Committee on Brisbane Airport recommended re-siting of the runways with the associated terminals and maintenance facilities to the north-east of the existing site. The main considerations were projected growth in traffic, runway capacity, space for expansion of terminals and aprons, noise in adjacent suburban areas and the removal of certain building height restrictions in central Brisbane.

In the BTE study, two groups of strategies have been considered, those based on retaining the existing runway complex and those based on several new runway configurations to the north-east of the existing site.

The approach was to project passenger and aircraft movements in order to estimate what facilities will be required and what should be the timing of their construction for the various alternatives. The construction cost of each strategy was assessed as well as the differences between the strategies in airport operation and surface access costs. Total costs for each case were then discounted to a common base year.

The least costly alternatives are those that retain the existing runway complex in use as long as possible. The movement forecasts suggest that the existing runway complex will provide adequate capacity until about 2010, given restriction of general aviation aircraft movements after 1995. The discounted quantified costs of this type of strategy, including the provision of terminal and apron facilities as they become necessary is about $18m less than that of providing a new airport by 1985. In addition, retention of the existing runways allows development options

to remain open should the demand for air travel, aircraft technology, or operational techniques vary from the assumptions made in the study.

The effects which might be considered to favour development of an airport on a new site need to be set against the discounted cost difference of $18m and the closing of future options. It is shown that from the national view point there is no resource cost associated with the restrictions placed on building heights in centra Brisbane. The likely upper bound of discounted cost for noise disamenity is $2m.

In summary, therefore, the analysis shows that on economic considerations the development of Brisbane Airport should be based on the existing runway complex. Detailed planning of the development of facilities associated with the existing airport should be carried out as the need arises.

CHAPTER 1. INTRODUCTION

1.1 ORIGIN OF THE STUDY

In September, 1973, the Minister for Transport, the Honourable C.K. Jones, directed the BTE to investigate and report upon the redevelopment of Brisbane Airport. The terms of reference were:

(i) the likely future civil aviation requirements of the Moreton Region

(ii) the extent to which these requirements should be met by
  (a) further expansion of the present site
  (b) the provision of a second or alternative airport

(iii) the appropriate characteristics of airport facilities and the timing of new construction.

In examining these matters, the BTE was asked to take full account of the operating requirements for aircraft, noise nuisance, and effects upon ground transport.

1.2 PREVIOUS REVIEW OF BRISBANE AIRPORT

In February, 1971, a joint committee consisting of representatives of the Australian Government, the State of Queensland and the Brisbane City Council, was formed to study and report upon the development of airport facilities to serve the City of Brisbane. Its terms of reference were to revise and update the requirements of Brisbane Airport, to ensure that the airport continued to operate without causing undue noise nuisance in existing urban areas, and to ensure that the development of other than existing urban areas remained compatible with aircraft operations.

After a first stage screening of nine basic alternatives,[1] which with variations on the basic concepts resulted in seventeen separate analyses, the Advisory Committee subjected three basic concepts to more detailed study:

- P - within the existing boundaries
- Q - astride the northern boundary
- R - still further to the north.

With variations on these basic concepts, eleven alternatives were compared in detail. The Committee recommended that concept Qc should be the basis of the master plan of Brisbane Airport.[2] This scheme consisted of two widely spaced parallel runways and one cross runway, with associated building, drainage and road access works, and it:

- provided for the development of a high capacity airport which would cater for the aviation needs of Greater Brisbane beyond the turn of the century;
- was compatible with planning envisaged for the Brisbane metropolitan area;
- reduced aircraft noise nuisance to the city and closely settled residential areas;
- eased the height limitations on the central city and Spring Hill areas;
- could be integrated with existing airport facilities during its development.

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(1) Six were within the existing boundaries (including 600 additional acres then being acquired in Pinkenba), one was astride the northern boundary, and two were within the Serpentine area.

(2) Commonwealth of Australia, State of Queensland, and City of Brisbane, Advisory Committee Report on the 1970/71 Review of Primary Airport Facilities to Serve the Future Needs of Brisbane (January, 1972).

The Committee further recommended that, in the first stage, construction works should be undertaken in the following order:

(i) the new east side runway;

(ii) health, customs and immigration facilities, passenger accommodation, aircraft and car parking in the new building area;

(iii) the balance of the terminal area; and

(iv) the cross runway.

The proposed layout of concept Qc is shown in Annex A. The proposed timing for the completion of the first stage (i, ii and iv above) of this facility was the end of the 1979 and (iii) above by 1985. Land acquisition commenced in August 1974.

The Coombs' task force report of June, 1973 referred to the proposed redevelopment of Brisbane Airport[1] and questioned the validity of the traffic forecasts on which the arguments for development were based. It suggested that the growth of passenger traffic and hence aircraft movements would be slower if more appropriate pricing policies were followed. Furthermore, it anticipated that the growth rate in aircraft movements would be substantially reduced with the introduction of wide-bodied jets later in this decade and finally, that the number of aircraft movements at Brisbane Airport could be reduced by a deliberate policy of transferring general aviation operations to other airfields. The report also referred to a number of possibilities concerning the redevelopment of Brisbane Airport including[2]:

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(1) Report of the Task Force appointed by the Prime Minister the Honourable E.G. Whitlam, QC, MP, Review of the Continuing Expenditure Policies of the Previous Government (Canberra: AGPS, June, 1973), Item 41, pp. 149-151.

(2) Ibid., pp. 150-151.

(a) Defer the project for a specified period.

(b) Decide on the timing of the project on receipt of the report of the Government's Urban and Regional Development Committee, which had been asked to give further consideration to the proposal.

(c) Carry out the necessary minimum of site preparation to enable construction of some new terminal facilities at the long-term optimum position, while prolonging as far as possible the use of the existing terminals, runways, and airway facilities (e.g. by transferring general aviation operations elsewhere).

(d) As a concomitant of this course of action, commission a detailed cost-benefit analysis of the nature and standard, sequences, and timing of further development of the site and facilities, with full regard for the possibilities of damping demand at Brisbane Airport by the use of alternative facilities.

1.3 OUTLINE OF BTE STUDY OF BRISBANE AIRPORT

Following the Coomb's Report, the Minister for Transport directed the BTE to investigate and report on the likely future civil aviation requirements of the Moreton Region and the most appropriate development plan for Brisbane Airport to meet these requirements. The full terms of reference were cited at the beginning of this Chapter.

In the performance of this task, the BTE was assisted by a working group comprised of officers from the Ground Facilities Division of the Department of Transport

and the Department of Housing and Construction. The steps in the analysis comprised:

(i) forecasting annual passenger and aircraft movements at Brisbane Airport through to the year 2000-01;

(ii) the use of these forecasts to estimate the scale of future airport requirements including runway, apron and terminal capacity at specific dates;

(iii) formulation of alternative strategies for meeting those requirements, including the sequence and timing of individual developments within those strategies;

(iv) comparison of ascertainable costs and other consequences of each strategy. This comparison included land costs, airport construction and operating costs, airport user costs, airport access costs, and the impact of aircraft noise nuisance and building height restrictions along the approach paths of the existing or proposed runways. The implications of each strategy for the long-term development of Brisbane Airport were also considered;

(v) consideration of other alternatives for coping with future demand (i.e. changes in operational or pricing policies).

1.3.1 Interim BTE Report on the International Terminal

The BTE also prepared as a matter of urgency an interim report on immediate measures to be taken with respect to the international terminal at Brisbane. These could not be delayed until the completion of the full BTE

study. Quite apart from questions of capacity, it was considered by the Ground Facilities Division of the Department of Transport that industrial relations, passenger comfort and airport security made it necessary to have a new terminal no later than summer 1975/76. The BTE issued the interim report in March, 1974.

This report was confined to a consideration of the most appropriate way of providing Brisbane with a new international terminal. The evaluations were carried out in such a way that the conclusion would be consistent with whatever outcome the overall study concerning Brisbane's longer term civil aviation requirements might have.

The BTE interim report gave preliminary consideration to four alternatives for replacing the international terminal. The two most appropriate alternatives were then subjected to detailed comparison on a net present value basis. An important consideration was the need to keep open as many options as possible for the longer term plan for Brisbane Airport. It was concluded that the most desirable course of action was to construct a new terminal near the north-east end of the present runway. This was the site proposed for a maintenance area for development concept Qc recommended by the Commonwealth-State Committee of Enquiry in its 1972 report.

In April 1974, the Australian Government accepted the conclusion reached in the BTE interim report, and construction of the international terminal commenced in July 1974. It is expected that the new building will be completed late in 1975.

CHAPTER 2. AIRCRAFT AND PASSENGER MOVEMENT FORECASTS FOR BRISBANE AIRPORT: 1975-76 TO 2000-01

2.1 INTRODUCTION

Five classes of traffic are considered in this chapter: international scheduled airline services; domestic and Papua New Guinea scheduled airline services; commuter services; non-scheduled civil traffic; and military aircraft movements.

The domestic and Papua New Guinea scheduled airline passenger and aircraft movement forecasts have been developed by the BTE.(1) Forecasts of other demands were made by the then Department of Civil Aviation in December 1972.

The remaining sections of this chapter deal with forecasting methods and results. A more detailed coverage of the techniques and qualifications is contained in Annex C.

2.2 DOMESTIC AND PAPUA NEW GUINEA MOVEMENT FORECASTS

2.2.1 Passenger Movement Forecasts

Several techniques can be used to forecast the level of passenger movements at a particular airport.(2) However, little is known about the individual characteristics of air travellers using Brisbane Airport facilities, so that the techniques used in this study have been limited to trend extrapolation and aggregate econometric analyses.

(1) Source data were provided by the Research and Planning Branch, Air Transport Policy Division, Department of Transport.

(2) See for example: Commission on the Third London Airport, Papers and Proceedings (London: HMSO, 1970), Vol. VII, Chapter 4.

The final forecast was checked for consistency with overseas studies and other Australian experience.

Forecasts based on extrapolation of trend curves fitted to historical statistics need to be modified by judgements concerning the future impact of economic and other forces. For this study, the major casual factors influencing demand were determined and a function relating these to demand estimated. This function was used to project future demand on the basis of forecasts of the factors. Forecasts of airline revenue-passenger movements were made using a demand function relating aggregate airline passenger movements between all Australian airports to gross domestic product and airline fares.

Forecast Selection: Projections of passenger movements per head of population at Brisbane were compared with forecasts for Sydney made by the Sydney Airport study group. The implied movements per head of population for that study group's preferred scenario were found to be similar to the econometric forecast for Brisbane.

Historical data for Sydney, Melbourne, Brisbane and Canberra was also examined. Sydney, Melbourne and Brisbane showed similar growth in domestic air travel, with Brisbane having the highest absolute level of movements per capita of the three. Canberra, the nation's capital, on the other hand, had a lower rate of growth but higher absolute levels of movements per capita than those other capital city airports over the same period. The higher level of passenger movements per capita can be attributed to Canberra's unique characteristics. Accordingly, movements per capita at Canberra were considered to be an upper bound to movements at other capital city airports. The results from two trend forecasts of revenue-passenger movements at Canberra Airport confirmed that the econometric forecasts for Brisbane Airport were within this bound.

Finally, a review of overseas studies that have been made of air travel demand indicated that the aggregate income elasticity of demand of + 2.11 generated by the econometric model was within the range of estimates reported in those studies.

Route Stratification and Forecast Results: Further refinement of the forecasts discussed above was required to take account of the different trends from route to route. Four groups of routes were delineated; the projections for these are shown in Table 2.1.

2.2.2 Aircraft Movement Forecasts

In developing aircraft movement forecasts from passenger movement forecasts, several factors were considered: aircraft type, minimum daily frequency and average load factors, by route and over time. Expected developments in the size of operators' fleets were used as a check upon the projected fleet required to service passenger movements.

The forecasts presented in Table 2.2 were based upon a medium rate of introduction of large aircraft with a medium frequency of service on routes through Brisbane. The approach is amplified in Annex C. For the purposes of this study, it was assumed that there will be no change in route structure during the period. The forecasts presented in Table 2.2 must be read with this qualification in mind.

2.3 FORECASTS OF OTHER DEMANDS

Projections of military, commuter, non-scheduled and international movements excluding those to Papua New Guinea were prepared by the then Department of Civil Aviation in December 1972. International and commuter passenger and aircraft movements are shown in Tables 2.3 and 2.4 respectively; non-scheduled and military aircraft

TABLE 2.1 - ANNUAL DOMESTIC AND PAPUA NEW GUINEA SCHEDULED AIRLINE PASSENGER MOVEMENT FORECASTS FOR BRISBANE AIRPORT BY ROUTE

('000)

Year	Domestic[a]			Papua New Guinea	Total
	South	North	West		
1975-76	1,460.7	821.1	27.0	142.1	2,450.9
1980-81	2,201.6	1,229.2	36.8	201.8	3,669.4
1985-86	3,235.8	1,797.6	48.3	284.4	5,366.1
1990-91	4,531.4	2,500.9	52.3	380.7	7,465.3
2000-01	8,769.4	4,784.6	71.4	657.0	14,282.4

(a) Domestic routes are defined as follows: South-interstate routes between Brisbane and southern centres; North-Brisbane-Mt Isa-Darwin, and Brisbane-Cairns routes; West-intrastate routes between Brisbane and western ports.

TABLE 2.2 - ANNUAL DOMESTIC AND PAPUA NEW GUINEA AIRCRAFT MOVEMENT FORECASTS FOR BRISBANE AIRPORT BY ROUTE[a]

Year	Domestic[b]			Papua New Guinea	Total
	South	North	West		
1975-76	16,372	14,704	1,668	1,460	34,204
1980-81	18,980	20,858	1,668	2,086	43,592
1985-86	20,440	25,132	1,876	2,190	49,638
1990-91	26,280	31,702	1,982	2,500	62,464
2000-01	26,280	36,708	2,712	2,920	68,620

(a) An aircraft movement is an aircraft landing or taking off.

(b) Domestic routes are defined as follows: South-interstate routes between Brisbane and southern centres; North-Brisbane-Mt Isa-Darwin, and Brisbane-Cairns routes; West-intrastate routes between Brisbane and western ports.

movements appear in Table 2.5.

2.4 COMPARISON OF PASSENGER AND AIRCRAFT MOVEMENT FORECASTS

The aircraft and passenger movement forecasts by traffic class are brought together in Tables 2.6 and 2.7. An important aspect for future airport planning is the projected increasing proportion of non-scheduled aircraft movements. The forecasts indicate that the percentage of non-scheduled to total aircraft movements will increase from 42 per cent in 1975-76 to 55 per cent in 2000-01. If this growth in aircraft movements by traffic class were to be realised, the major contributing factor to future runway congestion would be non-scheduled aircraft movements.

TABLE 2.3 - ANNUAL INTERNATIONAL AND COMMUTER PASSENGER MOVEMENT FORECASTS FOR BRISBANE AIRPORT(a)

('000)

Year	International Airline			Commuter
	Trans-Tasman	Other	Total	
1975-76	62	28	90	9
1980-81	100	45	145	13
1985-86	160	70	230	17
1990-91	280	120	400	23
2000-01	854	353	1,207	42

(a) The forecasts to the year 1990-91 were made by the then Department of Civil Aviation, December 1972. Forecasts for the year 2000-01 were made by extrapolation.

TABLE 2.4 - ANNUAL INTERNATIONAL AND COMMUTER AIRCRAFT MOVEMENT FORECASTS FOR BRISBANE AIRPORT(a)

Year	International Airline			Commuter
	Trans-Tasman	Other	Total	
1975-76	700	1,600	2,300	2,700
1980-81	1,000	2,100	3,100	3,000
1985-86	1,500	2,500	4,000	3,500
1990-91	2,100	3,500	5,600	4,000
2000-01	4,100	6,800	10,900	9,700

(a) The forecasts to the year 1990-91 were made by the then Department of Civil Aviation, December 1972. Forecasts for the year 2000-01 were made by extrapolation.

TABLE 2.5 - ANNUAL NON-SCHEDULED AND MILITARY AIRCRAFT MOVEMENT FORECASTS FOR BRISBANE AIRPORT(a)

Year	Non-Scheduled Aircraft (including general aviation)	Military Aircraft
1975-76	30,900	2,700
1980-81	42,800	3,600
1985-86	55,400	4,600
1990-91	71,400	5,800
2000-01	118,600	9,300

(a) The forecasts to the year 1990-91 were made by the then Department of Civil Aviation, December 1972. Forecasts for the year 2000-01 were made by extrapolation.

TABLE 2.6 - ANNUAL AIRCRAFT MOVEMENT FORECASTS FOR BRISBANE AIRPORT

Year	Domestic and Papua New Guinea	International	Commuter	Non-scheduled (including general aviation)	Military	Total
1975-76	34,204	2,300	2,700	30,900	2,700	72,804
1980-81	43,592	3,100	3,000	42,800	3,600	96,092
1985-86	49,638	4,000	3,600	55,400	4,600	117,138
1990-91	62,464	5,600	4,000	71,400	5,800	149,264
2000-01	68,620	10,900	9,700	118,600	9,300	217,120

Source: Derived from Tables 2.2, 2.4 and 2.5.

TABLE 2.7 - ANNUAL PASSENGER MOVEMENT FORECAST FOR BRISBANE AIRPORT

('000)

Year	Domestic	Papua New Guinea	International	Commuter	Total
1975-76	2,308.8	142.1	90.0	9.0	2,549.9
1980-81	3,467.6	201.8	145.0	13.0	3,827.4
1985-86	5,081.7	284.4	230.0	17.0	5,613.1
1990-91	7,084.6	380.7	400.0	23.0	7,888.3
2000-01	13,625.4	657.0	1,207.0	42.0	15,531.4

Source: Derived from Tables 2.1 and 2.3.

CHAPTER 3 . CURRENT CAPACITY AND FUTURE REQUIREMENTS

The most appropriate development strategy for Brisbane Airport cannot be identified without reference to the existing airport facilities and future requirements. Accordingly, a brief description of the existing facilities and their adequacy in relation to future demand follows.

3.1 RUNWAYS(1)

3.1.1 Main Runway

The main runway (04/22) runs north-east and south-west, is 2,365 metres long and is capable of handling commercial aircraft up to B747 size. However, runway length imposes payload penalties on long range flights.

3.1.2 Secondary Runway

The secondary runway (13/31) runs north-west and south-east, is 1,530 metres long and is capable of handling aircraft up to F27 (Fokker Friendship) size.

3.1.3 Capacity

The capacity of a runway system is determined by a number of factors which include air traffic control and navigational systems, aircraft performance characteristics, approach/departure procedures and runway and taxiway configurations. The practical capacity of the main runway is currently assessed to be approximately 156,000 aircraft movements per annum. The main and secondary runway configuration increase this capacity for the airport as a whole to approximately 165,000 aircraft movements per annum.(2) The increase in capacity is only small because of the aircraft limitations imposed by the secondary runway.

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(1) The present runway arrangement is shown in Annex A.

(2) This represents a maximum capacity of approximately 61 aircraft movements per hour.

The main runway alone could handle the forecast growth of aircraft movements, at least until 1990. The combination of the main and limited secondary runways caters for projected aircraft movements to approximately 1995. However, various levels of constraint upon aircraft movements in some traffic classes at Brisbane Airport would ensure that the capacity of the existing runways was adequate for a further 10 to 15 years.

TABLE 3.1 - EXPECTED PERCENTAGE REDUCTION OF GENERAL AVIATION AIRCRAFT MOVEMENTS REQUIRED IN VARIOUS YEARS TO ENSURE THAT EXISTING RUNWAYS DO NOT EXCEED CAPACITY

Year	Reduction Required
	(percent)
1995	0
2000	50
2005	80
2010	90

Source: Derived by extrapolating the forecast aircraft movements presented in Table 2.6 and assuming that the capacity of the existing runways is 165,000 aircraft movements per annum and that general aviation aircraft movements represent 90 per cent of all non-scheduled movements.

The projections of aircraft movements at Brisbane Airport presented in Chapter 2 indicated that, without constraint, 55 per cent of total aircraft movements will be made by non-scheduled aircraft by the year 2000. Approximately 90 per cent of these movements is expected to be made by general aviation aircraft. Constraining these movements to lower levels would enable the existing runways to accommodate scheduled traffic after 1995. The expected level of constraint required in various years to keep the existing runways at capacity are presented in Table 3.1.

The estimates indicate that if general aviation movements are limited to approximately 10 per cent of projected movements, the existing runways would have adequate capacity until 2010.

3.2 INTERNATIONAL TERMINAL CAPACITY

Following Parliamentary approval in April, 1974 the construction of a new international terminal commenced in July, 1974. This will replace the present international terminal, which is a World War II wood and galvanised iron igloo hanger, inadequate for current requirements. The location of the new building in relation to other facilities is illustrated in Annex A. The complex is designed to service 240 arriving passengers at 20 minute intervals and simultaneously 240 departing passengers at 20 minute intervals.

The building should provide an acceptable level of passenger comfort into the early 1980s when further extension may be necessary. The initial apron area is designed to meet the 1980 forecast requirement and can be readily extended to provide for the 1985 forecast requirement.

Possible expansion of the facilities to meet the 1985 requirements would need to commence in 1980 and the Department of Housing and Construction has provided a cost assessment of $1.0m at 1974 prices for the work.

3.3 DOMESTIC TERMINAL CAPACITY

The present locations of the domestic terminals, hangers and other facilities are shown in Annex B.

The existing domestic terminals will require improvements to cope with the increasing passenger loads. The existing international terminal site provides a

convenient area into which Trans-Australia Airlines (TAA) and Ansett Airlines of Australia (AAA) could expand. The removal of international aircraft from that apron area would allow an orderly and balanced redevelopment of apron space to match the terminal expansion.

On the basis that it is necessary to retain the existing secondary runway, the area available for domestic apron and terminal expansion in the existing terminal complex is restricted by the approach splay of the main runway to the west, the approach splay of the secondary runway to the east, the secondary runway to the north, and the Pinkenba railway line and industrial development to the south. This area can be redesigned to cope with the forecast passenger and aircraft traffic volumes to about 1985, when saturation could occur. After that date, either one or both domestic operators may need to relocate.

3.4 MAINTENANCE AREA CAPACITY

The present maintenance hangers are too small to handle wide-bodied aircraft. Both domestic operators have indicated that they propose to establish new maintenance facilities at Brisbane Airport. The existing site, as shown in Annex B, is not large enough for these requirements and in any event will be needed for domestic terminal and apron expansion within the next decade because of the lead time associated with longer term development of the airport. Future maintenance area requirements are therefore common to all alternative development strategies for Brisbane Airport. Their location, however, will depend upon the particular strategy adopted.

3.5 ROAD ACCESS AND CAR PARKING CAPACITY

Alternative proposals for road access and car parking for the existing terminal areas were examined by the Department of Housing and Construction.(1) It was concluded that access to the domestic terminals at a satisfactory level of service and adequate car parking spaces can be provided until the mid 1980's.

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(1) Australian Government Department of Housing and Construction, "Brisbane Airport Development-Surface Transport Considerations: Report on Alternative Access Strategies for Brisbane Domestic Airport to 1985 and Road Transport Implications of Alternative Airport Development Strategies to 2000" (December, 1974).

CHAPTER 4. ALTERNATIVE DEVELOPMENT STRATEGIES FOR BRISBANE AIRPORT

As a starting point, concept Qc was accepted as the most sensible course to pursue if it were decided to abandon the present runway area.(1)

The development alternatives devised by the BTE were examined jointly by specialist officers of the Departments of Transport, and Housing and Construction in order to define problem areas and check engineering and operational feasibility before costing was undertaken. In the course of this review it became evident that the timing of development in concept Qc was premature, given the changes in passenger and aircraft movement forecasts since 1971, and that the proposed timing recommended by the 1971 Commonwealth-State Advisory Committee(2) should be extended. Accordingly, a modified plan of development (scheme 1) was recommended, scaling down the initial stages of concept Qc and delaying construction by five years. This report compares alternative strategies with that revised plan.

To find whether abandoning the existing runway was economically warranted, a number of strategies for developing the existing site were examined. These included varying sequences and timings of activities. The strategies considered, along with the assumptions under which they were devised, are briefly described in this chapter.

4.1 DERIVATION OF THE VARIOUS STRATEGIES

A major consideration in identifying various development strategies was the capacity of the existing

(1) This is the conclusion reached by the 1971 Commonwealth-State Advisory Committee Report.

(2) The Advisory Committee recommended that development of the new site be completed by 1980.

terminal area. In devising the strategies, the following constraints upon the existing area were assumed:

(i) building development should allow for the retention of the existing runways and their associated clearance surfaces as illustrated in Annex B;

(ii) car parking should desirably be at ground level;

(iii) parallel scheduling of domestic aircraft operations will continue and no action will be taken to extend the life of the existing terminal area by spreading the peaks of aircraft operations;

(iv) international operations will be transferred to the new international terminal building early in 1976.

Various developments of the existing terminal area to cope with expected aircraft and passenger movements were considered. It was concluded that, as far as apron and building requirements were concerned, the domestic airline operators could remain in the existing terminal area until about 1985.(1) In order to do so, the following work would be needed in the existing airport area (see Annex B):

(i) extension of the existing apron and associated taxiways;

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(1) The airline operators have expressed doubts about the possibility of remaining in the existing terminal area until 1985. Nevertheless, for the purposes of this study it was assumed that this would be possible. Additional space in the terminal area could be provided if the Pinkenba branch railway line were relocated.

(ii) progressive development of domestic terminal buildings as required;

(iii) improved road access into the area;

(iv) increased car parking facilities.

The total cost of this work would vary according to the long term development strategy adopted but is estimated to be in the order of $12m at 1974 prices. A further $1m would be required to expand the international terminal.

For both domestic airlines to continue operations on the existing site until 1985, it would be necessary to relocate the existing maintenance facilities. Advice has been received from TAA to the effect that the company needs to construct a very large hanger during the 1970's to provide for its aircraft maintenance needs.

There has also been discussion of maintenance requirements with AAA which indicated that its needs would be comparable to TAA's. Relocation of the existing maintenance facilities are therefore compatible with current domestic airline planning. The estimated total cost of constructing these maintenance facilities would be between $7m and $11m (1974 prices) depending on their location.

For strategies involving the relocation of both domestic airlines it was assumed that all operations would continue in the existing and new international terminal areas until 1985. For strategies involving the relocation of one domestic airline, the timing of construction of new facilities for the use of that airline was determined on capacity considerations.

In preparing details of the completion times for the strategies, it was assumed that all necessary agreements and approvals could be obtained soon enough to avoid delays and that there would be no crash programming. It was also assumed that adequate manpower, plant and materials would be available in the critical periods, and that there would be no restrictions upon annual expenditure. No allowance has been made for any abnormal interruptions to construction.

4.2 STRATEGIES CONSIDERED

A total of eight broad development strategies for Brisbane Airport was devised. Each strategy represents a course of action designed to provide for expected passenger and aircraft movements. The layout and timing of each strategy are detailed in Annex E. The strategies can be classified into three categores:

(i) Strategies 1, 2 and 3 in which operations commence in a new terminal area and runway complex on the Qc site in 1985;(1)

(ii) Strategies 4 and 5 in which both domestic operators vacate the existing site in 1985 and relocate either north-west or south-east of the existing 04/22 runway;

(iii) Strategies 6, 7 and 8 in which only one domestic operator completely vacates the existing site by 1985.

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(1) The development of aviation facilities on a site other than the existing or proposed Qc sites were not considered because over the planning horizon to the year 2000, the access costs to such an alternative site would outweigh any possible cost savings compared with the existing or Qc sites.

The strategies in categories (ii) and (iii) all allow for the retention of the existing secondary runway in operation at approximately its existing length. In addition, the extension of the existing main runway to a total length of 3,570 metres and provision of additional taxiways are included. The timing of construction of the latter two facilities assumed them to be operational by mid-1985, the same time as the main runway in strategies 1, 2 and 3 was assumed to be operational.

For all strategies, commencement of operations in any new area is assumed to be timed to provide for forecast demand. With the exception of strategy 6, all strategies cater for projected passenger and aircraft movements to approximately the year 2000. Strategy 6 would only cater for expected passenger and aircraft movements up to about the year 1990 because of constraints upon the domestic terminal areas.

The essential features of each strategy are outline below.

4.2.1 Strategy 1

This strategy provides for the construction of a 3570 metre main runway (02/20) and a 2440 metre secondary runway (16/34) to come into operation in 1985. The layout and timing are shown in Annex E. This strategy contains the option of providing a western parallel runway if further capacity is needed some time after the year 2000. Airline maintenance facilities are located south of the proposed main runway adjacent to the 1976 international terminal complex as shown in Annex E.

4.2.2 Strategy 2

Strategy 2 is similar to strategy 1 but involves the construction of the secondary runway to F27 standard

with a length of 1500 metres rather than the 2440 metres in strategy 1. The cost savings achieved by constructing a secondary runway of this reduced standard are about $16m (1974). The layout and timing are shown in Annex E.

4.2.3 Strategy 3

Strategy 3 is similar to strategy 1 but involves the deletion of the secondary runway. The saving compared with strategy 1 is in the order of $21m (1974). This strategy leaves the option of providing a secondary runway at some future date. The layout and timing are shown in Annex E.

4.2.4 Strategy 4

This strategy provides for the construction of new domestic, international and general aviation facilities on the north-west side of the existing main runway. It requires that operations commence in that area in 1985, and that the existing building area would be abandoned completely. Relocation of various existing ground facilities which are in the way of the proposed terminal complex development would be required. This strategy involves the provision of a parallel taxiway system together with access to the new terminal area from Nudgee Road, with a view to an ultimate link into the Northern and North-South Freeways. Development of the airline maintenance area would take place in the location proposed in concept Qc. The layout and timing are shown in Annex E.

4.2.5 Strategy 5

This strategy provides for the construction of new domestic and general aviation facilities on the south-east side of the existing main runway. As in strategy 4, it requires that operations commence in that area in 1985 and that the existing building area would be abandoned.

This strategy also requires the development of the existing parallel taxiway system and the continued expansion of the new international terminal facility. Development of the airline maintenance area would take place further to the north of the proposed concept Qc location. The layout and timing are shown in Annex E.

4.2.6 Strategy 6

This strategy provides for the construction of one new domestic terminal complex on the south-east side of the existing main runway, between the new international terminal and the existing secondary runway. One domestic airline operator would commence operations on the new site in 1978 and the other would continue to operate in the existing terminal area. Strategy 6 also requires the development of the existing parallel taxiway system and continued expansion of the new international terminal. An airline maintenance area would be developed on the concept Qc location.

From the forecasts of passenger and aircraft movements, it is estimated that the size of the existing terminal area would allow one domestic operator to remain there until 1990. After this date extreme congestion could occur, so that an alternative site for this facility would be required.(1) Construction costs and possible future location for this domestic facility have not been examined. The layout and timing are shown in Annex E.

4.2.7 Strategy 7

This strategy provides for the construction of one new terminal complex on the north-east side of the

(1) One possibility could be to close the existing secondary runway and use the area so released for domestic terminal expansion.

existing main runway. One domestic airline operator would commence operations on this site in 1978. The other domestic operator would continue operations on the existing site and use the area between the existing secondary runway and the expanded new international terminal complex. Strategy 7 also requires extension of the parallel taxiway system on the north-east side of the existing main runway and the development of airline maintenance facilities on the north-west side of the existing main runway. The lay-out and timing are shown in Annex E.

4.2.8 Strategy 8

This strategy is similar to strategy 7 with the difference that one domestic airline operator is located on the north-west side of the existing main runway and the airline maintenance facilities are located on the north-east side of the existing main runway on the concept Qc site. The layout and timing are shown in Annex E.

4.3 STANDARD OF FACILITIES IN THE DEVELOPMENT STRATEGIES

All facilities comprising the various development strategies were costed on the basis that they would be constructed to provide the same level of service. However, it was not always possible or practicable to achieve this aim because of the different nature of activities in the various strategies. Despite these differences in service levels it was initially assumed that the level of service provided by all strategies was equal. The effects of the differences in service levels were then considered in the light of the evaluation results. Some major differences in the level of service that would be provided under each strategy are briefly summarised below.

4.3.1 Movement Area

With the exception of strategies 1 and 3, the

movement areas in all strategies could be considered to be of equal service level. In strategy 1, the construction of a secondary runway capable of handling aircraft greater than F27 size would result in a level of service above that of other strategies. On the other hand the elimination of the secondary runway in strategy 3 would result in a level of service below that of other strategies.

4.3.2 Terminal Complex

With the exception of strategies 6, 7 and 8 all terminal facilities were assumed to be constructed to provide the same level of service. Because strategies 6, 7 and 8 allow for one domestic airline to continue operations in the existing site after 1985, the level of service provided by the facilities in that area might be lower than in the other strategies where terminals are adjacent to each other. Furthermore, for strategy 6, it was assumed that the level of service provided by the domestic terminal facility to be constructed to the north of the existing secondary runway need not be as high as that assumed for other strategies, on the basis that forecast movements could only be contained in the terminal areas until the year 1990. Further, strategies 6, 7 and 8 might involve a lower level of service than strategies 1 to 5 because they would require some upgrading of existing facilities.

4.3.3 Drainage

In all strategies, adequate drainage and protection from flood flows in the Kedron Brook have been included in the cost estimates for the various facilities.

CHAPTER 5. COSTS OF ALTERNATIVE DEVELOPMENT STRATEGIES

The evaluation of the alternative development strategies involves a number of trade-offs. Three groups stand to gain or lose: airline operators, airline passengers and local residents. The costs or benefits to airline operators and passengers can be measured by changes in delay costs. The effects of height restrictions on buildings or of noise nuisance need to be evaluated by other methods.

This chapter sets out a comparison of strategies which is carried out in terms of the differences in costs and/or other consequences. The comparison was carried out on the initial assumption that runway capacity would be adequate until 2000.

5.1 CAPITAL COSTS

The capital costs associated with each strategy were provided by the Department of Housing and Construction. The estimated capital cost associated with strategies 6 to 8 are not strictly comparable with those of strategies 1 to 5 since the cost estimates were not subjected to such detailed analysis as those for strategies 1 to 5.

Contained in Table 5.1 is a summary of the estimated capital cost for each strategy by five year intervals up to 1999-2000. The assumed timings of the various activities in each strategy are outlined in Annex E. The strategies can be ranked in order of decreasing total capital cost:

(i) Strategy 1 is the most costly strategy due to the high standard secondary (16/34) runway.

TABLE 5.1 - ESTIMATED TOTAL COST OF ALTERNATIVE DEVELOPMENT STRATEGIES FOR BRISBANE AIRPORT 1974-75 TO 1999-2000

($ Million)

Strategy	Costs Incurred					
	1974-75 to 1979-80	1980-81 to 1984-85	1985-86 to 1989-90	1990-91 to 1994-95	1995-96 to 1999-2000	Total
New Airport Site						
1	26	145	2	29	-	202
2	26	129	2	29	-	186
3	26	124	2	29	-	181
Existing Airport Site: both airlines relocated						
4	30	93	3	30	-	156
5	30	86	3	30	-	149
Existing Airport Site: one airline relocated						
6(a)	28	35	-	-	-	63
7	31	48	20	28	-	127
8	32	54	20	28	-	134

(a) Unlike other strategies, strategy 6 does not allow sufficient area to expand terminal and apron capacity to cater for expected domestic traffic beyond 1990.

NOTE: All estimates are expressed in March 1974 dollars and exclude costs associated with the construction of the new (1976) international terminal complex.

Source: Derived from cost estimates prepared by the Department of Housing and Construction.

(ii) Strategies 2 and 3 are cheaper than strategy 1 due to the reduced capability or absence of the secondary runway.

(iii) Strategy 4, while providing for new domestic and international terminal facilities, is cheaper than strategy 3 because the existing runway complex is not replaced.

(iv) Strategy 5 is cheaper than strategy 4 because the 1976 international terminal is used as the basis for new international facilities.

(v) Strategies 7 and 8 are cheaper than strategy 5 because one domestic operator continues to use some of the existing facilities. Strategy 7 is cheaper than strategy 8 because the latter requires a new parallel taxiway.

(vi) Strategy 6 is the cheapest because it does not include the provision of sufficient terminal capacity to cater for expected traffic after 1990.

The cost estimates contained in Table 5.1 were provided by the Department of Housing and Construction. The cost of each activity in each strategy was prepared as a best estimate of the likely order of cost of the activity.

5.2 AIRPORT OPERATION AND TAXIING COSTS

As with capital costs, the comparison of alternative development strategies is based on the assumption that similar ground operating and terminal facilities are provided under each alternative. The likely effects of this assumption are discussed later in this Chapter.

The distances of terminals and aprons from their associated runways in each strategy are such that the cost and time of aircraft taxiing to and from these apron areas would be similar. On this basis, the aircraft taxiing costs were taken to be the same for all strategies. The location of terminals and aprons in relation to runways in each strategy is illustrated in Annex E.

5.3 AVIATION COSTS AND BENEFITS

Six aspects of aviation costs or benefits were considered in comparing the alternative development strategies: air space, general aviation activities, defence costs and benefits, congestion costs on airways, closure cost, and curfews.

5.3.1 Air Space

The proximity to the existing Brisbane Airport of Amberley military control zone and of the general aviation lane of access to Archerfield Aerodrome constrains the manoeuvring of aircraft approaching Brisbane from the south to land on the northern end of the main runway or taking off towards the south and turning to the north. Strategies 1 to 3 would locate the new main runway further to the east thus providing about 2 nautical miles of additional manoeuvring distance. This extra distance would significantly improve the ability to efficiently control aircraft operations in the north-western sector. The effect of this additional air space would be to reduce delays to commercial aircraft.

5.3.2 General Aviation Activities

In comparing the strategies, it was initially assumed that runway capacity would be adequate until approximately the year 2000 provided some constraint is placed upon non-commercial general aviation movements, at Brisbane Airport. Any such constraints would be required at the same time in all strategies, with the exception of

strategies 1, 2 and 3. The annual capacity of the open-Vee runway complex proposed for strategy 1 would be greater than that for strategy 2 or strategies 4 to 8 because of the higher capability of the secondary runway. The annual capacity of the runway complex in strategies 4 to 8 would, however, be slightly lower than in strategy 2 because of the limited secondary runway. Strategy 3 does not include the construction of a secondary runway. Therefore constraints on aircraft movements would be required at an earlier date than for the other strategies. It is implicit in the argument for a possible constraint on aircraft movements that the benefits of reduced congestion costs will be greater than the costs imposed on the constrained aircraft operators. The effect can be expected to be of more benefit in strategy 1 than in strategy 2 and to impose a cost on strategy 3 relative to the other five strategies considered.

5.3.3 Runway Capacity

Strategy 1 was developed with a secondary runway in an open-Vee configuration which allows simultaneous independent operation of the two runways. This gives a higher capacity (234,000 aircraft movements per annum) than strategy 2 (183,000), or strategies 4 to 8 (165,000). Strategy 3 (156,000) does not provide for the construction of a secondary runway. Therefore, runway congestion would eventually be greater in strategy 3 and less in strategies 1 and 2 than with the other strategies. These differences would result in a benefit from strategies 1 and 2 and a cost associated with strategy 3 relative to the other strategies.

5.3.4 Defence Potential

The provision of two high capacity runways in strategy 1 would be significant from a defence viewpoint,

5.3.5 Runway Closure (Due to Weather)

The proximity of the runway complexes in strategies 1, 2 and 3 to the existing complex is such that identical weather conditions would occur in both locations. The lack of a secondary runway in strategy 3 would however, impose a cost to this strategy relative to all other strategies.

5.3.6 Curfews

A curfew on jet aircraft operations between the hours of 11.00 p.m. and 6.00 a.m. is currently in force on the existing runways. Emergency situations and mercy flights are excluded from this curfew. The curfew is imposed because there are houses close to the airport. A relocation of the runway(s) to the Qc site would remove noise aspects from curfew considerations. Whether in fact the curfew would be lifted is not clear.

Some possible benefits from removal of curfew conditions at Brisbane Airport include:

- improved ability to recover from disruptions to airline services and cater for any increased demand during holiday peak traffic periods
- reduced inconvenience to passengers from avoiding an overnight stop due to the current curfew
- more commercially acceptable schedule times (off peak) for group travel or late charters
- improvement in the ability to schedule international services
- greater utilisation of the domestic jet fleets through night freight operations.

The benefits from allowing 24 hours a day jet aircraft operations at Brisbane would however depend upon a

number of factors. The benefits to domestic operators and passengers would depend on curfew conditions in force at other airports. For example, with the present curfew at Sydney Airport between 11.00 pm and 6.00 am, the only advantage from lifting the curfew at Brisbane would be to allow aircraft on the Sydney-Brisbane route to depart from Sydney between 9.45 pm and 11.00 pm. It would, however, be expected that the demand for aircraft services to Brisbane after 10.00 pm would be small.

The benefits from lifting curfew restrictions on international operations would depend on curfews operating at overseas airports. If the Brisbane Airport curfew were lifted it would give international operators more flexibility in planning their services. When determining schedules, operators are generally constrained by the desire of passengers to arrive and depart during "commercially attractive" (6.00 am to 11.00 pm) hours. Scheduling flexibility is further constrained when a curfew at any airport encroaches into the commercially attractive hours at any other airport. A combination of limited commercially attractive hours at a distant originating airport and curfews at a number of airports en-route can result in the number of available hours at the terminating port being a very small proportion of non-curfew hours. Under these circumstances lifting curfews can be beneficial, the benefits being enhanced by the curfews existing at overseas airports.

Nevertheless, it is unlikely that there would be a significant number of international aircraft movements between the hours of 11.00 pm and 6.00 am if the existing curfew were lifted. Consequently, in the context of this study, any benefit in resource terms would be small.

The removal of restrictions on night aircraft operations might result in a redistribution of some domestic aircraft movements from other hours of the day. Such a redistribution might reduce congestion in cases where runway,

apron or terminal areas are reaching or have reached capacity. The extent to which redistribution of domestic aircraft passenger operations would occur would depend on the demand for domestic air travel by time of day. Since it is unlikely that the demand for air travel between the hours of 11.00 pm and 6.00 am would be sufficient to encourage many domestic night operations, any benefits from the relief of congestion would be small.

The removal of the curfew at Brisbane Airport would allow an increase in overnight jet air freight operations. Any such increase will however, depend on curfew conditions at other airports.

5.4 HEIGHT RESTRICTIONS

The two basic groups of alternative development strategies considered for Brisbane Airport involve either:

(i) utilising the existing runway system until runway capacity is reached; or

(ii) moving the airport further to the north by the year 1985.

The present aircraft clearance surfaces to the south-west associated with the existing main runway, require height restrictions on some very high building projects within the Brisbane central business district (CBD). There would be no aviation requirement for these restrictions after 1985 should the airport be moved to the north. It should be noted that the runway alignments for the new airport to the north were influenced by the broad terms of reference of the 1971 Advisory Committee wherein the judgement was made that building height restrictions within the CBD were not in the best interests of Brisbane.

In previous studies of alternative development strategies at Brisbane Airport any relaxation of CBD building height restrictions has been regarded as a benefit. The arguments for and against this judgement are similar to those regarding the inclusion of some part of the increment in

land values resulting from a transport improvement project as a benefit to that project.[1] The easing of building height restrictions over part of the CBD may have local value. However, from the standpoint of society as a whole, an increase in the allowable height of buildings in a CBD can be regarded unambiguously as a benefit only if the resources entailed in any additional construction and/or operation would not otherwise have been employed. While a relaxation of building height restrictions over part of the CBD after 1985 may result in additional development in that area, it needs to be ascertained whether this development would have taken place in some area not limited by height restrictions.

If the additional development did not result in a reduction of economic activity elsewhere in the economy then benefits from relaxing the restrictions arise. Provided resources in the economy are fully employed, an airport project which allows some relaxation of CBD building height restrictions generates benefits only to the extent that the area to which the transfer of resources took place is "better". This is because a relaxation of building height restrictions on part of the CBD will only result in a transfer of the locus of economic activity and not in the

(1) See for example:

- E.J. Mishan, Cost-Benefit Analysis (London: George Allen and Unwin, 1972), pp. 63-64.
- C.D. Foster and M.E. Beesley, "Estimating the Social Benefit of Constructing an Underground Railway, in London", Journal of the Royal Statistical Society, Series A Vol. 126, Part 1 (1963), pp. 47-49.
- A.R. Prest and R. Turvey "Cost-Benefit Analysis: A Survey", Economic Journal, Vol. 75 No. 300 (Dec. 1965), p. 688.
- David Barrell, Cost Benefit Analysis in Transport Planning (Oxford Polytechnic, 1971), pp. 21-23.
- J.S. Dogson, "External Effects and Secondary Benefits in Road Investment Appraisal", Journal of Transport Economics and Policy, Vol. VII, No. 2 (May 1973), pp. 169-185.
- H. Mohring, "Land Values and the Measurement of Highway Benefits", Journal of Political Economy, Vol. LXIV, No. 3 (June 1961), pp. 236-249.
- H. Mohring and M. Harwitz, Highway Benefits: An Analytical Framework (Northwestern University Press, 1962), pp.40-44.

creation of entirely new economic activity. Although such changes may be deemed socially desirable, they cannot unambiguously be considered so. To do so is to make an explicit judgement regarding the relative merits of alternative forms of output (and place of production).(1)

The benefits in resource terms of any relaxation of building height restrictions over part of the CBD after 1985, depend upon an assessment of what development would take place in other areas, with and without the height restriction. It is clearly impossible to predict such development with any degree of accuracy. The benefit would however, be small. Therefore the possible relaxation of building height restrictions in the Spring Hill area of Brisbane CBD can be taken to have zero value to the nation as a whole.

5.5 AIRCRAFT NOISE

The various development strategies for Brisbane Airport require all aircraft operations to be on the existing runways until at least 1985 and on the Qc site some time after the year 2000. Therefore, in the periods between 1975 and 1985 and after the assumed move to the Qc site some time beyond the year 2000, the effects of aircraft noise would be identical for all strategies considered.

The adoption of a strategy utilising the existing runways after 1985 would result in greater noise nuisance compared with strategies in which operations would commence on the new runway(s) in that year. This nuisance would represent a cost to those strategies utilising existing runway facilities after 1985. In general terms, the level of aircraft noise after 1985 will depend on the increase in aircraft movements offset by any reduction in the noise

(1) The arguments presented above are similar to those outlined by Mohring and Harwitz, op. cit., pp. 40-44.

produced by each aircraft movement.

To demonstrate the possible extent of aircraft noise in 1985, Noise Exposure Concepts (NEC) for the alternative runway configurations have been developed by the Airways Operations Division of the Department of Transport. These NEC's were calculated from the forecast aircraft movements for 1985 on the basis that:

(i) noise reduction modifications would be incorporated in the current aircraft types which have not yet been noise certificated;

(ii) existing noise abatement procedures nominating preferred runway usages would be continued (leading to a great majority of take-offs to the north-east for both main runways considered).

As yet, no program has been established for the incorporation of noise reduction devices on any aircraft in the Australian airline fleet. Further, as aircraft traffic volumes increase at Brisbane, the existing noise abatement procedures which are already difficult to maintain will become increasingly so. Should either of the assumptions used to calculate the NEC's prove to be invalid, expanded NEC contours could be expected. On the other hand, introduction of the proposed Microwave instrument landing system, with its curved flight path capabilities, could strengthen noise abatement procedures.

The NEC's contained in this report depict circumstances which, on the best information available, would be expected to occur in 1985. Given the counteracting effects of increased aircraft movements and quieter aircraft types, these NEC's could be taken to approximately represent the level of aircraft noise over the period 1985 to 2000.

The 1985 NEC's for the existing runways (strategies 4 to 8), the new main runway (strategy 3), and the new main and secondary runways (strategies 1 and 2) are contained in Annex F. These NEC's are considerably contracted compared with the noise forecasts prepared by the 1971 Advisory Committee.(1) This is due to the improvements in noise forecast methodology, particularly in the assessment of the likely mix of aircraft types and level of engine noise, that have occurred since the 1971 forecasts were prepared.

The NEC's indicate that aircraft operations on the proposed new runway(s) on the Qc site would virtually eliminate all aircraft noise over residential areas. Therefore, there would be a cost of noise associated with those strategies in which aircraft operations continue on the existing runways after 1985.

The first major effort to attach a cost to aircraft noise disamenity was undertaken by the Roskill Commission.(2) The essential argument in the Commission's analysis was that noise disamenity would be reflected in property prices. The groups of people distinguished were as follows:

Group	Social Costs (Roskill Commission's Symbols)
(a) Moving because of airport	S + R + D
(b) Moving anyway	D
(c) Remaining	N
(d) New entrants	Zero

(1) 1972 Advisory Committee Report, op. cit., Appendices One and Seven.

(2) Commission on the Third London Airport, Papers and Proceedings (London: HMSO, 1970), Vol. VII, Parts 1 and 2.

where:

R = removal costs

S = consumer's surplus

D = change in market price

N = "sum of money which would just compensate ... (the house owner) ... for the nuisance suffered and make him as well off as he was before".(1)

The aircraft noise cost model developed by the Roskill Commission has been criticised on a number of counts.(2) Further, the results of a number of overseas studies have indicated that residential land values around airports fall during periods of substantial change but that after the change they increase to approximately their previously established long-run trend.(3)

The only work on the cost of aircraft noise in an Australian situation was undertaken in Sydney. That work is unfinished and confidential.

The conclusions in this report regarding noise nuisance are based on the estimate of the number of dwellings in the two NEC bands developed for the alternative runway configurations for Brisbane Airport (Table 5.2). These dwelling counts were determined from the 1971 Census data, aerial photography and data collected during previous studies of Brisbane Airport.

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(1) Ibid., p. 366, para. 20.3.

(2) See for example M.E. Paul, "Can Aircraft Noise Nuisance be Measured in Money", Oxford Economic Papers, Vol. 23 (1971), pp. 297-321, and Ajit K. Dasgupta and D.W. Pearce, Cost Benefit Analysis - Theory and Practice (London, Macmillan, 1971), pp. 230-232.

(3) See for example Ronald W. Crowley, "A Cast Study of Effects of an Airport on Land Values", Journal of Transport Economics and Policy, Vol. VII, No. 2 (May 1973), pp. 144-152.

5.6 ACCESS COSTS

Four types of costs were considered in evaluating road access proposals associated with each of the airport development strategies:

(i) Capital costs associated with right of way acquisition and construction costs of the North-South Freeway and associated interchange works in the section from Brisbane River to Schultz Canal.

(ii) Road maintenance and drainage pumping costs.

(iii) Vehicle operation cost and travel time differentials for alternative strategies.

(iv) Other considerations, including compatability with Gateway Bridge requirements, compatability with surface streets, road traffic operations, impact on existing and future land uses and social and environmental considerations.

TABLE 5.2 - NUMBER OF DWELLINGS AND OTHER STRUCTURES WITHIN THE 25-30 NEC BAND AND 30 + NEC BAND: EXISTING RUNWAYS, 1985

Structure	NEC Band	
	25-30	30+
Dwellings	300	105
Commercial premises	10	2
Churches	2	
Large industries	1	
Small industries	1	
Wharves	1	
Schools		2

NOTE: These estimates are approximate only. They were derived from the 1971 Census data, aerial photographs and data collected during previous studies of Brisbane airport.

The first three areas of costs for strategies 1 to 5 were examined in detail by the Queensland Main Roads Department, and are the subject of a report by that Department.(1) Access costs for strategies 6 to 8 were derived from that report. A quantitative treatment of the other considerations and an analysis of the implications of the Queensland Main Roads Department's report on alternative development strategies for Brisbane Airport, are the subjects of a Report prepared by the Australian Government Department of Housing and Construction.(2)

A number of alternative alignments of the North-South Freeway in the area Brisbane River to Nundah were considered in the analysis of surface transport under alternative development strategies. These included alignments around or along the existing secondary runway. To compare the relative access costs associated with the various development strategies, an alignment that locates the freeway around the north-western end of the existing secondary runway was taken as representative for strategies in which the existing runways would still be in operation in 1991. An alignment that located the freeway on the existing secondary runway was taken as representative for strategies in which the existing runways would be vacated by 1991. Relative access costs to the alternative terminal locations were based on these two alignments.

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(1) Queensland Main Roads Department, "Brisbane Airport Development Strategy 'K': A Report on Ground Access Requirements for Brisbane Airport Developed Under Strategy 'K'" (August, 1974).

(2) Australian Government Department of Housing and Construction, "Brisbane Airport Development - Surface Transport Considerations: Report on Alternative Access Strategies for Brisbane Domestic Airport to 1985 and Road Transport Implications of Alternative Airport Development Strategies to 2000" (December, 1974).

The method used to derive the cost differences between various strategies is outlined in Annex G. The discounted access costs differences for each strategy are summarised in Table 5.3.

TABLE 5.3 - DISCOUNTED DIFFERENTIAL ACCESS COSTS FOR ALTERNATIVE DEVELOPMENT STRATEGIES, 1975-2000

($ million 1974)

Strategy	7 per cent discount rate	10 per cent discount rate
1	0	0
2	0	0
3	0	0
4	- 16.06	- 11.09
5	+ 0.85	+ 0.13
6	- 6.89	- 4.64
7	- 6.30	- 4.03
8	- 8.76	- 5.45

NOTE: A negative sign indicates a lower access cost than for strategy 1.

Source: Derived from Tables G.9 and G.10, Annex G.

5.7 LAND SALE AND ACQUISITION

The purchase of land for the development of concept Qc commenced in 1974. On the assumption that this land would be retained for future airport development regardless of what development takes place on the existing site, this land was treated as a sunk cost in the analysis. If occupation of the Qc site is advanced in time a benefit will accrue, being equal to the annual rental value of the land in other uses. Since the land would only be used for existing purposes (mainly agriculture except for some residences at Cribb Island), this benefit would be small, and has not been calculated.

A move to the Qc site would result in some of the land in the existing airport being available for other than airport use. This area would comprise the land, pavement and buildings south of the existing secondary runway. Therefore, the opportunity cost of this land would be a benefit to each strategy in the year that the existing runways and terminal areas are vacated. In computing this benefit, the current value of the land involved was taken to represent its opportunity cost, and the current value of the existing airport building on the land taken as representative of the opportunity cost of all buildings on the site at the time of possible disposal.

The area of land that could be released once the existing runways and terminal areas are vacated was divided into three notional areas for valuation:

(i) the airport terminal building area encompassing 20.3 hectares of land bordered on the south by the Pinkenba railway line and including the existing hangers, terminal buildings, stores and vehicle parking areas;

(ii) an area of 36.2 hectares comprising the main aircraft taxiways and apron areas north of the existing building area; and

(iii) an area of 3.2 hectares south of the Pinkenba railway line on which are erected three large warehouse buildings, various small buildings and a spur railway with platform siding.

Each of these three areas was valued by officers of the Australian Taxation Office, Valuation Branch, Brisbane Office, with and without buildings. The total land and aprons without buildings was valued at approximately $16.6m. The existing buildings were valued at approximately $2.4m.

CHAPTER 6. EVALUATION OF ALTERNATIVE DEVELOPMENT STRATEGIES

This chapter contains an evaluation of the alternative development strategies. Differences between strategies are compared and their implications for the long term development of Brisbane Airport examined.

6.1 COMPARISON OF STRATEGIES 1, 2 AND 3 (USING THE PROPOSED NEW SITE)

The significant difference between these strategies, which all make use of the Qc site, is the difference in capability of the secondary runway between strategies 1 and 2, and the absence of this runway in the case of strategy 3. The discounted cost of adopting these strategies to the year 2000, for discount rates of 7 and 10 per cent, are presented in Table 6.1. The results indicate that if strategy 1 were to be justified then a net present value of at least $8m (10 per cent discount rate, Table 6.1) would have to be placed on the benefits of having a secondary runway capable of handling all existing commercial aircraft rather than aircraft up to Fokker Friendship size. The results also indicate that if strategy 2 were to be justified then a net present value of at least $2m would have to be placed on the benefits of having a limited secondary runway.

Insufficient information is available to the BTE to assess the relative benefits of alternative cross-wind runway proposals. Therefore, to illustrate the relative differences between pursuing a development strategy on the existing site or on the concept Qc site, strategy 2 was chosen since this strategy includes a secondary runway similar to the existing one.

TABLE 6.1 - COMPARISON OF DISCOUNTED COSTS OF NEW AIRPORT SITE STRATEGIES: 1, 2 AND 3, 1975-2000

($ million 1974)

Item	Strategy		
	1	2	3
7 per cent discount rate			
Discounted cost of strategy	113	104	101
Difference (relative to strategy 1)	0	-9	-12
10 per cent discount rate			
Discounted cost of strategy	91	83	81
Difference (relative to strategy 1)	0	-8	-10

NOTE: A negative sign indicates a lower cost than strategy 1.

6.2 COMPARISON OF STRATEGIES 4 TO 8 (USING THE EXISTING AIRPORT SITE)

Strategies 4, 5, 7 and 8 all utilise the existing site so that there is sufficient area for terminal expansion to cater for the expected passenger movements until at least 2000. Strategy 6, unlike the other strategies, does not provide sufficient area for terminal and apron expansion to cater for expected passenger movements beyond 1990. For terminal and apron capacity to be increased after that date, development of the airport along the lines of either strategy 7 or 8 would be required. Therefore, the costs associated with either strategy 7 or 8 could be taken to represent the cost of providing adequate areas for future terminal expansion beyond 1990. On this basis, strategy 6 was excluded from the following analysis. It should be noted that strategies 6, 7 and 8 are really only variations of developments and could utilise some of the existing terminal facilities.

TABLE 6.2 - COMPARISON OF DISCOUNTED COSTS OF EXISTING AIRPORT SITE STRATEGIES: 4, 5, 7 AND 8, 1975 - 2000

($ million 1974)

Item	Strategy			
	4	5	7	8
7 per cent discount rate				
Discounted cost of strategy	86	83	68	72
Access costs (relative to strategy 4)				
Operating and capital costs (net of time)	0	9	6	4
Time cost	0	8	4	3
Total	86	100	78	79
10 per cent discount rate				
Discounted cost of strategy	70	67	55	58
Access costs (relative to strategy 4)				
Operating and capital costs (net of time)	0	5	3	3
Time cost	0	6	4	3
Total	70	78	62	64

The discounted cost of adopting either strategy 4, 5, 7 or 8 to the year 2000, for discount rates of 7 and 10 per cent, are presented in Table 6.2. The results indicate that strategy 7 has a cost advantage over strategy 8 of between $1m and $2m. Strategy 8, furthermore, involves the location of one domestic terminal on the opposite side of the main runway to the other domestic and international terminal without having any compensating advantages. Compared with strategies 4 and 5, strategy 7 has a cost advantage of between $8m and $22m without having

any major disadvantages.(1) All non-quantifiable costs such as noise, curfews and height restrictions would be identical for strategies 4, 5, 7 or 8. Therefore, of the strategies which use the existing airport site, strategy 7 is the least cost method of continuing operations on this site until at least the year 2000.

6.3 COMPARISON OF STRATEGIES 2 (NEW AIRPORT SITE) AND 7 (EXISTING AIRPORT SITE)

Having determined that strategies 2 and 7 are representative of the least cost ways of using the Qc site and the existing runways respectively, the differences between these two alternative courses of action are now analysed.

The discounted costs of adopting either strategy 2 or strategy 7 as the development strategy for Brisbane Airport until the year 2000 are presented in Table 6.3. This comparison includes the construction costs, the relative access costs and opportunity cost of the land south of the existing secondary runway between the years 1975-2000. The results presented in Table 6.3 do not include any residual value of terminal facilities or runways in the year 2000, or any costs that may be incurred after the year 2000. Further, in comparing strategies 2 and 7 it was assumed that in the year 2000 general aviation aircraft movements would be limited to approximately 70 and 50 per cent of the forecast of unlimited movements respectively. No limits in either strategy would need to be applied until after approximately 1995.

---

(1) Strategy 7 does involve the terminal operations of one domestic airline being divided by the secondary runway clearance surfaces. Such a division would, however, only be required to provide for forecast traffic after 1995.

The results presented in Table 6.3 indicate that, for the period 1975 to 2000, strategy 7 has a discounted cost advantage over strategy 2 of $36m at a 7 per cent discount rate and $27m at a 10 per cent discount rate. These cost differences must, however, be compared with the non-quantified differences between strategies 2 and 7, which are summarised in Table 6.4 and are discussed in the following paragraphs.

TABLE 6.3 - COMPARISON OF DISCOUNTED COSTS OF NEW AIRPORT SITE (STRATEGY 2) AND EXISTING AIRPORT SITE (STRATEGY 7), 1975-2000

($ million 1974)

Item	New Airport Site (strategy 2)	Existing Airport Site (strategy 7)
7 per cent discount rate		
Discounted cost of strategy	104	68
Access costs (relative to strategy 2)		
Operating and capital costs (net of time)	0	-4
Time cost	0	-2
Opportunity cost of land	-6	0
Total	98	62
10 per cent discount rate		
Discounted cost of strategy	83	55
Access costs (relative to strategy 2)		
Operating and capital costs (net of time)	0	-3
Time cost	0	-1
Opportunity cost of land	-5	0
Total	78	51

NOTE: A negative sign indicates a lower cost than the other strategy.

6.3.1 Aircraft Noise

The technical aspects of this subject were discussed in Section 5.5, the noise exposure bands for various strategies being shown in Annex F. The number of dwellings contained in the 25-30 and 30+ NEC bands were given in Table 5.2

No greater cost could be placed on aircraft noise over residential areas after 1985 than the cost of acquiring all dwellings within the effected areas. On the basis that dwellings within these areas have a current average value of about $25,000, the approximate discounted cost of acquisition in 1985 is $5m and $4m for a 7 and 10 per cent discount rate respectively. These values, however, only indicate the absolute maximum cost that could be placed on aircraft noise, and bear no relationship to the amount dwellers would be prepared to accept as full compensation for the noise disamenity. It is this latter amount that reflects the true cost of noise.

Even if the disamenity were as high as $1,000 per household per year, the total noise cost associated with aircraft operations on the existing site between 1985 and 2000 would be approximately $2m at 7 per cent discount rate. At this discount rate, such a total cost of noise would equal a lump sum payment of approximately $10,000 per household in 1985. It may well be considered that this value is a considerable over-estimate of noise disamenity. Therefore, when interpreting the comparative evaluation results for a 7 per cent discount rate, $2m should be regarded as an indication of the likely upper bound to the value of reducing noise over residential areas during the period 1985-2000. The corresponding value at a 10 per cent discount rate is $1.2m.

6.3.2 Curfews

As discussed earlier in this chapter, the adoption of strategy 2, using the new airport site, rather than strategy 7, using the existing airport site, would enable night restrictions on jet aircraft operations at Brisbane Airport to be lifted in 1985. Therefore, any cost associated with curfew conditions after 1985 should be added to the costs of strategy 7. It would, however, be expected that any such costs would be small in resource terms.

6.3.3 Differences in Level of Service of Terminal Facilities

The only difference in the level of service of terminal facilities proposed for strategies 2 and 7 is that, in the case of strategy 7, one domestic operator and international operators would utilise part of the existing facilities and the new (1976) international terminal building (expanded). Although the standard of these facilities may not be identical to completely new facilities on the Qc site, any differences in amenity would be small.

6.3.4 Building Height Restrictions

The adoption of strategy 2 rather than strategy 7 might make it possible to ease the existing building height restrictions on part of the Brisbane CBD in 1985. It was, however, argued in Section 5.4 that easing of building height restrictions over part of the CBD would only have local value, at the expense of value lost elsewhere in the economy. It is therefore taken to have zero economic value in net terms for the purposes of this study.

6.3.5 Airspace

The proximity of the main runway in strategy 7 to the Amberley military control zone and the Archerfield Aerodrome general aviation lane of access results in air-

space restrictions in the north-western sector. The adoption of strategy 2 rather than strategy 7 would provide an additional two nautical miles of manoeuvring distance, thus improving the ability to control aircraft operations in this sector.

6.3.6 Limitation of General Aviation Aircraft Movements

The main runways in strategies 2 and 7 have equivalent annual capacities. While capabilities of the secondary runways in both these strategies are similar, the combinations of main and secondary runways do not provide identical annual capacity. The practical capacity of the runways in strategies 2 and 7 are currently assessed to be approximately 183,000 and 165,000 aircraft movements per annum respectively.

The runway configuration in strategy 7 would cater for projected aircraft movements to approximately 1995. Because of the difference in the annual capacity of the runways in strategies 2 and 7, greater restrictions on general aviation aircraft movements will be required after this date if strategy 7 were to be adopted rather than strategy 2.

The upper estimate of the cost of restrictions on general aviation aircraft movements is the cost of providing alternative facilities. It is estimated that the total cost of such facilities would be in the order of $10m (1974). The forecasts of aircraft movements indicate that restrictions on general aviation would first be required about 1995 for strategy 7 and 1998 for strategy 2. Assuming that alternative general aviation facilities are constructed in 1995 and 1998 for strategy 7 and 2 respectively, the discounted differential cost between the two strategies is approximately $0.5m and $0.4m for 7 and 10 per cent discount rates respectively. These values however,

TABLE 6.4 - COMPARISON OF EXISTING AIRPORT SITE STRATEGY 7 WITH NEW AIRPORT SITE STRATEGY 2, 1975-2000

Item	Differences
Quantified Cost Differences[a]	
7 per cent discount rate ($m 1974)	-36
10 per cent discount rate ($m 1974)	-27
Non-quantified Cost Differences	
Noise	Noise would continue to be imposed on about 400 dwellings during the period after 1985 - upper limit of estimated discounted cost $2m.
Curfews	It is probable that curfews will continue to be imposed on night operations by jet aircraft after 1985 - it is expected that any costs would be small.
Building heights	It is unlikely that building height restrictions on part of the CBD would be eased after 1985 - assessed as having zero cost from the national view point.
Physical standard of terminal facilities	The standard of one domestic and the international terminal facilities will be slightly lower.
Limitations on general aviation aircraft movements	Greater restrictions on general aviation aircraft movements will be required after 1995 - upper limit of estimated discounted cost $0.5m.
Airspace	Airspace restrictions in the north-western sector would not be eased after 1985.

(a) A negative sign indicates a lower cost for strategy 7 than strategy 2.

only indicate the maximum cost that could be placed on the greater restriction of general aviation aircraft movements associated with strategy 7. The true cost would be considerably lower.

6.4 THE IMPLCATIONS OF NEW AIRPORT SITE STRATEGY 2 AND EXISTING AIRPORT SITE STRATEGY 7 FOR THE LONG TERM DEVELOPMENT OF BRISBANE AIRPORT

So far, in this report, only the relative costs of alternative development strategies between the years 1975 and 2000 have been compared. The implications of these strategies for further development of Brisbane Airport after the year 2000 must also be considered.

Strategy 2 provides for the long term option of constructing a second main runway in a widespaced parallel configuration (see Annex A). A runway complex of this configuration would have a nominal capacity of about 300,000 aircraft movements per annum. Although insufficient area is available on the present site to construct such a complex, capacity could be increased to approximately 230,000 aircraft movements per annum by constructing a second main runway, on a section of the Qc site, in a configuration such as an open-vee. Such a runway configuration was contained in concept Pc in the 1972 Advisory Committee's report on Brisbane Airport.(1)

To demonstrate the effect of strategies 2 and 7 on the provision of long term runway capacity, the total cost of the structures associated with strategy 2 on the Qc site can be added on to the cost of strategy 7. The construction cost of strategy 2 represents the maximum cost of repositioning all terminals and runways so that a widespaced parallel runway configuration could be provided. The comparison is presented in Table 6.5. The discounted cost of subsequently

(1) 1972 Advisory Committee Report, op. cit., Appendix Four.

TABLE 6.5 - DISCOUNTED COSTS OF NEW AIRPORT SITE STRATEGY 2 COMPARED WITH DISCOUNTED COSTS OF EXISTING AIRPORT SITE STRATEGY 7 FOLLOWED BY STRATEGY 2 IN THE YEAR 2000

($ million 1974)

Item	New Airport Site (strategy 2)	Existing Airport Site (strategy 7)
7 per cent discount rate		
Discounted cost of strategy	104	68
Access costs (relative to strategy 2)		
Operating and capital costs (net of time)	0	-4
Time cost	0	-2
Opportunity cost of land	-6	0
Sub Total	98	62
Discounted cost of subsequently constructing strategy 2	0	37
Total	98	99
10 per cent discount rate		
Discounted cost of strategy	83	55
Access costs (relative to strategy 2)		
Operating and capital costs (net of time)	0	-3
Time cost	0	-1
Opportunity cost of land	-5	0
Sub Total	78	51
Discounted cost of subsequently constructing strategy 2	0	20
Total	78	71

NOTE: A negative sign indicates a lower cost than the other strategy.

constructing an airport of the level of service of strategy 2 (new airport site) was calculated assuming that construction would need to commence 6 years before such an airport would be fully operational. The results indicate that at a 7 per cent discount rate, strategy 7 followed by strategy 2 (the latter to be operational by the year 2000), would have a discounted cost of $1m more than simply adopting strategy 2 and commencing operations on the Qc site in 1985. At a 10 per cent discount rate, the construction of strategy 7 followed by strategy 2 operational by the year 2000 would have a discounted cost of $7m less than simply adopting strategy 2. These net present values do not, however, include the residual value of the terminal and other facilities constructed in strategy 7. The cost of constructing these facilities in 1974 values exceeds $70m. If the residual value of these facilities in 2000 is only $10m, this represents a net present value of approximately $1.5m at a 7 per cent discount rate. It would be expected that the residual value of these facilities would be greater than this amount.

6.5 THE EFFECT OF DAMPENING DEMAND FOR THE USE OF BRISBANE AIRPORT FACILITIES

6.5.1 Limiting General Aviation Movements

The aircraft movement forecasts presented in Chapter 2 indicate that under existing procedures and pricing policies, non-scheduled aircraft are expected to comprise 55 per cent of total aircraft movements in 2000-01. The analyses of the alternative strategies outlined above were conducted on the basis that both the existing runways and runways on the Qc site could cater for total projected aircraft movements until 1995, and that for runway capacity to meet requirements until 2000, general aviation movements would need to be constrained to approximately 70 per cent

TABLE 6.6 - DISCOUNTED COSTS OF NEW AIRPORT SITE STRATEGY 2 COMPARED WITH DISCOUNTED COSTS OF EXISTING AIRPORT SITE STRATEGY 7 FOLLOWED BY STRATEGY 2 IN THE YEAR 2010(a)

($ million 1974)

Item	New Airport Site (strategy 2)	Existing Airport Site (strategy 7)
7 per cent discount rate		
Discounted cost of strategy to 2000	104	68
Access costs (relative to strategy 2)		
1975 - 2000(b)	0	-6
2001 - 2010(b)	0	-2
Opportunity cost of land	-7	0
Discounted cost of subsequently constructing strategy 2 in 2010(c)	0	22
Total	97	82
10 per cent discount rate		
Discounted cost of strategy to 2000	83	55
Access costs (relative to strategy 2)		
1975-2000(b)	0	-4
2001-2010(b)	0	-1
Opportunity cost of land	-6	0
Discounted cost of subsequently constructing strategy 2 in 2010(c)	0	9
Total	77	59

(a) Runway capacities in strategies 2 and 7 would be adequate until 2010 with general aviation aircraft movements in 2010 limited to approximately 20 and 10 per cent of forecast movements respectively. An upper limit of estimated discounted cost for this additional restriction associated with strategy 7 is $0.5m.

(b) Access costs between 2001 and 2010 were calculated on the assumption that road traffic in the study area would grow at 5.5 per cent per annum.

(c) The discounted cost of subsequently constructing strategy 2 was calculated assuming that construction would need to commence in 2004 and that construction work to the value of $30m would be incurred on both sites between 2001 and 2010 to provide additional capacity for domestic and international terminal operations.

NOTE: A negative sign indicates a lower cost than the other strategy.

and 50 per cent of the forecast level for strategies 2 and 7 respectively. Further progressive limitations of general aviation movements could ensure that aircraft movements do not exceed runway capacity for some years after 2000.

The reductions of general aviation aircraft movements required to ensure that the capacity of existing runways equal total demand was shown in Table 3.1. To demonstrate the effect of further limiting general aviation aircraft movements the differences between the discounted costs of constructing strategy 7 followed in 2010 by strategy 2 and the discounted costs of the original strategy 2 are presented in Table 6.6. The results indicate the limitation of general aviation movements by an additional 18,000 movements per annum would result in a discounted cost saving of between $15m and $18m if strategy 7 (existing airport site) is adopted rather than strategy 2 (new airport site). As discussed in section 6.3.6, the upper limit of estimated discounted cost for this additional restriction is $0.5m.

6.5.2 Pricing

The effect of relieving some peak hour airport congestion problems by adopting various peak hour pricing policies has received increasing attention in recent years.(1) The main proposal amounts to landing (or take-off) fees that would be substantially increased during peak periods. The effect of such fees would depend on the relative magnitude of the peaks and the troughs, as well as the operational interdependence of the entire air transport network. Hence, the effect of the implementation of peak

(1) See for example:

- William D. Grampp, "An Economic Remedy for Airport Congestion: The Case for Flexible Pricing", Business Horizons, Vol. XI, No. 5 (1968), pp. 21-30.
- M.E. Levine, "Landing Fees and the Airport Congestion Problem", Journal of Law and Economics, Vol.XII, No. 1 (1969), pp. 79-108.
- A. Carlin and R.E. Park, The Efficient Use of Runway Capacity in a Time of Scarcity (Santa Monica, California: The Rand Corporation, August, 1969), RM-5817-PA.
- J.V. Yance, "Movement Times as a Cost in Airport Operations", Journal of Transport Economics and Policy, Vol. III, No. 1 (1969), pp. 28-36.
- J.R. Minasian and R.E. Eckert, "The Economics of Airport Use, Congestion and Safety", California Management Review, Vol. XI, No. 3 (1969), pp. 11-24.
- A. Abouchar, "Air Transport Demand, Congestion Costs and the Theory of Optimum Airport Use", Canadian Journal of Economics, Vol. 3 (1970), pp. 463-475.
- R. Jackson, "Airport Noise and Congestion: A Peak Load Pricing Solution", Applied Economics, Vol. 3 (1971), pp. 197-203.
- I.M.D. Little and K.M. McLeod, "The New Pricing Policy of the British Airports Authority", Journal of Transport Economics and Policy, Vol. 6, No. 2 (1972), pp. 101-115.
- Robert R. Pipe, "Runway Congestion Cost Pricing Revisited", Transportation Journal, Vol. 13, No. 1 (1973), pp. 51-58.
- R. DeNeufville and L.J. Mira, "Optimal Pricing Policies for Air Transport Networks", Transportation Research, Vol. 8 (1974), pp. 181-192.
- P.F. Amos and G.N.T. Lack, "A Model for Evaluation of Peak Pricing of Transport Facilities", Paper presented to the 1st Australian Transport Research Forum, Sydney, April, 1975.

load pricing on Brisbane in isolation cannot be explicitly determined. Nevertheless, it is clear that should such policies be adopted their effect would be to postpone the necessity for increases in terminal, apron and runway capacities. As in the case of constraining general aviation movements, this will tend to favour strategy 7 (existing airport site) followed by strategy 2 over strategy 2 (new airport site).

6.6 FORECASTS AND CAPACITY

The discounted costs of strategies 2 (new airport site) and 7 (existing airport site) are dependent on the timing of construction. The timing of construction of each element in each strategy has in turn been based on forecasts of passenger and aircraft movements and of runway, apron and terminal capacity. Aircraft movement forecasts are dependent on assumptions about aircraft size and also rely on the underlying demand for air travel and the pricing policies expected in the future. Capacity criteria are no more certain. For example, the criterion used for annual runway capacity was that it would be reached once the average delay for all aircraft operations exceeded 4 minutes in the thirtieth busiest hour of the year. Any change in the assumptions regarding the capacity of facilities, or variation in the actual as opposed to forecast aircraft or passenger movements would alter the timing and hence, the discounted costs of strategies 2 and 7.

An alteration in the forecast capacity of particular airport facilities would have the same proportional effect on the discounted costs of strategies 2 or 7 as a change in expected aircraft and passenger movements. For example, in the case where runway capacity is the limiting factor on airport operations, the effect on relative costs of a 15 per cent increase in the forecast capacity of a runway would be the same as a 15 per cent reduction in the

forecast of aircraft movements. Therefore, the sensitivity of relative costs to either a change in the assumptions regarding capacity or in the expected aircraft and passenger movements at Brisbane can be seen by examining a change in either capacity or aircraft and passenger movements.

Strategy 2 (new airport site), in its initial development provides for all airport operations to commence on the Qc site in 1985. The lead time to construct some of these facilities has been estimated at 6 to 7 years. Consequently, for all facilities to be operational by 1985, construction would need to commence before 1979. Were a decision taken to adopt strategy 2 as the basis for the future development of Brisbane Airport, it would be unlikely that the additional 4 years data would result in much improvement in the estimate of 1985 traffic. Consequently, the expenditure required for site works and to develop the movement area in strategy 2 would be committed before any significant variation in traffic forecast could be identified. On the other hand the lead times required to construct the various facilities in strategy 7 (existing airport site) are such that if a significant shortfall or increase in airport activity were to be identified then the timing of the provision of facilities could be more readily changed than in the case of strategy 2. Therefore, shortfalls in forecast traffic would reduce the total discounted cost of strategy 7 more than strategy 2.

Apart from a lower discounted cost, one of the main advantages of a strategy such as 7, which would make use of existing facilities, would be to preserve flexibility and keep options open by delaying commitment to large capital works. Although not quantified, this is an advantage because of the probability of changes over the next 20 years, not only in patterns of demand but also in air transport technology.

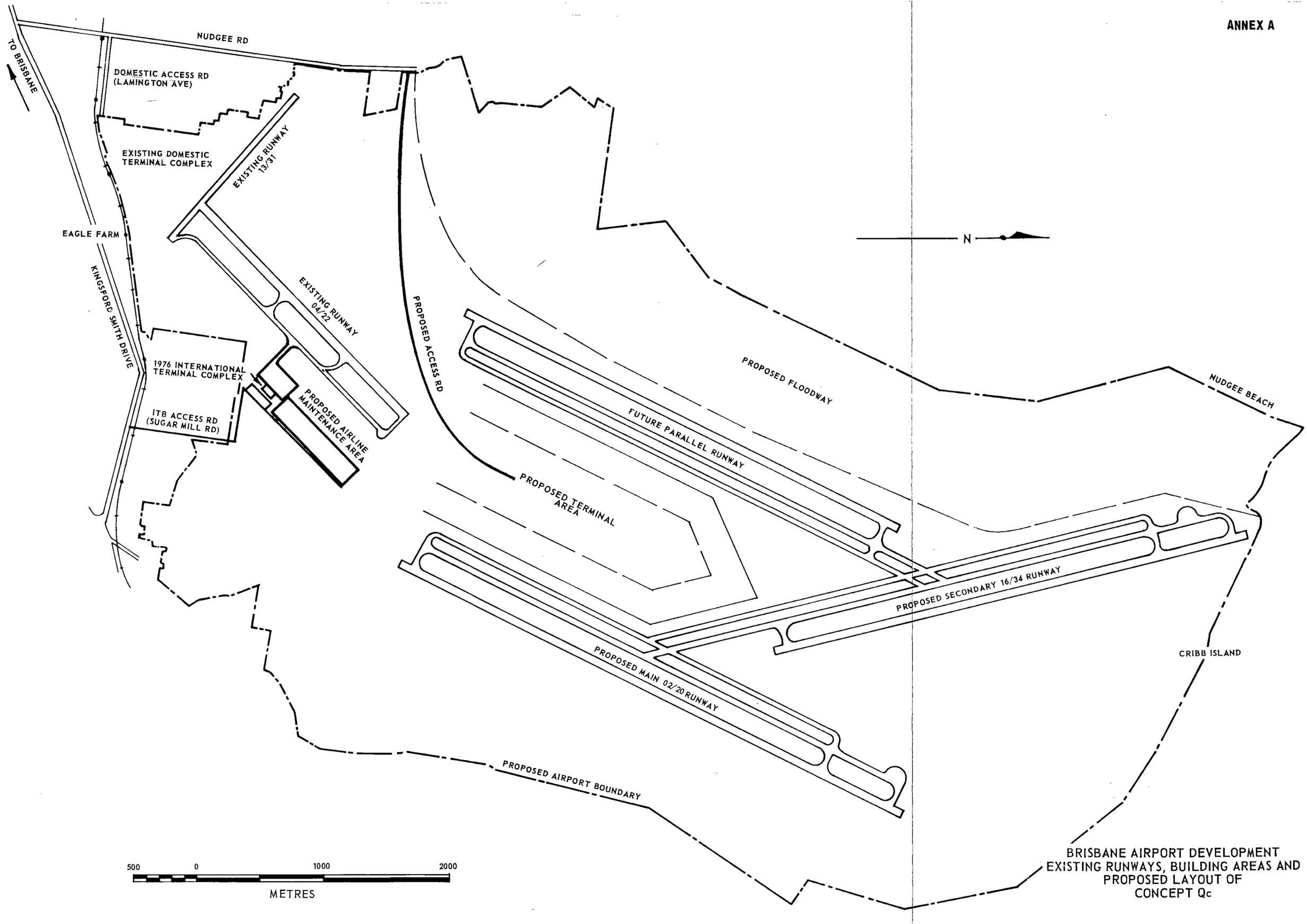
CHAPTER 7 CONCLUSION

The analysis outlined in this report is essentially based on minimising the discounted quantifiable costs of providing airport capacity for estimated annual aircraft and passenger demand. However, the cost differences are viewed in relation to the unquantified effects of the various airport development strategies. In some cases orders of magnitude of the costs of these effects have been estimated.

In general, the lowest cost strategies are those which keep the existing runway complex in use as long as possible. The existing runway complex, under a policy of restricting general aviation movements from about 1995 onwards has adequate capacity until about 2010. The quantifiable costs, in present value terms, of this type of strategy, including provision of all necessary terminal buildings etc, is some $18m less (at a 10 per cent discount rate) than the cost of providing a new airport north of the existing one by 1985. Retention of the existing runway complex also has the advantage of maintaining maximum flexibility for future planning in the likely event that forecasts of passenger demand and the technical aspects of air transport vary from those assumed.

The unquantified costs such as aircraft noise, which tend to favour an early move to the new site, must be set against the cost differential of staying on the existing site. However, it is unlikely that any reasonable estimate of such costs would reach even one quarter of the $18m calculated advantage of adopting a strategy which uses the existing runway complex.

ANNEX A



BRISBANE AIRPORT DEVELOPMENT
EXISTING RUNWAYS, BUILDING AREAS AND
PROPOSED LAYOUT OF
CONCEPT Qc

ANNEX B

EXISTING MAIN RUNWAY 04/22

EXISTING SECONDARY RUNWAY 13/31

N

GENERAL AVIATION AREA

NOTE: AIRCRAFT CLEARANCE SURFACES LIMIT BUILDING HEIGHTS AND AIRCRAFT PARKING LOCATIONS IN TERMINAL AREA

FUEL INSTALLATION

AAA TAA

AIRPORT BOUNDARY

AAA TERMINAL

CAR PARK

INTERNATIONAL TERMINAL

TAA TERMINAL

TAA TERMINAL BLG EXPANSION

AAA TERMINAL BLG. EXPANSION

CAR PARK

CLEARANCE SPLAY

AIRPORT BOUNDARY

PINKENBA BRANCH RAILWAY

CLEARANCE SPLAY

CAR PARK

EAGLE FARM

PROPOSED CAR PARK

VIOLET ST

AIRPORT ACCESS (LAMINGTON AVE)

KINGSFORD SMITH DRIVE

TO BRISBANE

NOTE: AIRCRAFT CLEARANCE SURFACES LIMIT BUILDING HEIGHTS AND AIRCRAFT PARKING LOCATIONS IN TERMINAL AREA

LEGEND

* BUILDINGS REQUIRING DEMOLITION FOR FUTURE DOMESTIC TERMINAL COMPLEX EXPANSION

FUTURE ADDITIONAL PAVEMENT

BRISBANE AIRPORT DEVELOPMENT
EXISTING DOMESTIC TERMINAL COMPLEX SCOPE FOR EXPANSION

100 0 100 200 300

METRES

ANNEX C

AIRCRAFT AND PASSENGER MOVEMENT FORECASTS

These forecasts, prepared explicitly for use in planning the redevelopment of Brisbane Airport, are based upon several assumptions which may be subject to change over time. They are also susceptible to uncertainty and errors in the data base. Therefore considerable care should be exercised in the interpretation and use of these forecasts, especially outside the context of this report.

C.1 DEFINITION

A passenger movement is defined as a passenger arriving or departing on an aircraft at the airport. A passenger in transit to another airport contributes two movements to the total. This definition is appropriate for use in forecasting aircraft movements (one aircraft movement is one aircraft arrival or one aircraft departure). For airport access studies, transit traffic is excluded.

C.2 DOMESTIC AND PAPUA NEW GUINEA SCHEDULED PASSENGER AND AIRCRAFT MOVEMENT FORECASTS

Both trend forecasting and aggregate econometric forecasting techniques were used in the examination of air travel demand at Brisbane Airport.

C.2.1 Passenger Movement Forecasts

C.2.1.1 Trend Forecasts

The general algebraic formula used in trend extrapolation is of the form:

$$y = f(t)$$

where y is the variable to be forecast, t represents a time sequence and f in the functional form. The functional form used is that which best represents the past trend in the dependent variable.

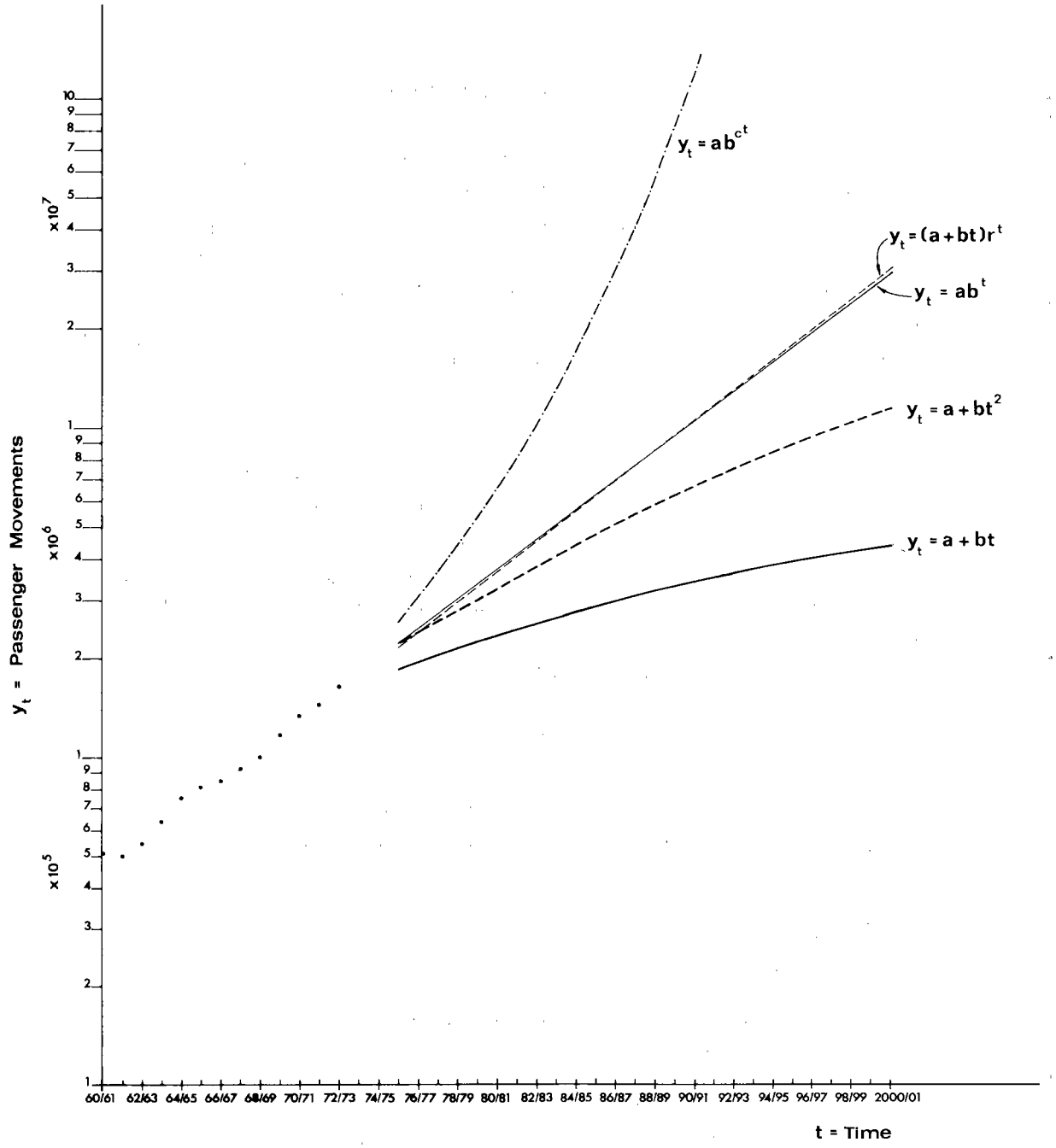


FIGURE C.1
TREND FORECASTS OF SCHEDULED AIRLINE PASSENGER MOVEMENTS AT BRISBANE AIRPORT

A time series of passenger movements at Brisbane Airport is given in Annex D. This series is actually an underestimate of passenger movements at the airport, the bias arising from the data collection methods employed. It is known that the bias increases with time, and that in 1972-73 the recorded statistic understated the true value by about 12 per cent.(1) However, the data available was inadequate to adjust the series appropriately.

Many alternative functional forms were estimated using the aggregate data to develop trend forecasts of passenger movements at Brisbane Airport.(2) Statistically, the models that had an inflexion point performed worse than others, and those that implied positive growth rates performed marginally better than the linear model. There were no statistical grounds for selecting one of the growth models in preference to another. The graph in Figure C.1 displays the long run trends implied by the various models estimated. As can be seen, the forecasts implied by "equally good" statistical models show a very wide range of future passenger movements. Thus it is clear that information other than historical data on passenger movements should be used in the forecasting procedure. As noted earlier this can be done in an informal way by modifying the trend forecasts by judgements concerning future economic and other forces. Alternatively, further information may be introduced explicitly into the estimating model.

---

(1) Department of Transport statistics of passenger movements at an airport record transit passengers only when a flight number change occurs at the airport. The number of flights through Brisbane Airport with the same flight number has been increasing over time. Thus the bias induced by this method of recording passenger movement statistics at Brisbane Airport has increased over time. The size of the bias in 1972-73 was estimated using TAA and AAA origin/destination data.

(2) Linear and non-linear regression methods were used as the estimating procedure.

C.2.1.2 Econometric Forecasting Models

These were developed on the basis of an analysis of aggregate airline passenger movements at all Australian airports over the period 1960-61 to 1972-73. Five major factors influencing the level of aggregate passenger movements through time were considered : real income and its distribution, changes in travel propensities within income classes; real air fares; population; and changes in the air network route structure. Changes in income distribution and route structure over time were not modelled explicitly because of data limitations. Thus changes in travel propensities within income classes through time had to be specified as class averages and changes to the route structure were assumed to continue as in the past. The latter assumption is not unreasonable since the airlines can be expected to use similar decision rules to change route structure in the future as they have in the past.

Many alternative models were hypothesised and estimated using quarterly data with total domestic airline revenue passenger movements per capita as the dependent variable. Autocorrelation was found to be significant so a Cochran-Orcutt transformation was included in the estimation procedure. The most appropriate model for forecasting aggregate airline revenue passenger movements in Australia was found to be:

$$\begin{aligned} ATC = &- 9.30 + 2.11\ GDP + 0.21\ RFI + 0.29 S_1 - 0.11\ S_2 \\ &\quad (19.8) \qquad (0.5) \qquad (15.4) \qquad (-5.2) \\ &+ 0.38\ S_3\ ,\ R^2 = 0.93, \quad (1) \\ &\quad (14.1) \end{aligned}$$

where,

$$ATC = \log_e ATC_t - 0.44 \log_e ATC_{t-1},$$

$$GDP = \log_e GDP_t - 0.44 \log_e GDP_{t-1},$$

$$RFI = \log_e RFI_t - 0.44 \log_e RFI_{t-1},$$

$$S_i = S_{i,t} - 0.44\ S_{i,\,t-1},\quad i = 1,3 \quad ,$$

---

(1) "t" values are shown in parentheses under the coefficient estimates.

and ATC is a quarterly time series of domestic airline revenue passenger movements per capita; GDP is a quarterly time series of real gross domestic product per capita; RFI is a quarterly real fares index; and $S_{i,t}$ = 1, 2, 3, is a seasonal dummy variable defined below:

Quarter	S_1	S_2	S_3
1	1	0	0
2	0	1	0
3	0	0	1
4	0	0	0

The fare coefficient in the selected equation was not significant due perhaps to the small variation in historical real fares. The equation did not provide a specific estimate of the effect of changing average travel propensities over time. Several models were specified to test this effect via the inclusion of a time trend variable but it was found to be highly collinear with income, thus creating estimation difficulties. The income coefficient was subsequently referred to as an "aggregate income elasticity".

Making use of the demand relationships reported above for forecasting aggregate demand was relatively straightforward. An examination of past data indicated that the ratio of passenger movements at Brisbane to aggregate Australian movements has remained reasonably constant. Assuming that this ratio remains constant, the next step was to forecast future levels of gross domestic product and the relevant population measure affecting demand at Brisbane Airport.

A constant growth rate function was used to extrapolate real income per head at the rate of 3.3 per cent per annum. The relevant population was assumed to comprise the population of the Brisbane statistical division plus one fifth of the population of the rest of Queensland. Constant

TABLE C.1 - ANNUAL DOMESTIC AND PAPUA NEW GUINEA SCHEDULED AIRLINE PASSENGER MOVEMENT FORECASTS FOR BRISBANE AIRPORT: ALTERNATIVE FORECASTING METHODS

Forecast Method	Year	Total Movements ('000)	95% Confidence Interval ('000)	Movements/ Capita
Actual	1972-73	1890.5	(a)	1.7
Econometric	1975-76	2450.9	(a)	2.1
	1980-81	3669.4	(a)	2.8
	1985-86	5366.1	(a)	3.7
	1990-91	7465.3	(a)	4.6
	2000-01	14282.4	(a)	7.1
Trend Extrapolation (constant growth model)	1975-76	2217.0	1976.0-2487.0	1.9
	1980-81	3732.0	3223.0-4324.0	2.8
	1985-86	6284.0	4727.0-6789.0	4.3
	1990-91	10581.0	8502.0-13174.0	6.5
	2000-01	29995.0	22248.0-40538.0	14.9

(a) Not calculated.

NOTE: The population projections are for calendar years.

TABLE C.2 - TREND FORECASTS OF REVENUE PASSENGER MOVEMENTS PER CAPITA AT CANBERRA AIRPORT

Year	Constant Growth Model	Linear Model
1975-76	4.6	4.4
1980-81	5.5	5.0
1985-86	6.6	5.7
1990-91	8.0	6.3
2000-01	11.5	7.5

growth rate functions were then used to forecast these populations, the Brisbane statistical division having displayed a growth rate of 2.3 per cent per annum, and the rest of Queensland 1.5 per cent per annum.

Given current trends in population growth this could be an over-estimate. It was assumed that real fares would remain at current levels as, although real costs of airline operation are increasing, airline operators are expected to continue to gain economies due to technological and marketing advances.

The forecasts given in Table C.1 were derived by combining the real gross domestic product and population forecasts with recorded data on airline revenue passenger movements at Brisbane Airport for 1972-73,(1) and the aggregate income elasticity estimate. Trend forecasts using the "constant growth" model are also included for comparative purposes.

C.2.1.3 Forecast Selection

To assist in the selection of the more appropriate of the two sets of forecasts, a comparison of per capita movements at Brisbane and other Australian airports was made.

The rates of growth in domestic revenue passenger movements per capita at Sydney, Melbourne and Brisbane Airports over the past decade have been similar, with Brisbane Airport displaying the highest level of movements per capita of these three. Canberra Airport on the other hand, had a lower rate of growth, but higher levels of movements per capita. The higher level of passenger movements per capita can be attributed to Canberra's unique characteristics. Accordingly movements per capita at this airport were considered to be an upper bound to movements at other capital city airports. Two trend forecasts of revenue passenger movements per capita at Canberra Airport were subsequently prepared. These are presented in Table C.2. The results suggest that the

(1) Aggregate movements at Brisbane Airport include transit passengers.

econometric forecasts for Brisbane Airport are preferable to those based on trend extrapolation.

Finally, several overseas studies of demand for air travel were reviewed. In the studies cited (1), all but the London Study dealt with aggregate demand by country rather than airport. The econometric model estimates for total Australian demand gave an aggregate income elasticity of +2.11 which was within the range of estimates reported in overseas studies. The demand functions in the overseas studies cited used revenue passenger miles as a dependent variable rather than revenue passenger movements. The former variable allows for variations in both total trips made and their length, as against total trips made. The Douglas Aircraft Company model estimated the income elasticity for aggregate U.S. air travel demand at 1.96. Lave reported income elasticities estimated by various researchers into U.S. air travel demand in the range .38 to 3.24. The P.E. Consultants' study of N.Z. air travel reported an income elasticity of 1.3. All these studies estimated a significant price elasticity of demand for air travel, which was not the case in this study.

C.2.1.4 Route Stratification and Forecasts

Before presenting the forecasts in final form, an indication of traffic density on particular routes in the network is required.

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(1) . Y.G. Aureille and C.T. Norris, Long-Term Forecasting Models of the U.S. Domestic and International Traffic and Forecasts to 1980 (Douglas Aircraft Company, 1972), Report No. CI-8-5-2741.
. Commission of the Third London Airport, Papers and Proceedings (London: HMSO, 1970), Volume VII.
. R.C. Fordham, "Airport Planning of the Third London Airport", The Economic Journal, Vol.LXXX, No.318 (June 1970), pp.307-322.
. L.B. Lave, "The Demand for Intercity Passenger Transportation", Journal of Regional Science, Vol.12, No.2 (April 1972), pp.71-84.
. P.E. Consultants, Review of Operations: New Zealand NAC (1973).
. Peat, Marwick, Livingston & Co, National Intercity Travel; Development and Implementation of a Demand Forecasting Framework (Springfield, Va:NTIS, 1970).

Four general routes were delineated and Brisbane Airport passenger movements were apportioned to each of these routes by projecting historical route shares using TAA origin/destination data for several years in the past decade. The passenger movement forecasts for each route are shown in Table 2.1 (Chapter 2).

C.2.2 Aircraft Movement Forecasts

In developing aircraft movement forecasts from passenger movement forecasts, the following factors were considered:

- the type of aircraft likely to operate on each route at any point of time;
- minimum acceptable daily frequencies on each route;
- the fleet size;
- acceptable average load factors on each route;
- future development of the route structure.

Consideration of the aircraft types likely to operate on each route required a further stratification of the route structure. The final route structure, and the aircraft types assumed to be operated on each of these routes over the forecast period are shown in Table C.3.(1)

Minimum average daily frequencies on each route was assumed to be those currently operating and it was assumed that they would not fall below these levels. These were taken from TAA and AAA timetables effective from 20 October, 1973. Maximum average load factors on the major routes were assumed to lie between 65 and 70 per cent. On the western route the maximum load factor was assumed to be 60 per cent.

---

(1) The aircraft types assumed for use on the routes defined are comparable to those used by the Sydney Airport Study Group.

TABLE C.3 - AIRCRAFT TYPE ASSUMED FOR OPERATION ON EACH ROUTE

Year	Domestic(a)					Papua New Guinea
	South	North 1	North 2	North 3	West	
1975-76	5,7	6,7	2	2,5	1,2	7
1980-81	5,8	6,7	2	5	1,2	7
1985-86	8	7,8	3	5,7	1,2	7,8
1990-91	8,9	7,8	3	7	2	8
2000-01	11,12	10,11	4	10,11	2	10,11

(a) Domestic routes are defined as follows: South: interstate routes between Brisbane and southern centres; North 1: Brisbane-Mt Isa-Darwin route; North 2: Brisbane-Maryborough-Bundaberg-Gladstone route; North 3: Brisbane to other northern coastal ports; West: intrastate routes between Brisbane and western ports.

KEY TO AIRCRAFT TYPE

1. Twin Otter
2. F27
3. F27-500
4. 80 seat aircraft
5. DC-9
6. B727-100
7. B727-200
8. Airbus (240 seats)
9. Airbus (280 seats)
10. 200 seat aircraft
11. 350 seat aircraft
12. 700 seat aircraft

The size and composition of the fleet required to service the demand for air services at Brisbane Airport was not considered explicitly in this Study. Such an analysis would require an examination of the composition and size of fleets required to service air travel demand over the total Australian air network because of aircraft utilisation, substitutability, and replacement considerations. A check was made to ensure that the assumed fleet size required to service Brisbane Airport passenger movement demand was consistent with expected developments.

It was recognised that some route development affecting aircraft and passenger movements at Brisbane Airport could take place over the forecast period. The routes that would be most affected are those between Brisbane and Papua New Guinea, and between Brisbane and the northern ports. In the former case, it is quite likely that direct flights between Sydney and Papua New Guinea, Townsville and Cairns will be introduced in the 1980's. This will tend to reduce aircraft movements at Brisbane. The structure on other routes will be altered as demand on particular links increases, however these changes should only have a small effect on movements at Brisbane Airport.

Using the above information and assumptions, it is possible to derive a large number of aircraft movement forecasts. However, upper and lower limits are set by the type of aircraft and minimum frequency assumptions. The assumptions regarding aircraft types are set out in Table C.3. The resulting upper and lower bounds of aircraft movements are presented in Table C.4. It should be noted that the 1975-76 forecasts coincide with the minimum daily frequency of service in October 1973.

A compromise projection of aircraft movements was arrived at by combining an average rate of introduction of large aircraft with a medium frequency of service. Such a projection is presented in Table 2.2. (Chapter 2). Tables

TABLE C.4 - MAXIMUM AND MINIMUM AIRCRAFT MOVEMENT FORECASTS FOR BRISBANE AIRPORT[a]

('000)

Year	Domestic[b]				Papua New Guinea		Total	
	South		North		West			
1975-76	16.3	-20.4	14.6	-14.8	1.6	-1.7	1.4	-1.5	33.9	-38.4
1980-81	16.3	-20.4	20.8	-21.1	1.6	-1.8	2.0	-2.1	40.7	-45.4
1985-86	20.4	-20.7	23.1	-28.9	1.6	-1.8	2.1	-2.5	47.2	-53.9
1990-91	24.9	-29.0	31.7	-33.3	1.8	-1.9	2.5	-2.5	60.9	-66.6
2000-01	24.9	-38.5	35.6	-45.6	2.5	-2.5	2.9	-5.1	65.9	-91.7

(a) An aircraft movement is an aircraft landing or take off.

(b) Domestic routes are defined as follows:
South: interstate routes between Brisbane and southern centres;
North: Brisbane-Mt Isa-Darwin, and Brisbane-Cairns routes;
West: intrastate routes between Brisbane and western ports.

C.5 and C.6 provide the information on service frequencies and aircraft usage from which Table 2.2 was drawn up. Table C.7 contains the number of passengers per aircraft implied by the assumptions.

C.3 OTHER USER DEMAND FORECASTS

The forecasts provided in this section were prepared by the then Department of Civil Aviation in December 1972. They include projections of international, commuter, military and non-scheduled aircraft movements.

The forecasts of international traffic exclude traffic between Australia and Papua New Guinea. The latter has been classified as part of the domestic travel because of current statistical collection procedures. International and commuter passenger forecasts appear in Table C.8 whilst the corresponding aircraft movements are presented in Table C.9. The forecasts of commuter traffic also include flights by charter operators following a fixed timetable under an exemption from Air Navigation Regulation 203.

Military aircraft movements in Table C.10 cover both fixed wing and helicopter movements by Australian and overseas military aircraft. Non-scheduled aircraft movements in Table C.10 include airline charter operations (as opposed to fixed timetable charters) both domestic and international, flying training, positioning flights and non-military helicopter flights.

Finally, forecasts of annual freight carried on scheduled services are summarised in Table C.11. These forecasts refer to freight embarked/disembarked on scheduled services by mixed configuration and pure freighter aircraft. They do not include freight carried on charter aircraft. Forecasts of annual freight carried on scheduled services have been used in calculating access costs for alternative development strategies.

The aircraft movement forecasts described in this Annex are brought together in Table 2.6 (Chapter 2).

TABLE C.5 - FORECAST SERVICE FREQUENCY ON DOMESTIC AND PAPUA NEW GUINEA AIRLINE ROUTES THROUGH BRISBANE[a]

(aircraft/day)

Year	Domestic[b]					Papua New Guinea
	South	North 1	North 2	North 3	West	
1975-76	24	2	7	$11\frac{1}{7}$	$2\frac{2}{7}$	2
1980-81	26	$2\frac{2}{7}$	$9\frac{2}{7}$	17	$2\frac{2}{7}$	$2\frac{6}{7}$
1985-86	28	$2\frac{6}{7}$	$11\frac{4}{7}$	20	$2\frac{4}{7}$	3
1990-91	36	$3\frac{3}{7}$	16	24	$2\frac{5}{7}$	$3\frac{3}{7}$
2000-01	36	$4\frac{2}{7}$	20	26	$3\frac{5}{7}$	4

(a) Does not include East-West Airlines operations through Brisbane Airport.

(b) Domestic routes are defined as follows: South: interstate routes between Brisbane and southern centres; North 1: Brisbane-Mt Isa-Darwin route; North 2: Brisbane-Maryborough-Bundaberg-Gladstone route; North 3: Brisbane to other northern coastal ports; West: intrastate routes between Brisbane and western ports.

TABLE C.6 - FORECAST DOMESTIC AND PAPUA NEW GUINEA SCHEDULED AIRLINE FLIGHTS AT BRISBANE AIRPORT

Route	Weekly flights x aircraft type Load factor %				
	1975-76	1980-81	1985-86	1990-91	2000-01
South	112x5+56x7	98x5+84x8	196x8	84x8+168x9	140x11+112x12
	68	68	66	65	66
North 1	14x6	16x7	15x7+5x8	8x7+16x8	14x8+16x11
	58	65	66	64	68
North 2	49x2	65x2	81x3	112x3	140x4
	58	66	65	66	65
North 3	78x5	119x5	70x5+70x7	168x7	133x8+63x11
	66	65	67	66	66
West	11x1+5x2	5x1+11x2	18x2	19x2	26x2
	60	60	59	60	60
Papua New Guinea	14x7	20x7	7x7+14x8	24x8	28x11
	64	64	62	63	64

NOTE: The aircraft type codes and route definitions are given at Table C.3.

TABLE C.7 - FORECAST AVERAGE PASSENGERS PER AIRCRAFT AT BRISBANE AIRPORT

Year	Domestic		Papua New Guinea
	South	North and West	
1975-76	89.2	51.8	97.3
1980-81	116.0	56.2	96.7
1985-86	158.3	68.3	129.9
1990-91	172.4	75.8	152.3
2000-01	333.7	123.2	225.0

Source: Derived from Tables 2.1 and 2.2.

TABLE C.8 - ANNUAL INTERNATIONAL AND COMMUTER PASSENGER MOVEMENT FORECASTS FOR BRISBANE AIRPORT (a)

('000)

Year	International Airline			Commuter
	Trans-Tasman	Other	Total	
1975-76	62	28	90	9
1980-81	100	45	145	13
1985-86	160	70	230	17
1990-91	280	120	400	23
2000-01	854	353	1,207	42

(a) The forecasts to the year 1990-91 were made by the then Department of Civil Aviation, December, 1972. Forecasts for the year 2000-01 were derived by extrapolation.

TABLE C.9 - ANNUAL INTERNATIONAL AND COMMUTER AIRCRAFT MOVEMENT FORECASTS FOR BRISBANE AIRPORT (a)

Year	International Airline			Commuter
	Trans-Tasman	Other	Total	
1975-76	700	1,600	2,300	2,700
1980-81	1,000	2,100	3,100	3,000
1985-86	1,500	2,500	4,000	3,500
1990-91	2,100	3,500	5,600	4,000
2000-01	4,100	6,800	11,100	9,700

(a) The forecasts to the year 1990-91 were made by the then Department of Civil Aviation, December, 1972. Forecasts for the year 2000-01 were derived by extrapolation.

TABLE C. 10 - ANNUAL NON-SCHEDULED AND MILITARY AIRCRAFT MOVEMENT FORECASTS FOR BRISBANE AIRPORT(a)

Year	Non-Scheduled Aircraft (including general aviation)	Military Aircraft
1975-76	30,900	2,700
1980-81	42,800	3,600
1985-86	55,400	4,600
1990-91	71,400	5,800
2000-01	118,600	9,300

(a) The forecasts to the year 1990-91 were made by the then Department of Civil Aviation, December, 1972. Forecasts for the year 2000-01 were derived by extrapolation. No allowance has been made for possible diversion of general aviation movements from Brisbane Airport.

TABLE C.11 - FORECAST ANNUAL FREIGHT CARRIED ON SCHEDULED SERVICES : BRISBANE AIRPORT[a]

('000 tonnes)

Year	International Airline	Domestic Airline	Total Airline	Commuter
1975-76	0.82	26.64	27.45	0.02
1980-81	1.36	37.18	38.55	0.03
1985-86	2.00	50.09	52.09	0.04
1990-91	3.09	70.09	73.18	0.05
2000-01	7.41	148.59	156.00	0.08

(a) The forecasts to the year 1990-91 were made by the then Department of Civil Aviation, December, 1972. Forecasts for the year 2000-01 were derived by extrapolation. The forecasts are for revenue freight embarked/disembarked on scheduled services by mixed configuration and pure freighter aircraft. Freight carried on charter aircraft is not included.

ANNEX D

HISTORICAL TIME SERIES DATA FOR BRISBANE AIRPORT

The following tables give statistics of:

(i) annual revenue passenger movements at Brisbane Airport for the period 1960-61 to 1972-73;

(ii) annual civil and military aircraft movements at Brisbane Airport for the period 1960-61 to 1972-73; and

(iii) origin/destination data for passengers arriving at, and departing from Brisbane Airport for the years 1962-63, 1966-67 and 1972-73.

The data sources from which these tables were derived are shown at the foot of each table.

TABLE D.1 - ANNUAL REVENUE PASSENGER MOVEMENTS AT BRISBANE AIRPORT, 1960-61 to 1972-73

Year	Airline		Commuter[a]
	International	Domestic	
1960-61	5.4	514.2	-
1961-62	5.7	506.6	-
1962-63	9.2	548.0	-
1963-64	15.3	640.1	-
1964-65	21.5	754.6	-
1965-66	25.7	814.1	-
1966-67	34.2	854.4	-
1967-68	38.1	927.7	2.5
1968-69	40.4	1,009.1	2.7
1969-70	48.8	1,184.9	6.5
1970-71	52.9	1,347.1	3.6
1971-72	61.7	1,450.1	7.8
1972-73		1,658.0	11.1

(a) Commuter services at Brisbane Airport commenced in 1967-68.

Source: Air Transport Policy Division, Department of Transport.

TABLE D.2 - ANNUAL AIRCRAFT MOVEMENTS AT BRISBANE AIRPORT, 1960-61 TO 1972-73

('000)

Year	Civil					Military
	Airline Scheduled		Commuter	Heavy Non-scheduled(a)	Total	
	International	Domestic				
1960-61	.3	19.0	-	12.0	31.2	.1
1961-62	.3	18.2	-	5.5	24.0	.1
1962-63	.4	19.2	-	5.9	25.5	.2
1963-64	.8	21.2	-	10.8	32.8	.3
1964-65	.9	25.3	-	9.4	35.6	.5
1965-66	.9	25.9	-	13.0	39.8	.8
1966-67	1.3	25.2	-	12.2	38.7	1.1
1967-68	1.5	24.1	1.1	12.2	38.8	1.3
1968-69	1.4	26.5	1.2	14.0	43.1	1.9
1969-70	1.5	28.6	2.3	13.5	45.9	2.4
1970-71	1.6	31.3	1.1	11.5	45.6	1.5
1971-72	1.7	31.7	2.6	7.6	43.6	1.7
1972-73	1.8	34.5	3.7	6.2	46.1	1.4

(a) Heavy non-scheduled movements are defined as non-scheduled movement of aircraft which exceed 5700 Kg. in weight.

Source: Air Transport Policy Division, Department of Transport.

TABLE D.3 - TAA PASSENGER TRAFFIC THROUGH BRISBANE AIRPORT, 1962-63[a]

('000)

Routes	Brisbane Generated Traffic		Other Traffic		Total Passenger Movements
	In	Out	In	Out	
South -					
Capital Cities	65.0	65.8	10.4	9.8	151.0
Coolangatta and Newcastle	1.2	1.3	0.4	0.4	3.3
North -					
Queensland Coast	28.4	27.1	8.6	8.5	72.6
Mt Isa and Darwin	1.3	1.3	1.5	1.8	5.9
West -					
Internal Queensland	14.5	13.5	0.5	0.9	29.4
Total Passengers					
Into Brisbane	110.4	-	21.4	-	131.8
From Brisbane	-	109.0	-	21.4	130.4
TOTAL	219.4		42.8		262.2

(a) Figures have been derived from analysis of TAA origin and destination statistics of journeys completed on a single day, compiled on the assumption that Brisbane handles two-thirds of the traffic between Sydney and Darwin and one-third of the traffic between Darwin and Melbourne. Excludes traffic between Australia and Papua New Guinea.

TABLE D.4 - TAA PASSENGER TRAFFIC THROUGH BRISBANE AIRPORT, 1966-67[a]

('000)

Routes	Brisbane Generated Traffic		Other Traffic		Total Passenger Movements
	In	Out	In	Out	
South -					
Capital Cities	104.9	101.5	19.8	19.5	245.7
Coolangatta and Newcastle	2.0	2.6	0.6	0.5	5.7
North -					
Queensland Coast	43.3	44.6	16.0	16.1	120.0
Mt Isa and Darwin	5.8	5.8	3.0	3.1	17.7
West -					
Internal Queensland	10.7	10.6	1.2	1.4	23.9
Total Passengers					
Into Brisbane	166.7	-	40.6	-	207.3
From Brisbane	-	165.1	-	40.6	205.7
TOTAL	331.8		81.2		413.0

(a) Figures have been derived from analysis of TAA origin and destination statistics of journeys completed on a single day, compiled on the assumption that Brisbane handles two-thirds of the traffic between Sydney and Darwin and one-third of the traffic between Darwin and Melbourne. Excludes traffic between Australia and Papua New Guinea.

TABLE D.5 - TAA PASSENGER TRAFFIC THROUGH BRISBANE AIRPORT, 1972-73[a]

('000)

Routes	Brisbane Generated Traffic		Other Traffic		Total Passenger Movements
	In	Out	In	Out	
South -					
Capital Cities	196.5	195.1	58.0	59.6	509.1
Coolangatta and Newcastle	2.9	3.6	-	-	6.5
North -					
Queensland Coast	85.7	84.9	33.7	35.0	239.3
Papua New Guinea	10.9	11.7	18.5	16.1	57.3
Mt Isa and Darwin	11.0	11.6	5.8	5.7	34.0
West -					
Internal Queensland	6.1	5.6	2.0	1.6	15.2
Total Passengers					
Into Brisbane	313.1	-	118.0	-	431.1
From Brisbane	-	213.4	-	118.0	430.3
TOTAL	625.5		236.0		861.4

(a) Figures have been derived from an analysis of TAA origin and destination statistics of journeys completed during a single day. Excluded movements between all city pairs which recorded fewer than 300 journeys in 1972-73. Compiled on the following assumptions:
(1) All traffic between Papua New Guinea and southern capitals passes through Brisbane. (This results in some overstatements.)
(2) Two-thirds of the traffic between Sydney and Darwin passes through Brisbane.
(3) One-third of traffic between Melbourne and Darwin passes through Brisbane.

NOTE: Figures may not add due to rounding.

TABLE D.6 - SCHEDULED PUBLIC AIR SERVICES: PASSENGER TRAFFIC THROUGH BRISBANE AIRPORT, 1972-73[a]

('000)

Routes	Brisbane Generated Traffic		Other Traffic		Total Passenger Movements
	In	Out	In	Out	
South -					
Direct with capital cities	446.1	423.6	115.3	130.3	1,115.3
Other	2.0	2.2	-	-	4.2
North -					
Queensland Coast	205.4	200.5	74.2	65.8	545.9
Papua New Guinea	23.7	19.9	38.2	29.2	111.0
Mt Isa and Darwin	21.3	26.7	15.4	21.5	84.9
West -					
Internal Queensland	8.4	10.6	1.4	1.8	22.2
Local -					
Within Moreton Region	3.4	3.6	-	-	7.0
Total Passengers					
Into Brisbane	710.3	-	244.5	-	954.8
From Brisbane	-	687.1	-	248.6	935.7
TOTAL	1,397.4		493.1		1,890.5

(a) Figures have been compiled from an analysis of regional origin and destination estimates undertaken within the Department of Transport.

ANNEX E

LAYOUT PLANS AND TIMING

OF CONSTRUCTION OF

STRATEGIES 1 TO 8

STRATEGY 1

(NEW AIRPORT SITE)

TABLE E.1 - BRISBANE AIRPORT DEVELOPMENT - TIMING OF STRATEGY 1

Activity Number	Activity	Year Completed	Construction Time (years)
1	Construct fillets to 04/22 runway	Late 75	1.0
2	Expand 1976 international terminal	Mid 80	1.0
3	Upgrade TAA terminal	Mid 81	6.0
4	Upgrade AAA terminal	Mid 81	7.0
5	Maintain 04/22 runway	End 74	0.5
6	Site works AAA maintenance base	Late 75	1.0
7	Site works TAA maintenance base	Late 75	1.0
8	Construct AAA maintenance base	Late 77	2.0
9	Construct TAA maintenance base	Late 77	2.0
10	Enlarge car parks, roads and services	Mid 78	0.5
11	Enlarge aprons 1978	Mid 78	0.5
12	Enlarge aprons 1981	Mid 81	0.5
13	Site works TAA terminal (including apron)	Late 83)	
14	Site works AAA terminal (including apron)	Late 83)	4.5
15	Site works international terminal (including apron)	Late 83)	
16	Site works 02/20 runway	End 82	2.75
17	Construct 02/20 runway	Mid 84	1.75
18	Construct international terminal (including apron)	Early 85	3.0
19	Construct AAA terminal (including apron)	Early 85	3.0
20	Construct TAA terminal (including apron)	Early 85	3.0
21	Site works primary services	Mid 83	1.25
22	Expand aprons to 1995 requirement	Late 90	1.0
23	Site works ground facilities	End 82	2.75
24	Fuel facility including hydrants	Mid 85	1.75
25	Construct ground facilities	Mid 84	2.5
26	Construct primary services	Early 84	1.0
27	Equip ground facilities	Mid 85	2.0
28	Site works 16/34 runway	Early 84	2.5
29	Construct 16/34 runway	Early 85	1.25
30	Expand airlines maintenance area	Mid 92	1.0
31	Expand terminals and aprons to 2000 requirement	Mid 95	5.0
32	Siteworks and services general aviation facilities	Late 83	1.25
33	Construct general aviation facilities	Early 85	1.5
34	Maintain 04/22 runway and taxiways	Mid 80	0.5
35	Enlarge car parks, roads and services	Mid 82	1.0

ANNEX E

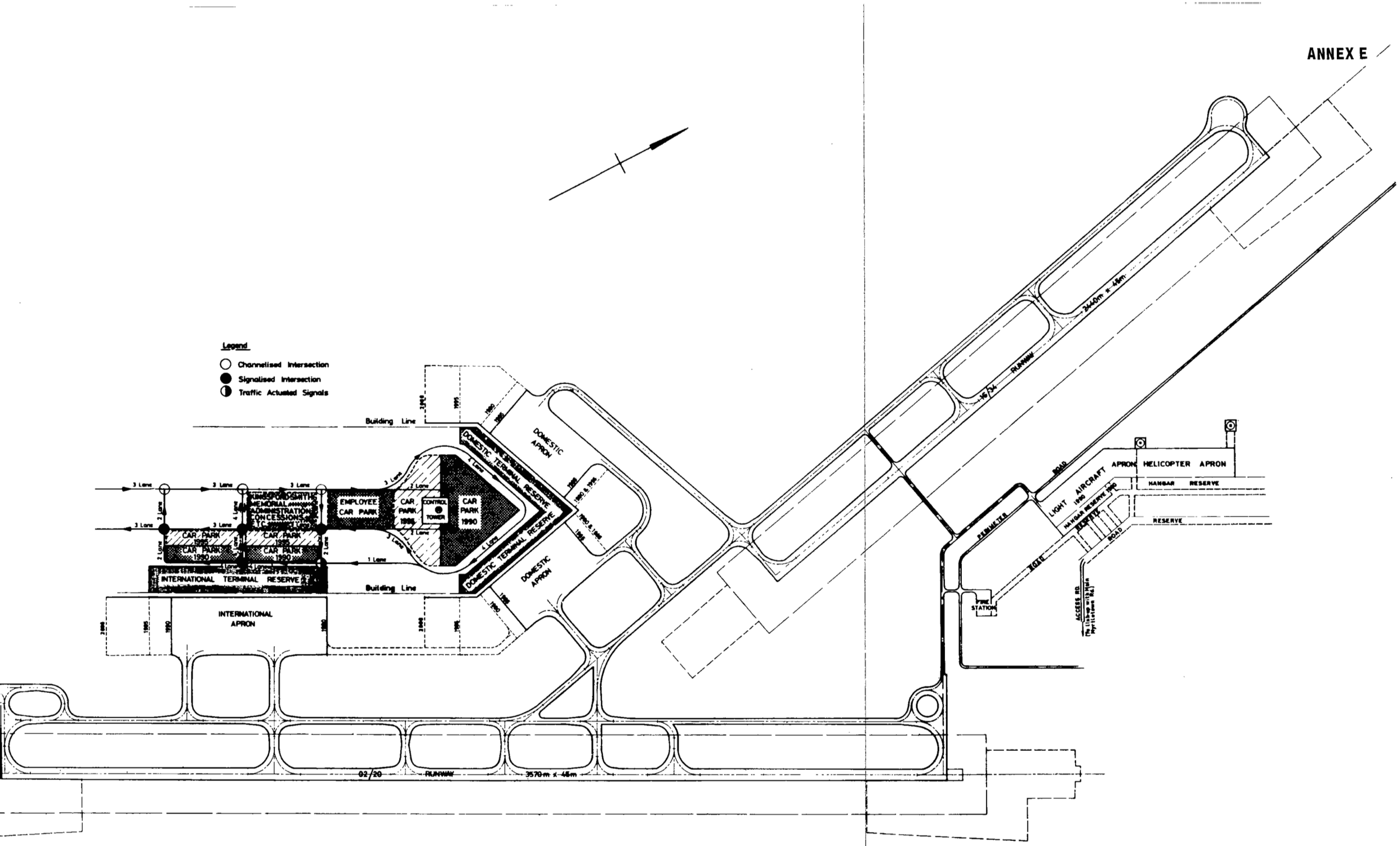

FIGURE E.1

BRISBANE AIRPORT DEVELOPMENT
LAYOUT PLAN FOR
STRATEGY 1

STRATEGY 2

(NEW AIRPORT SITE)

TABLE E.2 - BRISBANE AIRPORT DEVELOPMENT - TIMING OF STRATEGY 2

Activity Number	Activity	Year Completed	Construction Time (years)
1	Construct fillets to 04/22 runway	Late 75	1.0
2	Expand 1976 international terminal	Mid 80	1.0
3	Upgrade TAA terminal	Mid 81	6.0
4	Upgrade AAA terminal	Mid 81	7.0
5	Maintain 04/22 runway	End 74	0.5
6	Site works AAA maintenance base	Late 75	1.0
7	Site works TAA maintenance base	Late 75	1.0
8	Construct AAA maintenance base	Late 77	2.0
9	Construct TAA maintenance base	Late 77	2.0
10	Enlarge car parks, roads and services	Mid 78	0.5
11	Enlarge aprons 1978	Mid 78	0.5
12	Enlarge aprons 1981	Mid 81	0.5
13	Site works TAA terminal (including apron)	Late 83)	
14	Site works AAA terminal (including apron)	Late 83)	4.5
15	Site works international terminal (including apron)	Late 83)	
16	Site works 02/20 runway	Late 83	3.5
17	Construct 02/20 runway	End 84	1.75
18	Construct international terminal (including apron)	Early 85	3.0
19	Construct AAA terminal (including apron)	Early 85	3.0
20	Construct TAA terminal (including apron)	Early 85	3.0
21	Site works primary services	Mid 83	1.25
22	Expand aprons to 1995 requirement	Late 90	1.0
23	Site works ground facilities	End 82	2.75
24	Fuel facility including hydrants	Mid 85	1.75
25	Construct ground facilities	Mid 84	2.5
26	Construct primary services	Early 84	1.0
27	Equip ground facilities	Mid 85	2.0
28	Site works 16/34 runway (F27)	Early 84	2.25
29	Construct 16/34 runway (F27)	End 84	0.75
30	Expand airlines maintenance area	Mid 92	1.0
31	Expand terminals and aprons to 2000 requirement	Mid 95	5.0
32	Siteworks and services general aviation facilities	Late 83	1.25
33	Construct general aviation facilities	Early 85	1.5
34	Maintain 04/22 runway and taxiways	Mid 80	0.5
35	Enlarge car parks, roads and services	Mid 82	1.0

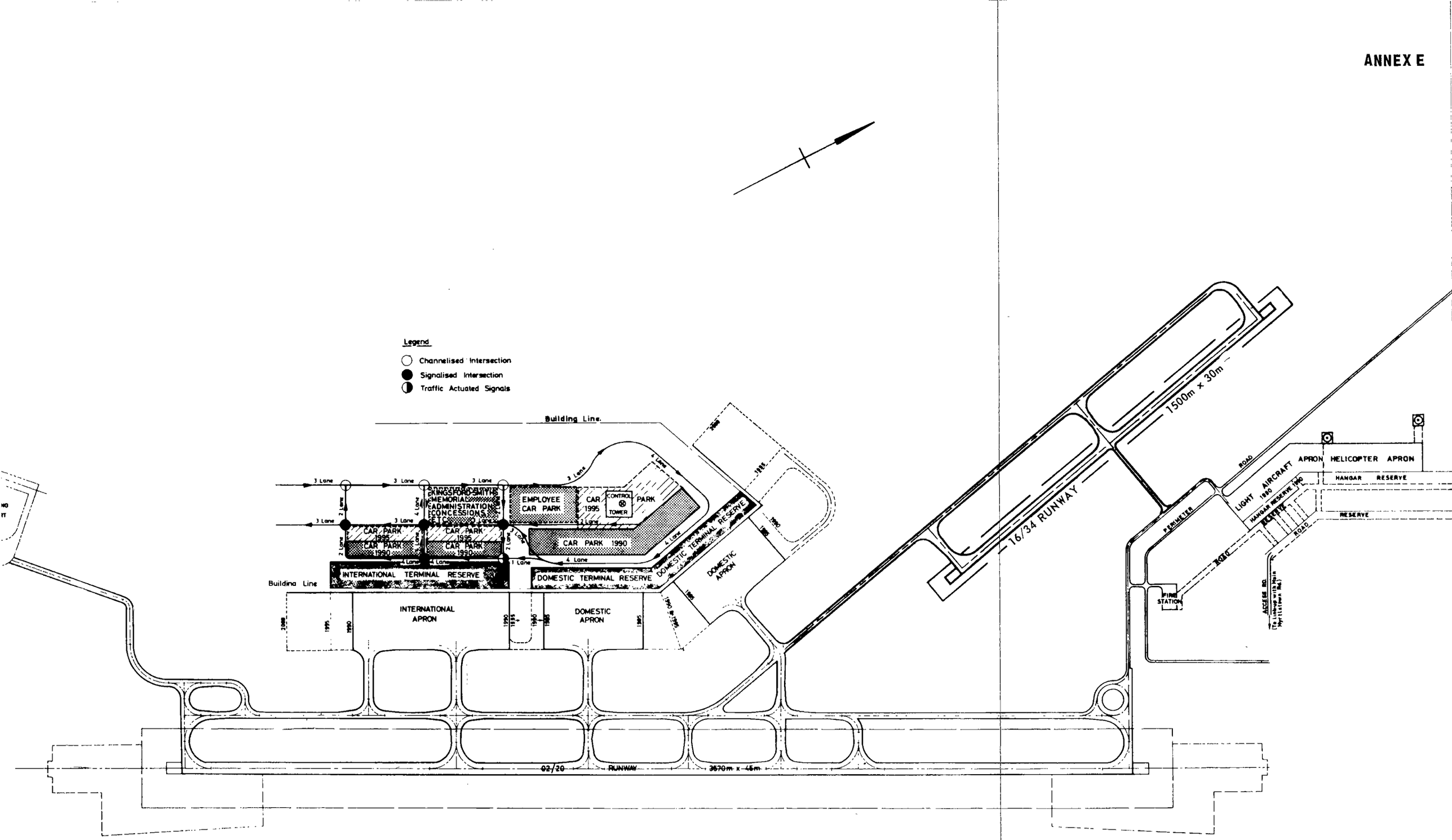

FIGURE E.2

BRISBANE AIRPORT DEVELOPMENT
LAYOUT PLAN FOR
STRATEGY 2

STRATEGY 3

(NEW AIRPORT SITE)

TABLE E.3 - BRISBANE AIRPORT DEVELOPMENT - TIMING OF STRATEGY 3

Activity Number	Activity	Year Completed	Construction Time (years)
1	Construct fillets to 04/22 runway	Late 75	1.0
2	Expand 1976 international terminal	Mid 80	1.0
3	Upgrade TAA terminal	Mid 81	6.0
4	Upgrade AAA terminal	Mid 81	7.0
5	Maintain 04/22 runway	End 74	0.5
6	Site works AAA maintenance base	Late 75	1.0
7	Site works TAA maintenance base	Late 75	1.0
8	Construct AAA maintenance base	Late 77	2.0
9	Construct TAA maintenance base	Late 77	2.0
10	Enlarge car parks, roads and services	Mid 78	0.5
11	Enlarge aprons 1978	Mid 78	0.5
12	Enlarge aprons 1981	Mid 81	0.5
13	Site works TAA terminal (including apron)	Late 83)	
14	Site works AAA terminal (including apron)	Late 83)	4.5
15	Site works international terminal (including apron)	Late 83)	
16	Site works 02/20 runway	Late 83	3.5
17	Construct 02/20 runway	End 84	1.75
18	Construct international terminal (including apron)	Early 85	3.0
19	Construct AAA terminal (including apron)	Early 85	3.0
20	Construct TAA terminal (including apron)	Early 85	3.0
21	Site works primary services	Mid 83	1.25
22	Expand aprons to 1995 requirement	Late 90	1.0
23	Site works ground facilities	End 82	2.75
24	Fuel facility including hydrants	Mid 85	1.75
25	Construct ground facilities	Mid 84	2.5
26	Construct primary services	Early 84	1.0
27	Equip ground facilities	Mid 85	2.0
28	Expand airlines maintenance area	Mid 92	1.0
29	Expand terminals and aprons to 2000 requirement	Mid 95	5.0
30	Siteworks and services general aviation facilities	Late 83	1.25
31	Construct general aviation facilities	Early 85	1.5
32	Maintain 04/22 runway and taxiways	Mid 80	0.5
33	Enlarge car parks, roads and services	Mid 82	1.0

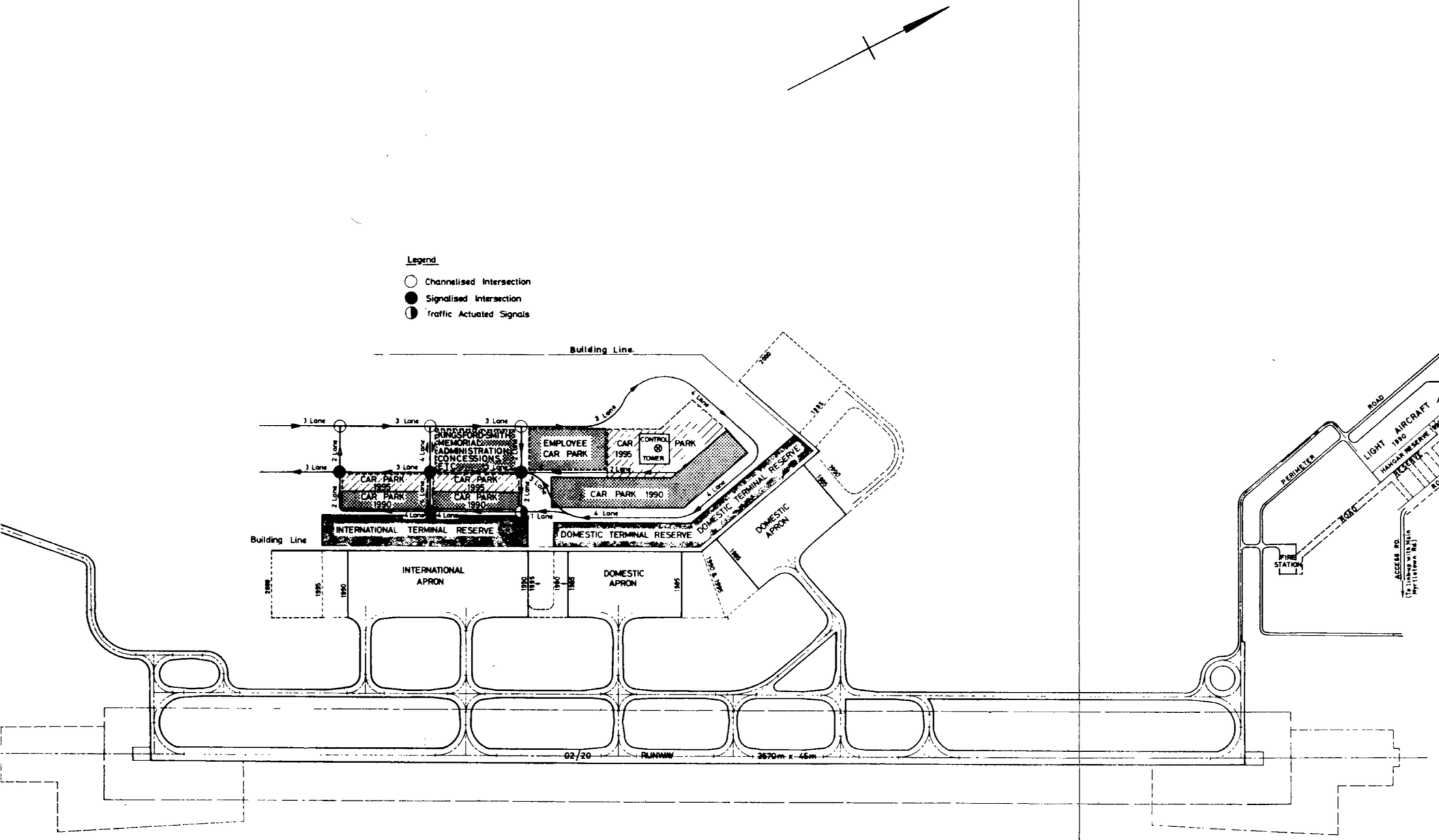

FIGURE E.3

BRISBANE AIRPORT DEVELOPMENT
LAYOUT PLAN FOR
STRATEGY 3

STRATEGY 4

(EXISTING AIRPORT SITE)

TABLE E.4 - BRISBANE AIRPORT DEVELOPMENT - TIMING FOR STRATEGY 4

Activity Number	Activity	Year Completed	Construction Time (years)
1	Maintain 04/22 runway	End 74	0.5
2	Siteworks and services AAA maintenance base	Late 75	1.0
3	Site works and services TAA maintenance base	Late 75	1.0
4	Fuel facility including hydrants	Mid 85	1.75
5	Fillets to 04/22 runway	Late 75	1.0
6	Construct AAA maintenance base	Late 77	2.0
7	Construct TAA maintenance base	Late 77	2.0
8	Enlarge aprons ext. blg. area (1978)	Mid 78	0.5
9	Enlarge car parks, roads and ext. area	Mid 78	0.5
10	Expansion 1976 international terminal	Mid 80	1.0
11	Maintain 04/22 and 13/31 runways and 04/22 taxiways	Mid 80	0.5
12	Upgrade AAA terminal	Mid 81	7.0
13	Uptrade TAA terminal	Mid 31	6.0
14	Enlarge aprons ext. blg. area (1981)	Mid 81	0.5
15	Enalarge car parks, roads and services ext. blg. area	Mid 82	1.0
16	Site works ground facilities	End 82	6.5
17	Site works primary services (including road access)	Mid 83	1.25
18	Site works international terminal (including apron)	Late 83)	
19	Site works AAA terminal (including apron)	Late 83)	4.5
20	Site works TAA terminal (including apron)	Late 83)	
21	Site works and services general aviation facilities (including apron)	Late 83	1.25
22	Construction primary services (including access)	Early 84	1.0
23	Site works for extension 04/22 runway and additional taxiways	Early 84	3.75
24	Construct ground facilities	Mid 84	7.5
25	Construct international terminal (including apron)	Early 85	3.0
26	Construct AAA terminal and apron	Early 85	3.0
27	Construct TAA terminal and apron	Early 85	3.0
28	Construct 04/22 runway extension and additional taxiways	End 84	1.25
29	Maintain existing pavements (1985)	Mid 85	0.5
30	Maintain existing pavements (1990)	Mid 90	0.5
31	Construct general aviation facilities (including apron)	Early 85	1.5
32	Equip ground facilities	Mid 85	2.0
33	Expand aprons to 1995 requirement	Late 90	1.0
34	Expand airlines maintenance area	Mid 92	1.0
35	Exp. terms and apron to 2000 requirement	Mid 95	5.0
36	Maintain existing pavements (1995)	Mid 95	0.5

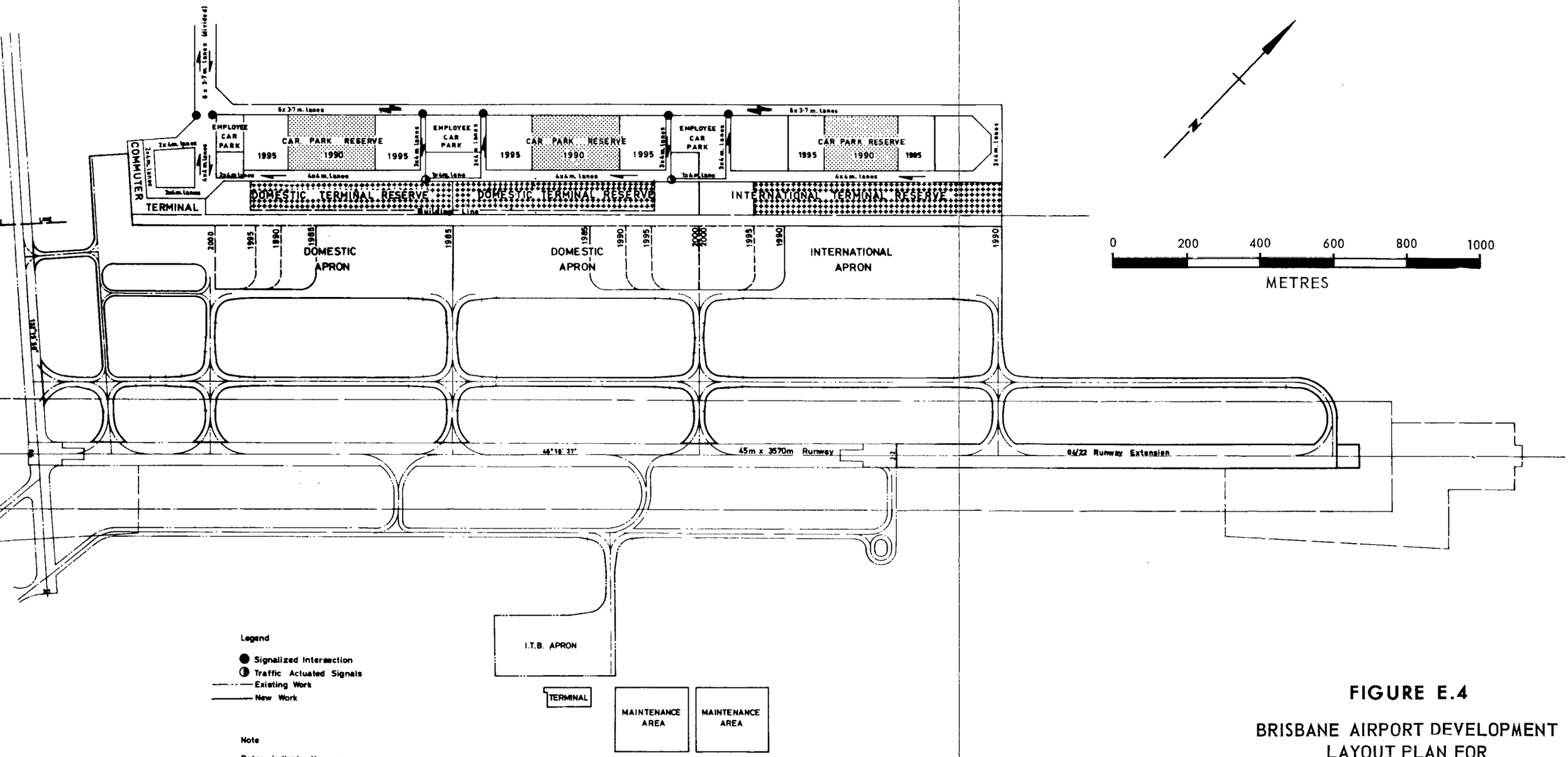

FIGURE E.4

BRISBANE AIRPORT DEVELOPMENT
LAYOUT PLAN FOR
STRATEGY 4

STRATEGY 5

(EXISTING AIRPORT SITE)

TABLE E.5 - BRISBANE AIRPORT DEVELOPMENT -TIMING FOR STRATEGY 5

Activity Number	Activity	Year Completed	Construction Time (years)
1	Maintain 04/22 runway	End 74	0.5
2	Site works and service AAA maintenance base	Mid 76	1.5
3	Site works and service TAA maintenance base	Mid 76	1.5
4	Fuel facility including hydrants	Mid 85	1.75
5	Fillets to 04/22 runway	Late 75	1.0
6	Construct AAA maintenance base	Late 77	2.0
7	Construct TAA maintenance base	Late 77	2.0
8	Enlarge aprons ext. bldg. area (1978)	Mid 78	0.5
9	Enlarge car parks, roads and service extension area	Mid 79	0.5
10	Expansion 1976 international terminal	Mid 80	1.0
11	Maintain 04/22 and 13/31 runways and 04/22 taxiways	Mid 80	0.5
12	Upgrade AAA terminal	Mid 81	7.0
13	Upgrade TAA termihal	Mid 81	6.0
14	Enlarge aprons ext. bldg. area (1981)	Mid 81	0.5
15	Enlarge car parks and roads and service ext.bldg. area	Mid 82	1.0
16	Site works ground facilities	End 82	2.5
17	Site works primary service (including road access)	End 82	1.5
18	Site works international terminal (including apron)	Late 83)	
19	Site works AAA terminal (including apron)	Late 83)	4.5
20	Site works TAA terminal (including apron)	Late 83)	
21	Site works and service general aviation facilities (including apron)	Late 83	1.25
22	Construct primary services including road access	Late 84	1.5
23	Site works for extension 04/22 runway and additional taxiways	Early 84	3.75
24	Construct ground facilities	Mid 84	2.5
25	Construct international terminal (including apron)	Early 85)	
26	Construct AAA terminal and apron	Early 85)	3.0
27	Construct TAA terminal and apron	Early 85)	
28	Construct 04/22 runway extension and additional taxiways	End 84	1.25
29	Maintain existing pavements (1985)	Mid 85	0.5
30	Maintain existing pavements (1990)	Mid 90	0.5
31	Construct general aviation facilities (including apron)	Early 85	1.5
32	Equip ground facilities	Mid 85	2.0
33	Expand aprons to 1995 requirement	Late 90	1.0
34	Expand airlines maintenance area	Mid 92	1.0
35	Expand terminals and apron to 2000 requirement	Mid 95	5.0
36	Maintain existing pavements (1995)	Mid 95	0.5

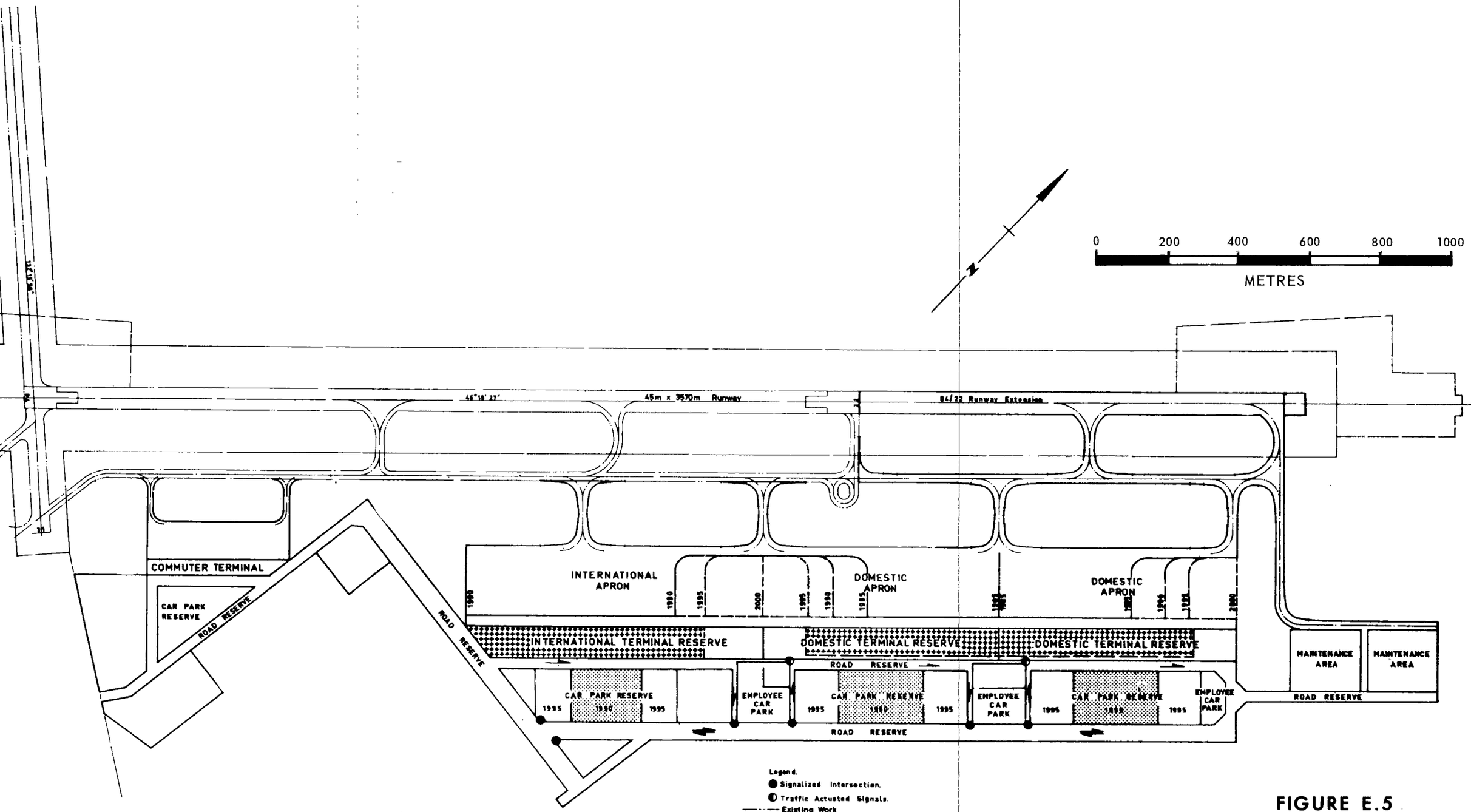

FIGURE E.5

BRISBANE AIRPORT DEVELOPMENT
LAYOUT PLAN FOR
STRATEGY 5

STRATEGY 6

(EXISTING AIRPORT SITE)

TABLE E.6 - BRISBANE AIRPORT DEVELOPMENT - TIMING FOR STRATEGY 6

Activity Number	Activity	Year Completed	Construction Time (years)
1	Maintain 04/22 runway	End 74	0.5
2	Site works and services AAA maintenance base	Late 74	1.0
3	Site works and services TAA maintenance base	Late 75	1.0
4	Fuel facility including hydrants	Early 76; Mid 84	1.25; 0.5
5	Fillets to 04/22 runway	Early 75	1.0
6	Construct AAA maintenance base	Late 77	2.0
7	Construct TAA maintenance base	Late 77	2.0
8	Enlarge aprons ext. blg. area (1978)	Mid 78	0.5
9	Enlarge car parks, roads and service extension area	Mid 78	0.5
10	Expansion 1976 international terminal	Mid 80	1.0
11	Maintain 04/22 and 13/31 runways	Mid 80	0.5
12	Upgrade AAA terminal		
13	Upgrade TAA terminal	Mid 78; Early 80; Early 85	1.0; 1.5; 1.5
14	Enlarge aprons ext. blg. area (1985)	Mid 85	0.5
15	Enlarge car parks, roads and service ext. blg. area	Mid 85	1.0
16	Site works international terminal (including apron)	Early 83	3.0
17	Site works AAA terminal (including apron)	Late 76	3.0
18	Site works and services general aviation facilities (including apron)	Late 83	1.25
19	Construct primary services (including road access)	Early 78; Early 85	1.0; 1.0
20	Site works for extension 04/22 runway and additional taxiways	End 79; End 83	2.0; 2.0
21	Construct ground facilities	Late 77; Mid 84	1.0; 0.75
22	Construct international terminal (including apron)	Early 85	2.0
23	Construct AAA terminal (including apron)	Early 78; Early 85	1.5; 1.5
24	Construct 04/22 runway extension and additional taxiways	End 79; End 84	0.75; 1.0
25	Maintain existing pavements (1985)	Mid 85	0.5
26	Construct general aviation facilities (including apron)	Early 80; Early 85	1.0; 1.0
27	Equip ground facilities	Mid 78; End 84	0.5; 0.5

ANNEX E

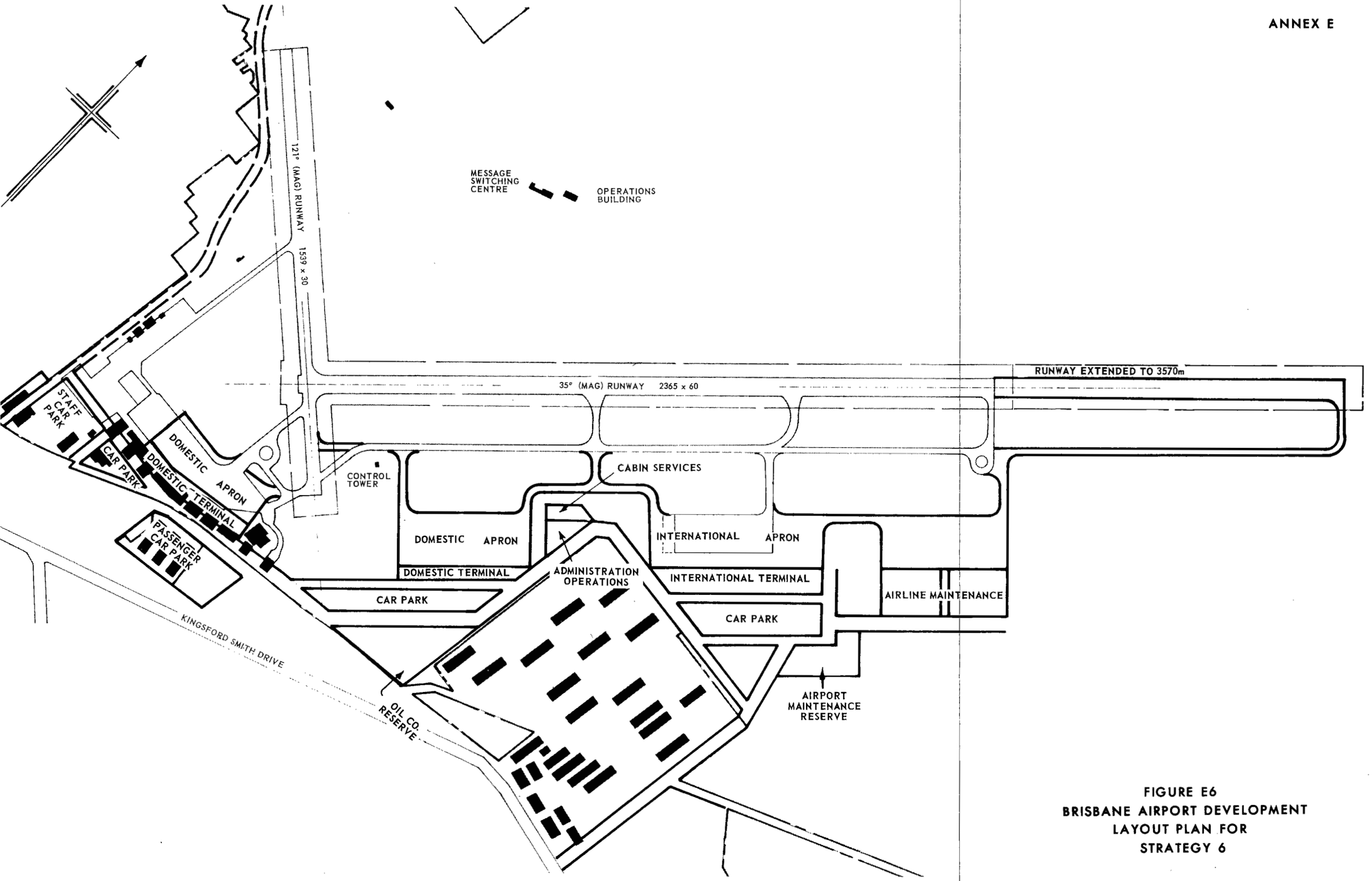

FIGURE E6
BRISBANE AIRPORT DEVELOPMENT
LAYOUT PLAN FOR
STRATEGY 6

500 0 METRES 500 1000

STRATEGY 7

(EXISTING AIRPORT SITE)

TABLE E.7 - BRISBANE AIRPORT DEVELOPMENT - TIMING FOR STRATEGY 7

Activity Number	Activity	Year Completed	Construction Time (years)
1	Maintain 04/22 runway	End 74	0.5
2	Site works and services AAA maintenance Base	Late 75	1.0
3	Site works and services TAA maintenance base	Late 75	1.0
4	Fuel facility including hydrants	Early 76; Early 85	1.25;0.5
5	Fillets to 04/22 runway	Late 75	1.0
6	Construct AAA maintenance base	Late 77	1.75
7	Construct TAA maintenance base	Late 77	1.75
8	Enlarge aprons ext. bldg. area (1978)	Mid 78	0.5
9	Enlarge car parks, roads and service ext. area	Mid 78	0.5
10	Expansion 1976 international terminal	Mid 80	1.0
11	Maintain 04/22 and 13/31 runways and 04/22 taxiways	Mid 80	0.5
12	Upgrade TAA terminal	Early 76; Early 80; Early 85; Early 90	1.0; 1.0; 1.0; 1.5
13	Enlarge aprons ext. bldg. area (1985)	Mid 85	0.5
14	Enlarge car parks, roads and service ext. bldg. area	Mid 85	1.0
15	Site works international terminal (including apron)	Early 82	3.0
16	Site works AAA terminal (including apron)	Early 77; Late 88	3.0; 3.0
17	Site works and services general aviation facilities (including apron)	Early 84	1.25
18	Construct primary services (including road access)	Early 77; Early 85; Early 90;	1.0; 1.0; 0.75
19	Siteworks for extn. 04/22 runway and additional taxiways	Early 79; End 83; End 88	2.0; 2.0; 2.0
20	Construct ground facilities	Late 75; Late 84; Late 89	1.0; 1.5; 0.5
21	Construct international terminal (including apron)	Early 85	3.0
22	Construct AAA terminal (including apron)	Early 78; Early 85; Early 90	1.0; 1.5; 1.5
23	Construct 04/22 runway extn. and additional taxiways	End 79; End 84; End 89	0.75; 1.0; 1.0
24	Maintain existing pavements (1985)	Mid 85	0.5
25	Maintain existing pavements (1990)	Mid 90	0.5
26	Construct general aviation facilities (including apron)	Early 80; Early 85; Early 90	1.0; 1.0; 0.5
27	Equip ground facilities	Early 76; Mid 85; Mid 90	0.25; 0.5; 0.5
28	Expand aprons to 1995 requirement	Late 90	1.0
29	Expand airlines maintenance area	Mid 92	1.0
30	Expand terminals and aprons to 2000 requirement	Mid 95	5.0
31	Maintain existing pavements (1995)	Mid 95	0.5

ANNEX E

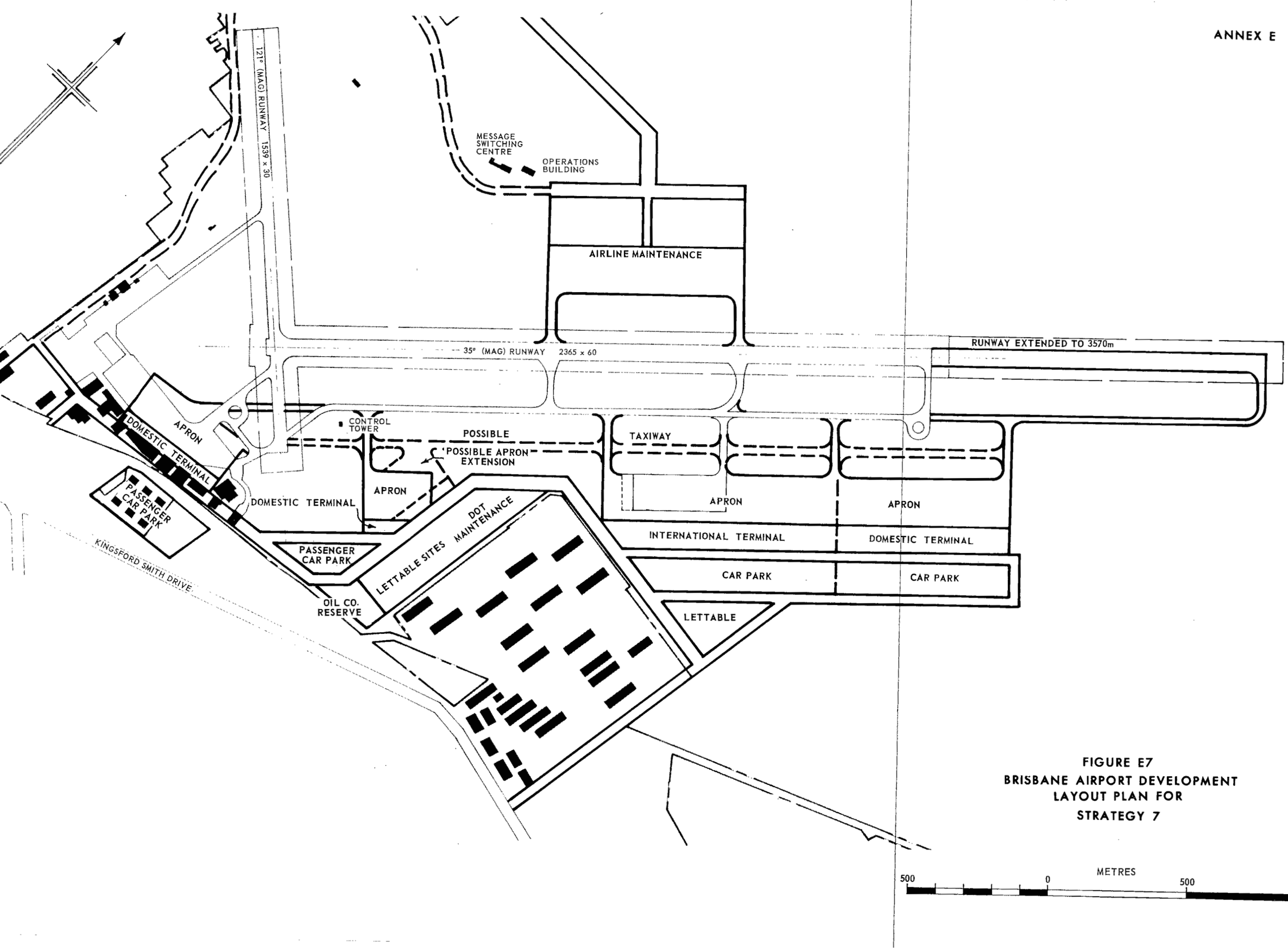

FIGURE E7
BRISBANE AIRPORT DEVELOPMENT
LAYOUT PLAN FOR
STRATEGY 7

STRATEGY 8

(EXISTING AIRPORT SITE)

TABLE E.8 - BRISBANE AIRPORT DEVELOPMENT - TIMING FOR STRATEGY 8

Activity Number	Activity	Year Completed	Construction Time (years)
1	Maintain 04/22 runway	End 74	0.5
2	Site works and services AAA maintenance base	Late 74	1.0
3	Site works and services TAA maintenance base	Late 75	1.0
4	Fuel facility including hydrants	Early 76; Early 85	1.25; 0.5
5	Fillets to 04/22 runway	Late 75	1.0
6	Construct AAA maintenance base	Late 77	2.0
7	Construct TAA maintenance base	Late 77	2.0
8	Enlarge aprons ext. blg. area (1978)	Mid 78	0.5
9	Enlarge car parks, roads and services extension area	Mid 78	0.5
10	Expansion 1976 international terminal	Mid 80	1.0
11	Maintain 04/22 and 13/31 runways and 04/22 taxiways	Mid 80	0.5
12	Upgrade TAA terminal	Early 76; Early 80; Early 85; Early 90	1.0; 1.0; 1.0; 1.5
13	Enlarge aprons ext. blg. area (1985)	Mid 85	0.5
14	Enlarge car parks, roads and serv. ext. blg. area	Mid 85	1.0
15	Site works (including apron)	Early 82	3.0
16	Site works AAA terminal (including apron)	Early 77; Late 83	3.0; 3.0
17	Site works and serv. gen. aviation facilities (including apron)	Early 84	1.25
18	Construct primary service (including road access)	Early 77; Early 85; Early 90	1.0; 1.0; 0.5
19	Site works for extn. 04/22 runway and additional taxiways	Early 79; Late 83; End 88	2.0; 2.0; 2.0
20	Construct ground facilities	Late 75; Late 84; Late 89	1.0; 1.5; 0.5
21	Construct international terminal (including apron)	Early 85	3.0
22	Construct AAA terminal (including apron)	Early 76; Early 85; Early 90	1.0; 1.5; 1.5
23	Construct 04/22 runway extn. and additional taxiways	End 79; End 84 End 89	0.75; 1.25; 1.0
24	Maintain existing pavements (1985)	Mid 85	0.5
25	Maintain existing pavements (1990)	Mid 90	0.5
26	Construct general aviation facilities (including apron)	Early 80; Early 85; Early 90	1.0; 1.0; 0.5
27	Equip ground facilities	Early 76; Mid 85; Mid 90	0.25; 0.5; 0.5
28	Expand aprons to 1995 requirement	Late 90	1.0
29	Expand airlines maintenance area	Mid 92	1.0
30	Exp. terminals and aprons to 2000 requirement	Mid 95	5.0
31	Maintain existing pavements (1995)	Mid 95	0.5

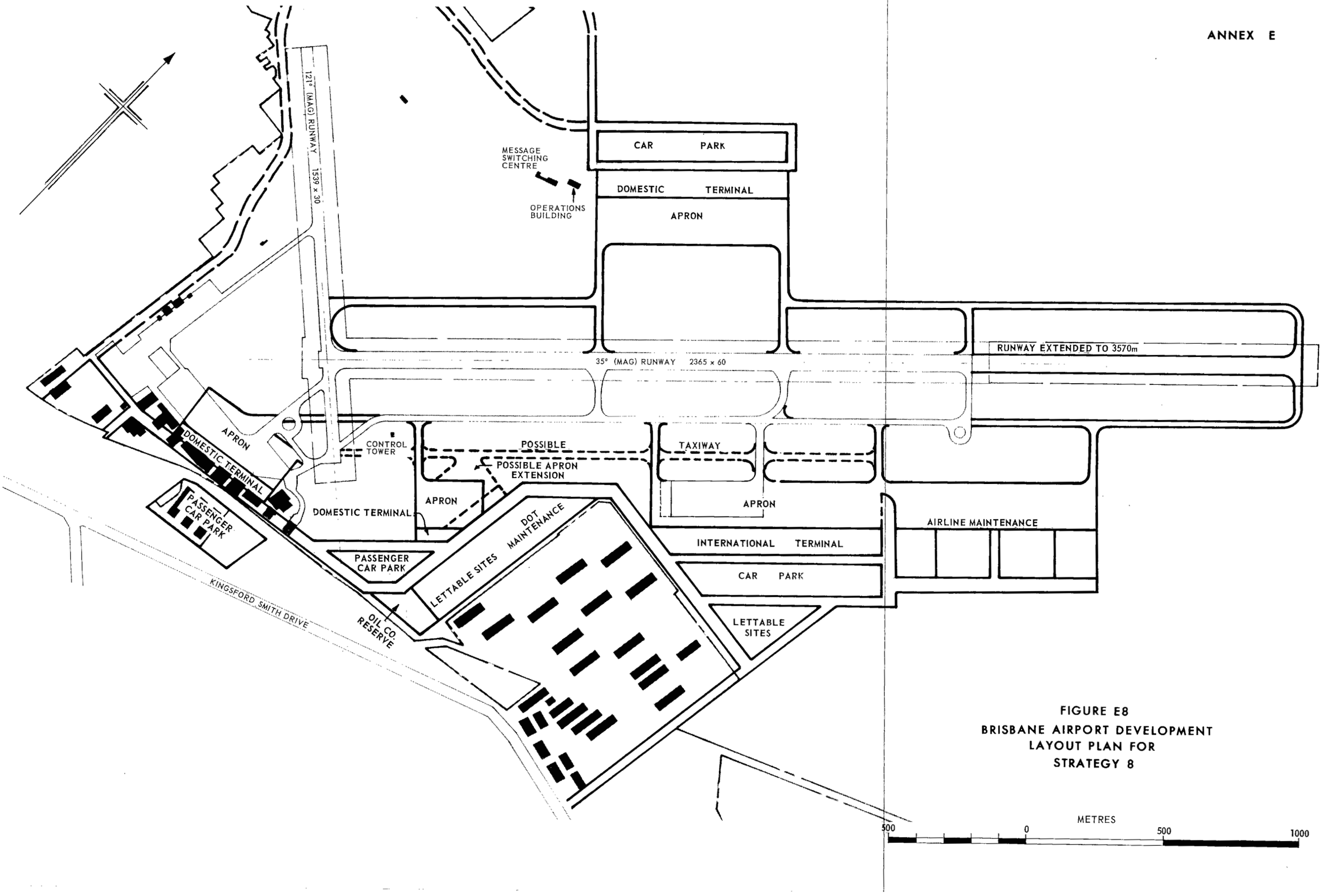

FIGURE E8
BRISBANE AIRPORT DEVELOPMENT
LAYOUT PLAN FOR
STRATEGY 8

ANNEX F

NOISE EXPOSURE CONCEPTS FOR

1985

ANNEX G

ACCESS COSTS

The access costs associated with the alternative development strategies proposed for Brisbane Airport were examined in detail by the Queensland Main Roads Department and the Department of Housing and Construction. The results of these studies are the subject of two reports.(1) The relative access costs for the alternative development strategies were calculated using some of the base data contained in these reports. This Annex summarises the procedure adopted in estimating access costs for the alternative development strategies.

G.1 TRIP GENERATION

The study area adopted for the airport access study comprised the 90 zones defined for the Down River Transportation Study.(2) This classification was modified slightly so that Down River Zone 7 which contains the airport was disaggregated into five sub-zones comprising the international terminal, the two domestic terminals and the general aviation and maintenance areas.

The number of vehicle trips in the study area was derived from the Down River Study 1981 Triptable and the 1991 Triptable developed for the 1971 Brisbane Airport

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(1) Queensland Main Roads Department, "Brisbane Airport Development Strategy 'K' : A Report on Ground Access Requirements for Brisbane Airport Development Under Strategy 'K'" (August, 1974), and Australian Government Department of Housing and Construction, "Brisbane Airport Development - Surface Transport Consideration: Report on Alternative Access Strategies for Brisbane Domestic Airport to 1985 and Road Transport Implications of Alternative Airport Development Strategies to 2000" (December, 1974).

(2) Rankine and Hill, Down River Transportation Study, Brisbane: Report on 1969 Data and Traffic Models (May, 1970), and Down River Transportation Study, Brisbane: Report on Projections, Analyses and Plans (October, 1970).

Ground Access Study.(1) A description of the method used is contained in the Queensland Main Roads Department's Report.(2) The 24 hour airport generated vehicle trip ends assumed by the Queensland Main Roads Department in their analysis was not consistent with the BTE forecasts of passenger and aircraft movements. This difference does not affect the overall results of the Queensland Main Roads Department's deficiency analysis or the estimated road construction requirements. It does however, slightly alter the estimated relative daily vehicle kilometres associated with the alternative development strategies. Therefore, the estimates of daily vehicle kilometres in the study area were modified so that they were consistent with the forecasts used in this study.

Traffic generated by the airport was estimated from the forecasts presented in Chapter 2 for four separate airport activities: air passenger movement; employment in airport activity; freight movement; and sightseeing, servicing, etc. The estimating procedure was similar to that used for the 1971 Brisbane Airport Ground Access Study.(3) The results for the years 1985 and 1991 are presented in Table G.1. The assumptions on which these estimates are based are outlined below.

Air Passenger Movement

Studies of airport traffic generation conducted by the University of Queensland in 1968 indicate that there were approximately 0.85 one way passenger vehicle trips per air passenger movement. Allowing for some improvement in the use of public transport over time, particularly in the form of airline coaches, a figure of 0.8 one way passenger vehicle trips was assumed to be associated with each air passenger movement.

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(1) Ground Transport Subcommittee, Brisbane Airport Advisory Committee, "Brisbane Airport Ground Access: A Study of the Ground Access Requirements for Brisbane to 1991" (May, 1971).

(2) Queensland Main Roads Department, op. cit., pp.5-8.

(3) Ground Transport Subcommittee, Brisbane Airport Advisory Committee, op. cit., pp.21-22.

Employment in Airport Activities

One way vehicle trips per employee were estimated from data contained in the 1971 Brisbane Airport Ground Access Report.(1) On the assumption that approximately 95 per cent of employees travel to the airport by motor vehicle and that average car occupancy is 1.3 persons per vehicle, the number of one way trips generated per employee was estimated to be 0.73.

Freight Movement

Past experience at Brisbane Airport suggests that five one way freight vehicle trips were associated with each short ton of freight passing through the airport.(2) Since no other data is available, this figure was adopted for estimating vehicle trips associated with the movement of freight at Brisbane Airport.

Airport Activity

The remaining vehicle trips to the airport are associated with general airport activity such as sightseeing and commercial vehicles servicing the airport. It has been estimated that there were approximately 500 one way trips of this nature per day in 1971.(3) The assumption that such trips are proportional to aircraft movements implies 6.33 one way vehicle trips for each aircraft movement. This ratio was adopted for estimating vehicle trips associated with airport activity.

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(1) Ibid.
(2) Ibid., p.22.
(3) Ibid.

TABLE G.1 - ESTIMATED 24 HOUR ONE WAY AIRPORT ASSOCIATED VEHICLE TRIP ENDS, 1985 AND 1991

Airport Activity	1985	1991
Domestic passenger movement	11,171	15,578
International passenger movement	1,209	1,171
Employment in airport activity(a)	3,650	4,599
Freight movement	714	1,003
General airport activity	2,031	2,588
TOTAL	20,811	26,524

(a) It was assumed that there would be 5,000 airport employees in 1985 and 6,300 in 1991.

Source: Derived from the forecasts presented in Chapter 2 and the assumptions outlined in the text.

G.2 DEFICIENCY ANALYSIS

Deficiency analysis is used to indicate where road capacity problems are likely to occur in the future and to provide a base upon which to develop new systems which may be required to alleviate such problems. The Queensland Main Roads Department carried out a deficiency analysis for the roads in the locality of the airport based on an assumed 1975 network which did not include freeway access to the airport area, and on an assumed 1991 network which incorporated the proposed Northern Freeway, the North-South Freeway and an airport access road linking the airport to the Northern Freeway. The results of this analysis are contained in their report.(1) The analysis suggests that there is little difference between the airport development strategies with respect to their effect upon the surrounding surface streets. Furthermore, irrespective of the airport development strategy adopted after 1985, the surrounding road system will be severely overloaded by 1991. Therefore, in all calculations it was assumed that the North-South Freeway will be required by that date to meet the forecast airport traffic demand and to ease congestion on Kingsford-Smith Drive and Nudgee Road.

G.3 AIRPORT ACCESS

Six basic alternative alignments of the North-South Freeway were considered in developing relative access cost differences between the alternative development strategies. These included alignments around or along the existing secondary runway. The alternatives are described in detail in the Queensland Main Roads Department's report.(2) To compare the relative access costs associated with the various strategies, an alignment which was designated scheme 2a that locates the freeway around the north-western

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(1) Queensland Main Roads Department, op. cit., pp.10-11.

(2) Ibid., pp.15-20 and Figures 5, 6 and 7.

TABLE G.2 - CAPITAL COSTS ASSOCIATED WITH PROVIDING ACCESS FOR ALTERNATIVE DEVELOPMENT STRATEGIES[a]

($million)

Airport Development Strategy	Access Scheme	Construction	Right of Way	Total
1	3	16.8	4.6	21.4
2	3	16.8	4.6	21.4
3	3	16.8	4.6	21.4
4	2a	16.0	6.0	22.0
5	2a	12.7	6.0	18.7
6	3	10.2	4.6	14.8
7	2a	12.7	6.0	18.7
8	2a	13.3	6.0	19.3

(a) The estimated capital costs associated with providing access for strategies 1 to 5 were provided by the Queensland Main Roads Department. The estimated capital costs for strategies 6 to 8 were derived from these costs. All costs are expressed in June 1974 dollars.

Source: Queensland Main Roads Department "Brisbane Airport Development Strategy 'K'. A Report on Ground Access Requirements for Brisbane Airport Development Under Strategy 'K'" (August 1974), Table 4, p.23.

end of the existing secondary runway, was taken as a representative alignment should the existing runways still be in operation in 1991. An alignment which was designated scheme 3, that locates the freeway on the existing secondary runway, was taken as a representative freeway alignment if the existing runways are vacated by 1991. Access costs to the alternative terminal locations were based on these two alignments.

G.4 EVALUATION PROCESS

In order to evaluate the relative access costs for each development strategy, four categories of cost were considered:

(i) capital costs;
(ii) roadway maintenance and drainage pumping costs;
(iii) vehicle operating costs including time costs;
(iv) non-quantifiable considerations.

G.4.1 Capital Costs

The capital costs associated with providing access for the alternative strategies include right of way and construction costs for the North-South Freeway and associated interchange works in the section from the Brisbane River to the Schulz Canal. Beyond these limits, freeway details are common to all strategies. The capital costs also included those road works to terminal areas and the associated car parks not included in the capital costs for each strategy. The capital costs refer to the period after 1985 and assume opening of the North-South Freeway by 1991. Prior to 1985 access road costs are common to all proposals and have not been considered.

Estimates of right of way and construction costs are contained in Table G.2. The unit rates used to derive these costs for strategies 1 to 5 are contained in the Queensland Main Roads Department's Report.(1) Cost estimates for strategies 6 to 8 were derived from these rates.

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(1) Ibid., Appendix A.

TABLE G.3 - ESTIMATED DAILY VEHICLE KILOMETRES OF THE VARIOUS DEVELOPMENT STRATEGIES, 1985 AND 1991

Strategy	Scheme	Daily Vehicle Kilometres	
		Freeway	Arterials
		1985	
1	3	-	2,014,397
2	3	-	2,014,397
3	3	-	2,014,397
4	2a	-	1,904,606
5	2a	-	2,003,044
6	3	-	1,937,480
7	2a	-	1,934,338
8	2a	-	1,927,267
		1991	
1	3	1,779,713	1,463,791
2	3	1,779,713	1,463,791
3	3	1,779,713	1,463,791
4	2a	1,579,511	1,522,815
5	2a	1,468,779	1,744,805
6	3	1,779,715	1,463,791
7	2a	1,452,737	1,706,982
8	2a	1,496,152	1,644,502

Source: Derived from data provided by the Queensland Main Roads Department.

TABLE G.4 - VEHICLE OPERATING COSTS FOR ARTERIAL AND FREEWAY ROAD TYPES

(cents per kilometre)

Vehicle Type	Running	Capital	Accident	Time	Total
		Arterial Roads			
Cars	2.33	-	1.06	2.99	6.38
Light trucks	4.29	0.50	1.06	4.97	10.82
Rigid trucks	7.30	1.12	1.06	6.22	15.70
Semi-trailers	8.70	2.24	1.06	6.06	18.06
		Freeways			
Cars	2.42	-	0.66	1.96	5.02
Light trucks	4.34	0.30	0.66	3.24	8.54
Rigid trucks	7.60	0.67	0.66	4.03	12.96
Semi-trailers	8.60	1.34	0.66	3.93	14.53

Source: Queensland Main Roads Department, "Brisbane Airport Development Strategy 'K': A Report on Ground Access Requirements for Brisbane Airport Under Strategy 'K'" (August 1974), Appendix B.

G.4.2 Vehicle Operating Costs

Annual vehicle operating costs were calculated for two specific years: 1985 assuming no North-South Freeway; and 1991 assuming that the North-South Freeway is in operation. The derivation of these vehicle operating costs for the period 1985-1990 and 1991-2000 are outlined below. Vehicle operating costs for the period 1975-1985 were not calculated since these costs are similar for all strategies.

Average weekday vehicle kilometres of travel by freeway and arterial road types were derived from traffic assignments to those portions of the Down River Study network sensitive to the various development strategies. The estimates for 1985 and 1991 are contained in Table G.3. It should be noted that the totals only refer to the network analysed and are for comparative purposes only. Annual vehicle kilometres were calculated on the assumption that 300 working days are equivalent to one year's traffic within the study area.

Vehicle operating costs per kilometre for freeway and arterial road types for different categories of vehicles were assessed according to procedures derived by the Commonwealth Bureau of Roads. The assumed running, capital, accident and time costs per kilometre by type of vehicle for arterial and freeway road types are outlined in Table G.4.

The vehicle operating costs per kilometre presented in Table G.4 were calculated using the following assumptions:

(i) Vehicle speeds (kilometres per hour)

Vehicle Type	Arterial Roads	Freeways
Cars, light trucks	48	74
Rigid trucks, semi-trailers	39	60

(ii) Capital costs were based on the values used in the Brisbane Central Freeway Review 1969, updated on the assumption that costs per vehicle kilometre have moved in sympathy with Consumer Price Index Movements.

(iii) Time costs (per vehicle hour)

Private car - $0.48
Business car - $5.32
Light truck - $2.40
Rigid truck - $2.40
Semi-trailer - $2.34

(iv) Vehicle composition in the study area was obtained from ground counts carried out by Queensland Main Roads Department. The assumed composition was:

Cars - 68 per cent
Light trucks - 14 per cent
Rigid trucks - 14 per cent
Semi-trailers- 4 per cent

Growth in vehicle kilometres of travel was assumed to be equal to 5.5 per cent per annum, the estimated growth in trip ends in the study area. This allows for a 4 per cent growth in vehicle kilometres in the area generally, obtained from Down River Study estimates, weighted to account for airport traffic growth of approximately 10.5 per cent per annum. It was assumed that Brisbane Airport will account for 22.6 per cent of traffic generation in the study area in 1991.

Annual 1985 operating costs without the North-South Freeway in operation and annual 1991 operating costs with the North-South Freeway in operation are shown in Table G.5. From these costs, and the assumed rate of growth in traffic, differential operating costs for the periods 1985-1990 and 1991-2000 were calculated. The net present value of these differentials, at discount rates of 7 and 10 per cent, are shown in Tables G.6 and G.7.

G.4.3 Non-Quantifiable Considerations

Non-quantifiable considerations of alternative access proposals for Brisbane Aiport include compatibility with the proposed Gateway Bridge and surface streets, possible effects upon road traffic operations, impacts upon existing and future land uses and social and environmental factors. A detailed discussion of these aspects is contained in the Queensland Main Roads Department's Report.(1)

G.5 EVALUATION RESULTS

A summary of the discounted differential access costs for discount rates of 7 and 10 per cent are contained in Tables G.8 and G.9 respectively. The discounted capital costs are based upon the staging of construction proposed by the Queensland Main Roads Department. The discounted costs shown in Tables G.8 and G.9 are calculated relative to the respective costs for strategy 1. Negative values indicate cost savings relative to strategy 1.

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(1) Ibid., pp.35-39.

TABLE G. 5 - ANNUAL VEHICLE OPERATING COSTS FOR ALTERNATIVE DEVELOPMENT STRATEGIES, 1985 AND 1991

($ million)

Cost Category	Strategy							
	1	2	3	4	5	6	7	8
	1985							
Operating Cost (net of time)	29.77	29.77	29.77	28.14	29.58	28.63	28.58	28.48
Time Cost								
Private car	3.27	3.27	3.27	3.09	3.25	3.14	3.14	3.13
Business car(a)	9.05	9.05	9.05	8.58	9.00	8.71	8.69	8.66
Light truck	4.20	4.20	4.20	3.97	4.18	4.40	4.04	4.02
Rigid truck	5.25	5.25	5.25	4.97	5.22	5.05	5.05	5.03
Semi-trailer	1.46	1.46	1.46	1.38	1.46	1.41	1.41	1.40
Total Annual Operating Cost	53.00	53.00	53.00	50.14	52.69	51.34	50.91	50.72
	1991							
Operating Cost (net of time)	45.67	45.67	45.67	43.84	45 62	45.67	44.85	44.51
Time Cost								
Private car	4.26	4.26	4.26	4.14	4.38	4.26	4.30	4.25
Business car(a)	11.79	11.79	11.79	11.47	12.15	11.79	12.35	11.77
Light truck	5.48	5.48	5.48	5.25	5.64	5.48	5.34	5.47
Rigid truck	6.83	6.83	6.83	6.65	7.04	6.83	6.91	6.82
Semi-trailer	1.90	1.90	1.90	1.85	1.96	1.90	1.92	1.90
Total Annual Operating Cost	75.93	75.93	75.93	73.20	76.79	75.93	75.67	74.72

(a) Calculated assuming that 20 per cent of car use is for business purposes.

Source: Derived from data provided by the Queensland Main Roads Department.

TABLE G.6 - NET PRESENT VALUE OF VEHICLE OPERATING COSTS FOR ALTERNATIVE DEVELOPMENT STRATEGIES: 7 AND 10 PER CENT DISCOUNT RATES, 1985-1990

($million)

Cost Category	Strategy							
	1	2	3	4	5	6	7	8
7 per cent discount rate								
Operating Cost (net of time)	81.93	81.93	81.93	77.46	81.41	78.80	78.67	78.39
Time Cost								
Private car	8.99	8.99	8.99	8.50	8.94	8.65	8.64	8.60
Business car	24.92	24.92	24.92	23.61	24.77	23.97	23.93	23.84
Light truck	11.57	11.57	11.57	10.94	11.51	11.13	11.11	11.07
Rigid truck	14.47	14.47	14.47	13.68	14.38	13.91	13.89	13.84
Semi-trailer	4.03	4.03	4.03	3.81	4.01	3.87	3.87	3.86
Total	145.91	145.91	145.91	138.00	145.02	140.33	140.11	136.90
Differential (relative to strategy 1)(a)	0	0	0	-7.91	-0.89	-5.58	-5.80	-6.31
10 per cent discount rate								
Operating Cost (net of time)	56.53	56.53	56.53	53.45	56.18	54.37	54.29	54.09
Time Cost								
Private car	6.21	6.21	6.21	5.87	6.17	5.97	5.96	5.94
Business car	17.19	17.19	17.19	16.29	17.10	16.54	16.51	16.54
Light truck	7.98	7.98	7.98	7.55	7.94	7.68	7.67	7.64
Rigid truck	9.98	9.98	9.98	9.44	9.92	9.60	9.58	9.55
Semi-trailer	2.78	2.78	2.78	2.63	2.77	2.67	2.67	2.66
Total	100.67	100.67	100.67	95.23	100.08	96.83	96.68	96.33
Differential (relative to strategy 1)(a)	0	0	0	-5.44	-0.59	-3.84	-3.99	-4.34

(a) A negative sign indicates a lower cost than strategy 1.

Source: Derived from Table G.6 assuming that growth in vehicle kilometres is 5.5 per cent per annum.

TABLE G.7 - NET PRESENT VALUE OF VEHICLE OPERATING COSTS FOR ALTERNATIVE DEVELOPMENT STRATEGIES: 7 AND 10 PER CENT DISCOUNT RATES, 1991-2000

($million)

Cost Category	Strategy							
	1	2	3	4	5	6	7	8
7 per cent discount rate								
Operating cost (net of time)	135.80	135.80	135.80	130.35	135.66	135.80	133.35	132.35
Time Cost								
Private car	12.65	12.65	12.65	12.31	13.04	12.65	12.80	12.63
Business car	35.07	35.07	35.07	34.11	36.11	35.07	35.47	35.01
Light truck	16.28	16.28	16.28	15.61	16.77	16.28	16.47	16.26
Rigid truck	20.31	20.31	20.31	19.76	20.92	20.31	20.55	20.18
Semi-trailer	5.66	5.66	5.66	5.51	5.83	5.66	5.72	5.65
Total	225.77	225.77	225.77	217.65	228.33	225.77	224.36	222.18
Differential (relative to strategy 1)(a)	0	0	0	-8.12	+2.56	0	-1.41	-3.59
10 per cent discount rate								
Operating cost (net of time)	75.42	75.42	75.42	72.39	75.35	75.42	74.06	73.50
Time Cost								
Private car	7.03	7.03	7.03	6.84	7.24	7.03	7.11	7.02
Business car	19.48	19.48	19.48	18.94	20.06	19.48	19.70	19.44
Light truck	9.04	9.04	9.04	8.67	9.31	9.04	9.15	9.03
Rigid truck	11.28	11.28	11.28	9.93	11.62	11.28	11.41	11.27
Semi-trailer	3.14	3.14	3.14	3.06	3.24	3.14	3.18	3.14
Total	125.39	125.39	125.39	119.83	126.81	125.39	124.61	123.40
Differential (relative to strategy 1)(a)	0	0	0	-5.56	+1.42	0	-0.78	-1.99

(a) A positive sign indicates a higher and a negative sign indicates a lower cost than strategy 1.
Source: Derived from Table G.6 assuming that the growth in vehicle kilometres is 5.5 per cent per annum.

TABLE G.8 - DISCOUNTED DIFFERENTIAL ACCESS COSTS FOR ALTERNATIVE DEVELOPMENT STRATEGIES: 7 PER CENT DISCOUNT RATE, 1975-2000

($million)

Strategy	Scheme	Discounted Construction and Land Acquisition Cost	Discounted Maintenance and Pumping Cost	Discounted Differential Operating Cost Relative to Strategy 1					Total Discounted Cost Relative to Strategy 1
				1985-1990		1991-2000		Total	
				Operating cost (net of time cost)	Time Cost	Operating cost (net of time cost)	Time Cost		
1, 2 and 3	3	0	0	0	0	0	0	0	0
4	2a	+0.01	-0.04	-4.47	-3.44	-5.45	-2.67	-16.03	-16.06
5	2a	-0.77	-0.05	-0.52	-0.37	-0.14	+2.70	+ 1.67	+ 0.85
6	3	-1.23	-0.08	-3.13	-2.45	0	0	- 5.58	- 6.89
7	2a	+0.93	-0.04	-3.26	-2.54	-2.45	+1.06	- 7.19	- 6.30
8	2a	+1.16	-0.02	-3.54	-2.77	-3.45	-0.14	- 9.90	- 8.76

NOTE: A positive sign indicates a higher and a negative sign indicates a lower cost than strategy 1.

Source: Derived from Tables G.2, G.3, G.7 and G.8.

TABLE G.9 - DISCOUNTED DIFFERENTIAL ACCESS COSTS FOR ALTERNATIVE DEVELOPMENT STRATEGIES: 10 PER CENT DISCOUNT RATE, 1975-2000

($million)

Strategy	Scheme	Discounted Construction and Land Acquisition Cost	Discounted Maintenance and Pumping Cost	Discounted Differential Operating Cost Relative to Strategy 1					Total Discounted Cost Relative to Strategy 1
				1985-1990		1991-2000		Total	
				Operating Cost (net of time cost)	Time Cost	Operating Cost (net of time cost)	Time Cost		
1, 2 and 3	3	0	0	0	0	0	0	0	0
4	2a	-0.07	-0.02	-3.08	-2.36	-3.03	-2.53	-11.00	-11.09
5	2a	-0.93	-0.03	-0.35	-0.24	-0.08	+1.50	+ 0.83	- 0.13
6	3	-0.75	-0.05	-2.16	-1.68	0	0	- 3.84	- 4.64
7	2a	+0.76	-0.02	-2.24	-1.75	-1.36	+0.58	- 4.77	- 4.03
8	2a	+0.89	-0.01	-2.44	-1.90	-1.92	-0.07	- 6.33	- 5.45

NOTE: A positive sign indicates a higher and a negative sign indicates a lower cost than strategy 1.

Source: Derived from Tables G.2, G.3, G.7 and G.8.