Assessment of the Australian Road System: 1984

Report

This report presents the results of a study of the Australian road system undertaken by the Bureau of Transport Economics in response to a direction by the then Minister for Transport in May 1982. The Terms of Reference required that the Bureau examine changes in conditions and performance of the road system in recent years, trends in levels and patterns of funding, the economics of road investment and the probable impact of alternative future funding patterns and levels.

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FOREWORD

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A number of discrete investigations were undertaken in support of this study and are reported in the following publications:

- Information Paper 10 'Assessment of the Australian Road System: Operational Characteristics'
- Occasional Paper 60 'Assessment of the Australian Road System: Travel Projections'
- Occasional Paper 61 'Assessment of the Australian Road System: Financing'
- Occasional Paper 62 'Assessment of the Australian Road System: Provision of Roads in Local Government Areas'
- Occasional Paper 63 'Assessment of the Australian Road System: Economic Assessment Model for Rural Arterial Roads'.

This report brings together the information from those documents and from other sources to provide a general assessment of the state and future of the road system. The Bureau reported on a previous assessment in 1979 and similar reports were prepared by the former Commonwealth Bureau of Roads in 1969, 1973 and 1975. A wider range of assessment criteria are explored in the present study than were used in previous work.

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CHAPTER 1-INTRODUCTION

BACKGROUND

In May 1982 the then Minister for Transport directed the Bureau of Transport Economics (BTE) to undertake an assessment of the Australian road system. The specific Terms of Reference for the study required that:

> 'The Bureau should in particular investigation and report on:
>
> (a) Changes in the condition and performance of the road system in each State and Territory over the past ten years.
>
> (b) Trends in the levels and patterns of funding of road programs by the three levels of government in Australia, and their impact on development of the system.
>
> (c) An economic assessment of alternative levels and patterns of expenditure on road construction and maintenance for each State and Territory for the period 1985-86 to 1989-90.
>
> (d) The likely impact on the system of alternative levels of road funding over the period 1985-86 to 1989-90, commenting, as necessary, on the regional impact of these alternative levels.
>
> The BTE may examine any other matter which it believes relevant to this study.'

The terms of reference required that the report on the study be completed by 31 May 1984, but left the Bureau free to produce reports on aspects of the work in advance of that date as appropriate.

The present work constitutes a continuation of a series of reports on the Australian road system dating back to the early 1960s when comprehensive studies were undertaken by the National Association of Australian State Road Authorities (NAASRA).

The Commonwealth Bureau of Roads (CBR) was established in 1964 specifically to undertake studies and advise the Commonwealth Government in respect of financial assistance to the states for roadworks. The CBR produced major reports on roads in 1969, 1973 and 1975 (Commonwealth Bureau of Roads 1969, 1973 and 1975). Each report contained an assessment of the economic merit of upgrading the existing road system and produced recommendations as to the level of future Commonwealth assistance to the states for road investment. Those reports also contained comment on road expenditure by other levels of government and specific suggestions for changes in existing legislation.

In 1977 the CBR was amalgamated with the BTE which produced a further report in 1979 (BTE 1979). That report built on the experience and techniques developed by the CBR, but incorporated three significant changes. Firstly, in keeping with specific terms of reference, neither total road funding recommendations nor expenditure targets for the three levels of government were formulated. Secondly, the report included an examination and assessment of the pattern of expenditure observed over the four year period 1974-75 to 1978-79 in terms of its economic merit, and, thirdly, the report covered possible effects of alternative road expenditure programs for the period 1979-80 to 1982-83.

PRESENT STUDY

The present study continues the evolution from a relatively narrow evaluation base to a much broader, more general assessment of alternatives. It is more descriptive than prescriptive in nature. A new look was taken at the assessment process with benefit cost analysis forming an integral, but not dominating, component. The current assessment incorporates physical performance (as well as economic) criteria and also addresses some distributional and institutional matters.

The approach adopted required the identification of an extensive series of indicators of road requirements, road state and returns on road investment. It is based on the view that road investment decisions are taken within two separate frameworks, each with its own set of decision criteria.

The first framework covers the provision of a basic roads infrastructure. Decisions here are based primarily on a concept of *equity,* with each person or community being entitled to a reasonable basic road system. Just what constitutes a 'reasonable basic road system' varies over time and with geographical location, and has exhibited a generally rising standard. The provision of this basic infrastructure tends to be regarded by society as a basic right and not necessarily subject to economic justification.

The second framework is related to provision of a road system above the 'basic' infrastructure level. Once basic access requirements have been met roads may be upgraded for a variety of reasons, but in this case society seems to take the view that such improvements should reflect *economically efficient use of resources.*

Explicit recognition of these two distinct frameworks for road investment decision-making and the changing balance between them goes far towards explaining past distributions of road funds expenditure and their apparent divergence from the distributions which might be expected from consideration of economic efficiency.

In addition, the present study has been undertaken in the context of a total socio-political environment quite different from that pertaining at the time of earlier work. Over the period since the Second World War the Australian road system has changed dramatically. In 1945 something like 5 per cent of the rural road network was sealed. By 1972 this had increased to over 20 per cent and, by the end of the seventies, to almost 30 per cent. This expansive investment had its roots in a general public acceptance of the desirability of making maximum economic use of the 'new' technology of the motor vehicle. This rapid development has slackened somewhat and appears to be entering a consolidation phase. The climate is no longer one of unquestioning support for rapid development, but rather seems to be one of acceptance that the basic structure is in place and that further development should be subject to close scrutiny.

Consideration of these factors suggested an approach to resource allocation analysis based on a three-step process:

- determination of resources required to keep the existing system in being;
- identification of the additional resources required to maintain existing levels of service (that is, to keep pace with existing traffic growth); and
- identification of further resources needed to upgrade the existing levels of service to match popular expectations or to maximise economic efficiency.

This three-step process aligns well with the basic priority-setting process employed by road construction authorities and so provides the basis for realistic assessment of the way in which different levels of funding are likely to be applied in practice.

Thus the broad philosophy of the present BTE study is based on a description of the existing road system and its performance and on the behaviour of various parties involved in its development as a basis for predicting the probable response to different levels and patterns of funding. This contrasts with the strong focus of previous studies on identification of a 'warranted' expenditure program based on a notional project list designed for optimal economic efficiency.

NAASRA ROADS STUDY

Another study of the Australian road system has recently been completed by a NAASRA team. That study is largely complementary to the BTE work, with a focus on predicting what will happen to the road system between 1981 and 1991 given different levels of funding.

The studies have been conducted using a largely common data base and close liaison was maintained in order to minimise any potential duplication. Although the emphasis of the studies is quite different BTE has been able to make considerable use of material produced by and for the NAASRA Roads Study Team.

INTERGOVERNMENTAL ARRANGEMENTS

Historically the construction and maintenance of roads in Australia have been undertaken by state and local government. However, since 1923 the Commonwealth Government has contributed funds for roadworks, mostly in the form of grants, but with some use of loan funds (BTE 1981). Grants were made under Section 96 of the Constitution which permits the Commonwealth to make grants to the states for any specific purpose, and to apply conditions approved by Parliament. The conditions actually applied have varied over the years with the various assistance Acts, but have been concerned mainly with setting requirements for matching funds from state and local government sources and requirements that specific proportions be spent on particular categories of road.

The hypothecation of specific Commonwealth taxes to the funding of road grants has been a bone of contention over almost the total period since the first Section 96 grants for roads were made in 1923. Since the 1960s successive Roads Grants Acts have been passed which appropriated funds directly from consolidated revenue and in amounts completely unconnected with fuel or other taxes. This was in line with general financial policy of avoiding hypothecation of any tax source. However, the Australian Bicentennial Road Development (ABRD) program is funded directly from a surcharge on road fuels and so represents a divergence from established trends.

State government contributions to road construction and maintenance are financed primarily by means of charges related to vehicle ownership and usage; mainly, in fact, from vehicle registration fees and drivers' licence fees, plus in all states except Queensland, a fuel franchise. Only a minor amount of state finance for roads comes from state consolidated revenue.

Contributions from the local government authorities (LGAs) in Australia come mainly from rate revenues, but with about a quarter from loan borrowings. Road works represent the major single expenditure item for LGAs, but significant proportions of this expenditure are of grant monies obtained from Commonwealth and State Governments (BTE 1984b). In fact, transfer payments of this type dominate the budgets of some of the less populous LGAs.

ROAD CLASSIFICATION

The current *Commonwealth Roads Grants Act* is based on a three category classification system, providing funds separately for national highways and developmental roads, arterial roads and local roads. While this system is satisfactory for dealing with funding legislation at a national level it is too aggregated for purposes of analysis. A more disaggregate system was needed for the BTE assessment of roads.

Each state has its own system for road classification as indicated in Table 1.1. The classifications shown in Table 1.1 were developed over a period of time to meet the particular legal and operational requirements in each state and are only partially comparable between states. They are used fairly extensively in the documentation on road related matters, but they are not suitable for comparative analysis. For this reason NAASRA developed a Functional Classification System for roads which has been generally adopted for analysis purposes (BTE 1979).

The NAASRA functional classes of roads are divided into nine categories. Categories one to five apply to rural roads and are, respectively, arterial, sub-arterial, collector, local and special. Categories six to nine apply to urban roads and are, respectively, arterial, sub-arterial, local and special.

Since an important concern of the BTE study was the allocation of Commonwealth funds, this consideration, together with a requirement for a classification system sufficiently disaggregated for detailed analysis, resulted in the use of a combination of Commonwealth and NAASRA functional classifications. For the purposes of discussion within this report roads are categorised as:

- national highways;
- rural arterial roads, comprising NAASRA Classes 1, 2 and 3;
- urban arterial roads, comprising NAASRA Classes 6 and 7; and
- local roads, comprising NAASRA Classes 4 and 8.

Special roads, NAASRA Classes 5 and 9, are subsumed into the other categories. For some parts of the analysis and discussion local roads were further divided in rural (Class 4) and urban (Class 8).

Distribution of Commonwealth funding between road categories is relatively straightforward. The Commonwealth funds national highway construction and maintenance approving programs of work proposed and undertaken by the various State Road Authorities (SRAs). Funds for arterial road works are distributed to the states who then have full control of the programs undertaken. Funds for local roads are distributed mainly to LGAs via state governments using formulae agreed to by the three levels of government. These funds may be used by LGAs for roadworks of any type, including maintenance.

ABRD funds are subject to a higher degree of Commonwealth control. They are currently restricted to construction projects only and are distributed to states in broadly the same proportions as funds under the *Roads Grants Act* 1981. Approvals for actual expenditure are made on a project-by-project basis.

ROAD STUDY REGIONS

A system of road study regions was developed to provide a framework for discussion of road matters in finer detail than at a state level only. Regions were selected by consideration of economic geography and were defined to provide maximum compatibility with existing data sets. The chosen regions were made up of integral numbers of local government areas and ABS Statistical Divisions. Full details of the regions are given in Appendix I.

STRUCTURE OF THE REPORT

This report presents a compendium of material obtained from a series of studies undertaken in response to the terms of reference set out previously. Much of the supporting analysis is reported elsewhere and is referred to in the body of the report.

In Chapter 2 the historical development of the Australian road system is examined with particular emphasis on development since the Second World War. Changing standards are discussed and statistics are presented on road length by surface type.

TABLE 1.1—STATE ROAD CLASSIFICATIONS

New South Wales	*Victoria*	*Queensland*	*South Australia*	*Western Australia*	*Tasmania*	*Northern Territory*
Freeways	Freeways					
State highways	State highways	State highways	Highways	State highways	Highways	
Trunk roads						
Main roads	Main roads	Main roads	Main roads[a]	Main roads	Main roads[b]	Main roads
Development roads[c]		Development roads[c]			Development roads[c]	
Tourist roads	Tourist roads				Tourist roads	
	Forest roads					
Secondary roads		Secondary roads		Secondary roads	Secondary roads[b]	Secondary roads
			District roads[a]			Local roads
Unclassified roads	Unclassified roads			Unclassified roads		Other roads
		Urban arterial roads				
		Urban sub-arterial roads				

a. South Australia has no State Road Classification system, but uses categories shown for practical purposes.
b. The roads are grouped as *Subsidiary Roads.*
c. Development Roads as classified in New South Wales, Queensland and Tasmania are *not* the same as the Commonwealth category of Developmental Roads as used in some legislation.

Chapter 3 covers the road planning process in Australia. The road classification system is discussed in some detail and the use of standards is examined. Constraints on investment and the changing pattern of project types undertaken are discussed.

The past and current state of the road system is discussed in Chapter 4. Physical performance indicators are used to assess changes over time and to identify relative needs. The analysis is relatively detailed, covering each category of road separately.

Chapter 5 presents a summary of trends in patterns and levels of road funding over recent years. The relative efforts of different levels of government are examined and the impacts of various funding arrangements are discussed.

Chapter 6 presents an analysis of trends in the demand for road space in Australia and provides forecasts of car and truck traffic by state to the year 2000.

The economics of road investments are examined in Chapter 7. Two basic approaches of analysis were adopted. The first consisted of economic evaluation of notional investment programs, a process very similar to that used in previous CBR/BTE studies. In this case the analysis was extended to programs based on different levels of funding in line with expected changes in actual work programs. The second form of analysis was an assessment of the expected economic return on different project types covering a range of parameter values likely to be met in practice. This analysis also provided some insights into the economics of road standards.

In Chapter 8 the forecast traffic growth and possible financial scenarios are brought together to provide an indication of anticipated future developments. The probable physical changes to road structures and traffic levels of service over the period to 1991 are discussed. Some general issues in relation to road and road fundings are also discussed.

Chapter 9 presents a summary of the findings of the study, with particular reference to expenditure over the 1985 to 1990 periods.

CHAPTER 2-ROAD SYSTEM DEVELOPMENT

BACKGROUND

The Australian road system has developed rapidly, especially in the period since the Second World War. In order to put the events of recent years into an historical context this chapter traces the development of the Australian road system from its beginnings in the nineteenth century to the present day.

Primary focus is on the period since 1945, over which development has been most rapid, but examination of the earlier period is instructive because of the insights it provides on the social and economic factors which continue to influence road development.

ROAD SYSTEM DEVELOPMENT PRIOR TO 1945

In the early days of European settlement in Australia roads were slow to develop. Governor Macquarie was perhaps the first major road builder. Between 1810 and 1821 he succeeded in constructing a number of all-weather turnpike roads to link the farming lands near Sydney (Blainey 1966, p120). In 1814, just one year after Blaxland, Lawson and Wentworth crossed the Blue Mountains, Macquarie commenced construction of a road to the west. Much of that original route remains in use today as part of the Great Western Highway.

Hobart and Sydney had available convict labour for road building, an advantage not then shared by other settlements. The development of road networks in what were to become Victoria and South Australia proceeded slowly until the arrival of convicts in 1850. When convict transportation ceased, roads in New South Wales and Tasmania began to deteriorate, the shortage of labour for roads being exacerbated by gold rushes and agricultural booms.

During early agricultural expansion roads quickly followed settlement and contributed to sustaining development. Basically, the growing road network extended radially from major ports, but each hinterland acquired its own distinctive road pattern, dependent upon the local terrain. The scattered pastoralists of the early nineteenth century lacked lobbying power compared with the urban merchants, and road development remained a low priority (Linge 1979, p72).

The discovery of gold in 1851 produced a sharp increase in demand for inland transport and precipitated the first major crisis in relation to the road system. Although the increased traffic rapidly destroyed existing roads, coach services began to be established and sufficient revenue was produced to enable governments to build good roads and bridges and to establish institutions to ensure their maintenance (CBCS 1973, p141). In the short term, however, little progress was made, since most potential labour had moved to the diggings, and so road conditions deteriorated even in the towns.

Conditions changed rapidly in the latter part of the nineteenth century with heavy government investment in railways. Many existing roads, especially trunk roads, were neglected while many new roads were constructed to provide access to rail-heads and to the towns which often grew there (Coane, Coane and Coane 1915). At the same time the availability of the electric tram helped give impetus to the spread of urban areas (Nilles, Carlson, Gray and Hannerman 1976).

The advent of the motor vehicle at the beginning of the twentieth century produced new pressures for improvement of road standards. The existing roads were 'designed' for low speed, horse drawn vehicles with the result that they exhibited sharp curves, poor visibility and no super elevation. Such geometry was inadequate for the higher speed motor vehicle which also imposed different loads on the road pavement leading to disintegration.

Governments were better prepared to deal with this new crisis than they had been at the time of the gold rushes and responded by establishing authorities to provide road systems which matched the increased demand. The Victorian Country Roads Board commenced operation in 1913 and by the mid 1920s all states had established road authorities.

The end of the First World War brought with it considerable unemployment, the establishment of soldier settlements and an increase in the number and speed of motor vehicles. The latter two factors increased pressure for better roads at a time when authorities were having difficulty finding the necessary finance. These conditions prompted the first Commonwealth assistance to the states for roads (under the *Loan Act* 1922) aimed primarily at alleviation of unemployment. The first Section 96 grants for roadworks were made to the States under the *Main Roads Development Act* 1923. This Act formed the basis for successive acts from 1926 to 1947 (BTE 1981a).

During this period long lengths of road were established and there was rapid development of low cost forms of construction to maximise the length laid down.

The depression of the 1930s slowed down the development of the road system. Vehicle ownership fell betwen 1930 and 1932 and did not reach the 1930 level again until 1935. As a result funds for roads (particularly main roads), which were mostly obtained from vehicle registration revenues, were depressed and so both construction and maintenance suffered.

Unemployment relief was used to finance work on some roads, but most roads remained relatively primitive, in some places 'only wheel tracks worn by decades of trucks' (Holmes 1949, p15).

Australia's involvement in the Second World War directly affected both the road network and the road user. The introduction of petrol rationing in 1940 reduced the use of motor cars for work, leisure and commerce and was a factor in the rapid growth of urban public transport patronage. On the other hand the development of strategically important roads began immediately and, from 1942, was the subject of formal planning and supervision by the Allied War Council.

The development of a system of major arterial roads was hastened and roads and bridges were constructed and strengthened to take heavy army traffic. Resources were concentrated on the construction of those roads needed to move troops and materiel and to provide access to many new airfields. The Stuart Highway, the Eyre Highway and a supply route linking Darwin with Brisbane were constructed during this period. New roads were also built in the isolated regions of Western Australia previously served only by camels and bullock teams.

This concentration of resources on strategic roads, however, exacerbated the deterioration of roads generally during the course of the war.

ROAD SYSTEM DEVELOPMENT SINCE 1945

A significant injection of funds was required in the years succeeding the Second World War to correct the imbalance in resource allocation which had occurred during the war and to halt the rapid deterioration of the rural road network (Lay, 1981).

The road system itself was largely complete by the beginning of the 1950s in the sense that few new links have been established since that time. Available figures suggest that the total length of road in Australia reached about 800 000 km in 1950 and has changed little since then (BTE 1984a, p288). A difficulty confronting the researcher into road matters in Australia is the lack of a consistent, reliable data base so that even simple facts, like the length of road at any time, are difficult to establish with certainty. Certainly there have been *some* additions to the stock of roads over this period (new urban sub-divisions, servicing of soldier settlements, servicing of new mining developments, etc), but these are a comparatively small portion of the total system. Most of the emphasis since the end of the Second World War has been on upgrading the existing road system.

Over the period 1950 to 1980 the Australian population almost doubled while the number of motor vehicles on register increased five fold. Over the same period, as shown in Figure 2.1, expenditure on road works rose in real terms from some $500 million per annum to around $2000 million per annum. However, real annual expenditure on roads exhibited a decline over the period 1975 to 1980 which continued into the early eighties. This decline was arrested by the introduction of the Australian Bicentennial Road Development program which began to have an impact in 1982–83.

The strong growth in (real) expenditure over the period 1950 to 1970 resulted in major improvements to the Australian road system. For example, as shown in Figure 2.2, the proportion of the road system having a sealed surface grew rapidly. In Victoria, New South Wales and Tasmania the proportion sealed grew from less than 10 to over 30 per cent, in Queensland and Western Australia the proportion grew from less than 5 to over 20 per cent, while in South Australia the growth was from 7 to 18 per cent. A decline in the *rate* of sealing was evident by the end of the period.

A significant proportion of the road sealing which took place over this period was on rural local roads, that is, rural roads other than highways, trunk roads and main roads. This had the result that, in some places, relatively lightly trafficked local roads were sealed while the arterial roads to which they gave access remained unsealed (Neutze 1978). Some anomalies of this nature exist to the present day, though by 1981 some 77 per cent of rural arterial roads were sealed (BTE 1984a).

During this period, also, the Commonwealth Government took two initiatives which have had lasting effects on the development of the road system. They were the introduction in 1950 of grants for beef road development and the delineation of a National Highway System in 1974.

Up to 1975 the Commonwealth provided almost $79 million (at current prices) in grants and loans to Western Australia, Queensland and South Australia for the construction of roads specifically to transport beef cattle. In practice, these roads have benefited the pastoralist, both through reduced costs in moving stock and in increased property values (Australian Transport 1977), as well as providing benefits for other users (Aschmann 1976, p14). A specific example is the Charters Towers-Lynd beef road, which also serves the nickel mining township of Greenvale as well as providing access for the construction of the Greenvale-Townsville railway (Queensland Main Roads Department 1973).

In addition, these roads have been instrumental in changing the relative influence of towns served by them. In western Queensland, for example, railhead towns served by beef roads not only gained from increased yarding of livestock, but also gained trade from neighbouring towns served only by poor quality roads (Allen 1965).

The *National Roads Act* 1974 saw the definition of a set of national highways as well as some export and major commercial roads which the Commonwealth Government was prepared to fund completely. The export and major commercial road categories were included to permit direct Commonwealth involvement in planning development of some specific roads and the passage of time has seen the completion of most works on roads in these categories. National highways are an enduring, defined set of roads for which the Commonwealth accepts continuing responsibility for maintenance and construction to standards which it sets itself. By 1981 some 40 per cent of Commonwealth expenditure on roads was applied to national highways which then constituted just over 16 000 kilometres of which about 12 per cent remained unsealed. An ongoing program for upgrading national highways is in place.

Unlike rural areas, where the main concern since the Second World War has been the provision of a basic all-weather road system, road development in urban areas has been dominated by congestion problems. By the early 1970s 46 per cent of road travel in Australia took place on urban arterial roads, which constituted only

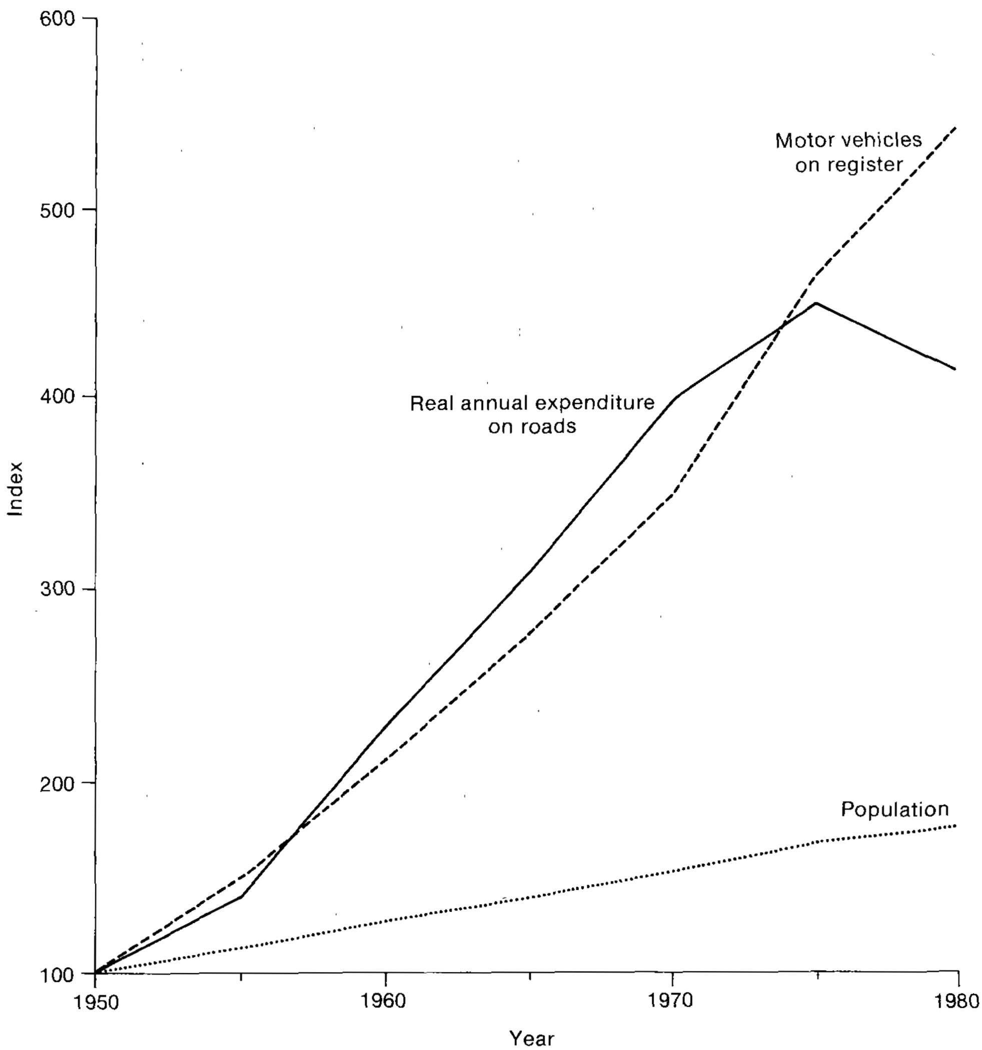
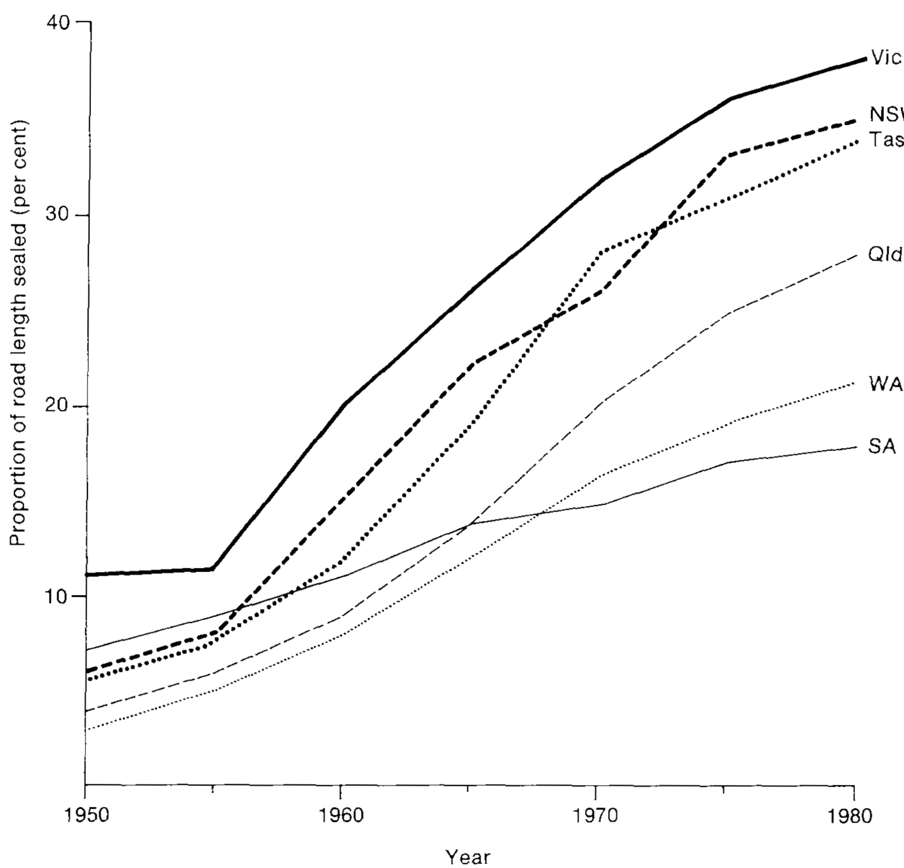


Figure 2.1—Index of growth in population, registered vehicles and real annual expenditure on roads, 1950-80

about 1 per cent of total road length. In addition, some 16 per cent of travel took place on urban local roads, which constituted only an additional 4 per cent of the road length (BTE 1984a, Figures 6.1 and 6.2). By the beginning of the 1980s urban roads were carrying some 66 per cent of the total traffic.

These conditions of increasing pressure for road space, combined with constraints imposed by costs, land availability, etc, have led to several lines of development in the urban road system. Provision of additional traffic lanes and intersection capacity improvements have been combined with traffic management techniques (parking restrictions, clearways, area traffic management control, etc) to make maximum use of existing road reserves. Very expensive alternatives, building of new river/harbour crossings and freeway construction, have been exercised relatively rarely in Australian cities. Figure 2.3 shows the growth in metropolitan freeway length from 1960 to 1980. Only some 250 kilometres was completed over that period, with the most rapid growth in the early 1970s and a fall off in the late 1970s.



Source: BTE (1984a).

Figure 2.2—Proportion of road length in each State sealed, 1950–80

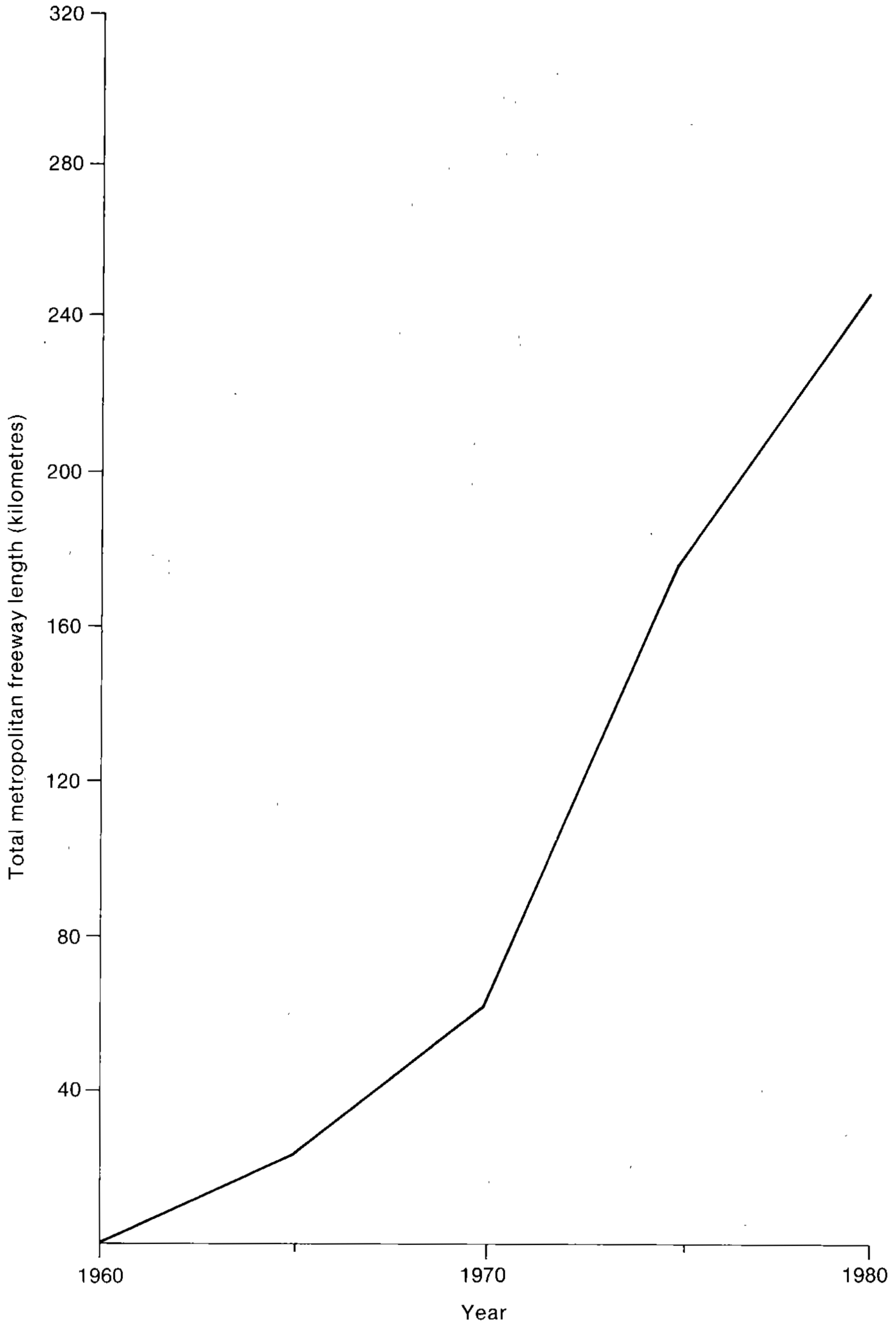


Figure 2.3—Metropolitan freeway length, 1960–80

ROAD SYSTEM IN 1981

The total length of road by state and category in Australia is shown in Table 2.1. Also shown in the table is the length of road which has a sealed surface.

Of the approximately 800 000 kilometres of road some 680 000 kilometres, or about 85 per cent, is classified as local road (either rural or urban). Most of this road length is intended for primary access to properties and services, and is constructed and maintained by local government (albeit with significant contributions from Commonwealth and State governments as indicated in Chapter 5). These roads are characterised by generally low traffic volumes, around 1000 vehicles per day on urban local roads and about 50 vehicles per day on rural local roads (BTE 1984a), and only about 19 per cent of the length of rural local roads is sealed. The proportion of local roads and sealed varies significantly between the states.

Urban arterial roads represent only about 1 per cent of total road length, but the average traffic for this class of road is around 13 000 vehicles per day, although actual conditions vary widely from place to place. Almost all urban arterial roads are sealed and many are multi-lane roads, with something like 20 per cent divided (that is, dual carriageway) road (BTE 1984a).

Rural arterial roads constitute some 12 per cent of total road length in Australia and are sealed for approximately 77 per cent of that length (although, once again, there is a fairly wide variation among States). Traffic averages around 600 vehicles per day.

The national highway system comprises about 2 per cent of the total road length and is sealed over about 88 per cent of its total length, the unsealed length comprising some 400 kilometres in Queensland, 900 kilometres in South Australia and 700 kilometres in Western Australia. Average traffic on national highways is about eleven hundred vehicles per day. Generally speaking national highway design standards are set a little above rural arterial roads standards for roads carring similar traffic volumes although the standards applied in each case vary with location and traffic volume.

TABLE 2.1-ROAD LENGTH, AUSTRALIA 1981

(km)

State or Territory	Road category											
	National highway		*Rural arterial*		*Rural local*		*Urban arterial*		*Urban local*		*Total*	
	All	*Sealed*	*All*	*Sealed*	*All*	*Sealed*	*All*	*Sealed*	*All*	*Sealed*	*All*	*Sealed*
New South Wales	1 300	1 300	30 000	21 100	150 000	36 400	2 200	2 200	12 000	11 000	195 500	72 000
Victoria	700	700	15 400	15 000	129 400	36 500	2 500	2 500	12 000	11 000	160 000	65 700
Queensland	3 900	3 500	19 300	14 400	130 800	22 000	1 100	1 100	8 000	7 000	163 100	48 000
South Australia	2 600	1 700	10 400	8 400	83 200	5 100	600	600	5 000	4 500	101 800	20 300
Western Australia	4 700	4 000	16 400	12 200	112 800	15 800	800	800	4 000	3 800	138 700	36 600
Tasmania	300	300	2 600	2 400	12 900	4 000	300	300	1 000	900	17 100	7 900
Northern Territory	2 700	2 700	3 100	1 400	14 700	800	..	..	500	500	21 000	5 400
Australian Capital Territory	..	..	100	100	400	200	300	300	700	700	1 500	1 300
Total	16 200	14 200	97 300	75 000	634 200	120 800	7 800	7 800	43 200	39 400	798 700	257 200

.. not applicable

CHAPTER 3-PLANNING ROAD INVESTMENT

BACKGROUND

Road investment planning is a highly complex activity involving all three levels of government. The vast majority of investment decisions are made by state governments or their authorities, although both Commonwealth and local governments exercise a significant degree of influence[1]. Investment planning and the mechanisms for distribution of road funds are closely related, and institutional rigidities in the latter process have a bearing on the effectiveness of the former. In principle, strategic planning is undertaken centrally with detailed (tactical) planning devolved to regional authorities and agencies, but, in practice, the process is much more complex.

The multiplicity of parties involved has led to a disparate collection of different systems of road classification. Each system has been developed, and/or modified from time to time, to meet the requirements of individual agencies, but lack of a common base presents major problems in setting goals, identifying aims and distributing resources. Functional classifications have been developed and are used by road planners which often do not correspond with legal classifications used to assign responsibilities and in the distribution of funds. An indication of the classifications currently in use is given in Table 1.1.

Add to these factors the inherent differences between states and regions (geographic, meteorological, demographic, etc) and the complicated nature of road investment planning in Australia becomes fully apparent.

The BTE is required to assess road investment from a national perspective, but it must be recognised that formal road investment planning is not undertaken on a national basis. It is essential to understand the processes used in road investment planning in order to forecast the likely results of different levels and patterns of funding.

Theoretically every road investment (capital or maintenance) could be subjected to a formal economic evaluation and programs developed on the basis of those projects showing the highest economic return. Clearly such an approach is quite impractical. Detailed evaluations are generally applied only in the case of very large projects, where the overhead costs of the study are justified by the size of both costs and benefits. For more regular day-to-day decisions on road investment the question of the 'worth' of each project is implicit in the standards used to set priorities and the design elements of projects. These standards should reflect the economic returns obtained from road investments and this aspect of road planning is discussed in some detail in Chapter 7. In addition, there are factors to be considered beyond pure economic efficiency as a basis for investment planning. Equity/distributional aspects are included, usually implicitly, but sometimes explicitly. Historical continuity is another important element. Sudden changes in allocation of road investment funds could produce dislocations in 'local' economies and hence the ability to vary funding patterns is limited and changes tend to be slow. Decisions made in the past about the appropriate standard for a particular road are rarely subject to formal reappraisal,

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1. The Commonwealth Government exercises its power to approve national highway and ABRD programs, but the project planning is undertaken by state and local governments.

on the assumption that roads already in existence at a certain standard are justified and should be maintained to that standard[1].

ROAD STANDARDS

The role of standards is fundamental to the current process of road planning. Much of the actual decision-making in relation to road investment is made at a relatively low (dispersed) level in the responsible organisation, and standards provide some basis for uniform implementation across administrative boundaries. This is not to say that a common set of standards is applied rigorously throughout Australia, but rather that such a set forms consistent broad guidelines which provide a basic starting point for the decision process.

The system of standards applied to planning investment in roads in Australia has evolved, and continues to evolve, over time. As community expectations have increased so the standards against which existing roads are judged (assessment standards) and the standards to which roads are upgraded (design standards) have risen steadily.

The standards used in both planning and road development and in analysis of investment programs reflect engineering judgment of the appropriate level of service to be provided. Traditionally the amount by which a road falls below the appropriate assessment standard is referred to as the degree of 'deficiency' and the investment required to bring that road to the appropriate design standard is identified as the road 'need'. These terms were used extensively in previous BTE and CBR reports on roads.

Standards are seen as a guide to road builders rather than as rules which must be followed. In practice there are marked variations among and within the states in regard to the application road standards in practice.

Any discussion of standards tends to focus on matters of degree rather than on matters of absolute level, on timing of upgrades rather than on magnitude. This is because there are serious technical difficulties in defining optimal standards at any one time in any particular set of circumstances, let alone defining optimal strategies in a general sense. Thus there exists an array of intermediate standards between that for an existing section of road and that which is judged technically desirable for that section of road. Application of any of these intermediate standards would release some resources for use elsewhere in the system, and these 'trade-offs' are one of the mechanisms by which planners take account of local needs. There are cases where standards are applied rigidly, usually where a more central body over-rides a less central body, often because of different perspectives in relation to road investment.

A particular problem of road investment is the 'lumpiness' of upgrading options compared with the generally continuous change in traffic pattern and volume. The criterion to be applied in moving from one standard to another (say unsealed to sealed, or two lanes to four) must, of necessity, be set at some (relatively) fixed traffic level although the traffic load on the road is changing continuously. It is practically impossible to change a road incrementally to match a changing traffic pattern, changes always result in some quantum leap in capacity or quality. Just like the standards themselves the criteria for their selection are only guidelines for any particular case. Taken together, however, the standards to be applied and the criteria for their selection form the main basis of practical road planning.

Applying engineering judgement, the NAASRA Roads Study Team put together

1. The high cost of long-term maintenance of sealed roads has caused some questioning of this stance recently. The suggestion has been made that some sealed roads will be returned to gravel status. However, in most cases this seems to have been used more as a bargaining ploy when seeking additional funds rather than as a serious proposition.

descriptions of quality of service which reflect current thinking (NAASRA 1984b, Chapter 4). Measures were developed relating to road type, surface, alignment, roughness, bridge strength and bridge width and were used to divide the road system into 'poor, 'fair' and 'good' quality of service. The boundary values produced should not be taken as absolute standards to be universally applied, but rather as indicative measures suitable for generalised assessment of road service.

The suggested boundary levels of traffic volume for roads of different surface type and width are given in Table 3.1.

TABLE 3.1—TRAFFIC VOLUME/ROAD TYPE INDICATORS OF SERVICE QUALITY
(vehicles/day)

Road type	*Fair*	*Poor*
Natural surface	60	100
Formed	60	100
Gravel 1 lane (up to 4.5m)	60	100
Gravel 2 lane (over 4.5m)	60	150
Sealed 1 lane (up to 4.5m)	150	300
Sealed 2 lane (4.6 to 6.4m)	1 000	4 000
Sealed 2 lane (6.5 to 9.1m)	4 000	6 000
Sealed 3 lane (8.2 to 11.6m)	6 000	10 000
Sealed 4 lane (over 11.6m)	10 000	13 000
Divided 4 lane (up to 9.1m x 2)	15 000	30 000

Source: NAASRA (1984b), Figure 4.4.

In regard to alignment criteria of service, NAASRA suggested that for sealed rural arterial roads curves giving a design speed of less than 70 kilometres per hour be defined as giving a poor quality of service while curves with design speeds in the range 70 to 90 kilometres per hour be defined as giving a fair quality of service.

The roughness of sealed roads as measured by the NAASRA Roughness Meter (NRM) was taken as another basis for assessing quality of service. Roads with roughness counts exceeding 140 per kilometre were classified as giving poor quality of service while roads with between 100 and 140 counts per kilometre were judged as fair. Roads with less than 100 counts per kilometre were assessed as providing a good quality of service in relation to roughness.

Level of service provided by bridges was assessed in two ways by the NAASRA Team. Carrying capacity was defined as a percentage of T44 design loading[1]. Bridges with a strength of less than 50 per cent of T44 were classified as poor, while those with a strength in the range 50–75 per cent of T44 were assessed as fair. Bridges with strength greater than 75 per cent of T44 were regarded as good on a strength basis. In relation to width the NAASRA Study Team suggested that bridges of less than six metres between kerbs be regarded as single lane and classified as fair for traffic volumes of less than 300 vehicles per day or poor if traffic exceeds that figure. Bridges with width greater than six metres were automatically classified as providing a good level of service.

While the above criteria certainly do not represent conditions which would automatically trigger upgrading action they do give an indication of the levels of service at which the practising roads engineer would look seriously at upgrading options. Clearly the roads falling into the poor quality of service classification would

1. T44 capacity corresponds to a 44 tonne gross mass articulated truck in each lane of the bridge. Legal load limits are roughly 75 per cent of T44 at present.

cause most concern, but would not automatically receive funding priority over roads in other categories because of the many other factors to be considered.

Similar criteria have been developed to assess the level of service provided by urban arterial roads. For the first Australian Roads Survey (ARS) CBR and NAASRA officers developed a set of criteria based on travel speeds, intersection delays, queue length and generalised road capacity (CBR/NAASRA 1969). Peak hour travel speeds were set appropriate to urban arterial roads passing through zones with different job densities, reflecting different types of environment. Roads where travel speeds fell below the set criteria were deemed to be deficient. The speed criteria are summarised in Table 3.2.

TABLE 3.2—SPEED CRITERIA FOR URBAN ARTERIAL ROAD DEFICIENCY, ARS 1969-74

Road type	*Job density (job/sq km)*	*Speed standard (kph)*	*Equivalent volume/ capacity ratio*
Arterial	>6000	16	0.90
	2000 - 6000	24	0.85
	400 - 2000	32	0.80
	200 - 400	40	0.75
	< 200	48	0.75
Freeway	All	56	0.90

Note: Figures shown in the table are nearest metric equivalents of the original imperial values.

Source: CBR/NAASRA ARS Specification 1969.

Criteria developed to identify deficient intersections were average delays in excess of 30 seconds per vehicle during the peak half hour or an average queue length exceeding three vehicles per lane.

Where there was reason not to use the detailed speed and intersection level of service criteria the same document suggested a reliance on road capacity based on twenty-four hour two way traffic. The limits specified were as shown in Table 3.3.

Such basic criteria for deficiency were adjusted to take account of particular intersection treatments, one-way traffic, presence of trams, etc, but give a reasonable

TABLE 3.3—CAPACITY BY ROAD TYPE (24 HOUR TWO WAY TRAFFIC)

Road type	*Capacity (000 vehicles/day)*
2 lane (with parking)	12
3 lane 17 4 lane (undivided)	20
4 lane (divided)	25
6 lane (undivided)	32
6 lane (divided)	40
8 lane (divided)	50
Freeway	
4 lane	50
6 lane	90
8 lane	120

Source: CBR/NAASRA ARS Specification 1969.

indication of standards current at the end of the 1960s and beginning of the 1970s.

For the current NAASRA Roads Study the study team identified daily traffic volume criteria as a basis for separating 'good', 'fair' and 'poor' levels of service on urban arterial roads (NAASRA 1984a). The criteria are summarised in Table 3.4.

TABLE 3.4—DAILY LANE TRAFFIC VOLUMES FOR POOR, FAIR AND GOOD PEAK FLOWS

	Vehicles per day per lane		
Road type	*Good service*	*Fair service*	*Poor service*
2 lane (undivided)	6 500	6 500– 8 500	8 500
Multilane	8 000	8 000–10 000	10 000
Freeway	11 000	11 000–14 000	14 000

Source: NAASRA (1984a).

The criteria in Table 3.4 are based on volume to capacity ratios of 0.7 for the boundary between good and fair and 0.9 for the boundary between fair and poor. These imply acceptance of a slightly lower standard of service than is implicit in the earlier deficiency criteria. Actual conditions have changed during the 1970s, however, with much greater use of traffic management procedures which smooth traffic flow at higher volumes so that the change in criteria may be imaginary rather than real.

Local roads serve a purpose entirely different from that served by arterial roads and so it is inappropriate to use similar criteria to define levels of service.

As indicated in Chapter 2, rural local roads generally carry very low traffic volumes and provide basic access. Limited research (BTE 1983) suggests that travel speed is relatively unimportant, the main concerns being all-weather trafficability and safety (reflected primarily in road geometry and surface condition). It is very difficult to convert these general concepts into quantitative criteria. The proportion of local road length in a given area which is sealed is an indicator of all-weather trafficability, but a well-maintained gravel road will also meet that requirement. Direct measurements related to the number of people 'cut-off' in bad weather and the length of the interruption to movement are hard to obtain. No really satisfactory set of criteria has been established to date.

Urban local roads also serve functions very different from arterial roads. The average traffic on them is much higher than for rural local roads and it is often this aspect which reduces their total level of service from a broad community viewpoint. The CRB/NAASRA officials who developed deficiency criteria suggested that residential streets should not carry more than 1500 vehicles per day and local roads in commercial/industrial areas not more than 3000 vehicles per day. These criteria have been fairly generally accepted as forming an appropriate traffic level at which action should be taken.

PROVISION OF ROADS

While the above discussion indicates the types of standards applied in assessing any particular length of road, there are other factors which affect the planning process, particularly as it relates to resource allocation at the higher levels (that is, regional and state levels). In particular, reconciliation of the (often conflicting) requirements of social equity and economic efficiency plays a major role.

Much of the analysis of road investment undertaken to date has focussed almost exclusively on the question of economic efficiency as indicated by benefit/cost analysis[1]. Clearly many other factors are taken into account in the development of road investment programs, as revealed by the fact that successive governments have allocated a greater share of funds to local roads than would be appropriate on efficiency grounds alone. In the present study an effort has been made to assess the impact of some of these factors, in particular the practical constraints on fund allocation.

The provision of roads may be seen as a two-stage process:

- the building of a basic infrastructure to a (gradually rising) socially acceptable standard; and
- the improvement of the basic system to provide an economically justified level of service appropriate to traffic volume, speed, etc.

It is apparent that the community as a whole sees the availability of a 'basic' road system in terms of access and connectivity as the right of all members of the population. What constitutes an appropriate standard for this basic system changes over time and geographical location, but reflects the views of governments as to what is reasonable and achievable at any particular time. Certainly community expectations of what is reasonable and achievable have been rising. For example, in a situation where a gravel, all-weather road may have been considered to be appropriate for a particular link in the 1950s, the 1960s would have seen the expectation of it being replaced by a narrow sealed road, and current expectations would probably be for a two-lane sealed road. This concept should not be confused with the idea of increased standards to meet increased traffic; it represents the perception of a 'basic right' and is (relatively) independent of traffic considerations.

The second stage of road provision is concerned with the provision of a facility over and above the 'basic' road. The primary focus of this stage is on matching the road standard to the traffic so as to maximise economic return.

In no state is the 'basic' road system complete to a publically 'satisfactory' standard and, indeed, constantly rising public expectations make it practically certain that it never will be. However, the differences in degree of development among the states makes it apparent why the different states give different weights to 'basic infrastructure' and 'economic efficiency' warrants for road investment[2].

Another significant aspect of the planning process associated with road investment is the presence of quite firm constraints on how funds are expended. Some of these constraints are inherent in the nature, age and condition of the road system itself; while others are the result of institutional and political factors.

One of the most important constraints to road investment arises from the historical pattern of road development (the age and condition of the existing network). Each year a greater proportion of available resources is required simply to physically maintain the existing network. Except in very rare instances, every upgrading of a road adds to the long-term annual maintenance cost[3]. Thus, all else being equal, a smaller proportion of resources is available annually for upgrading projects.

In practice, the order of priorities for expenditure on roads may be summarised as:

- firstly to maintain the asset;

1. See for example Commonwealth Bureau of Roads *'Roads in Australia 1975'* and Bureau of Transport Economics *'An Assessment of the Australian Road System: 1979'*.
2. Nor is this phenomenon limited to state governments and instrumentalities. The Commonwealth Government and local governments exhibit similar behaviour patterns in relation to the distribution of resources for which they are responsible.
3. In this context the term 'maintenance' is used to cover all activities aimed at restoring a road to its original physical condition. Under this definition resealing, resurfacing and pavement reconstruction would all qualify as maintenance.

- secondly to undertake improvements to match traffic growth (thus maintaining the level of service); and
- thirdly to improve the quality of service.

As indicated above the resources required to meet the first item (maintenance of the system) increase each year and, what is more, the location of required work is largely a function of age, climate and traffic, that is, it is outside the control of the planner. The constraints in relation to the second item (maintenance of the existing level of service) are slightly less severe, in that timing of upgradings may be manipulated to some extent or a conscious decision may be made to allow some rundown in level of service, but there still remains only limited scope for discretion on the part of the planner. It is really only in relation to the third item that the planner has wide discretion in allocation of resources.

The sheer size of some projects combined with institutional arrangements also has a major bearing on road investment decisions. The national highway program and the Australian Bicentennial Road Development (ABRD) program provide some insights into this aspect of the planning process. The various parties involved in the investment decision process see the road system from their own perspective and, hence, view projects and programs differently. The Commonwealth planner views a national highway as an interstate link. The state planner views the same road as an intrastate link and assesses its value on that basis. To a local government planner the road may appear more of a liability than an asset, especially if it divides the area in some significant way (BTE 1983, p82). Similarly a head office planner in a state road authority (SRA) will view a road in the context of the total state road system whereas a Divisional Engineer will see it in the context of his divisional road system.

These differing perspectives produce a number of effects.

A well-established effect is the tendency for authorities to upgrade roads selectively to meet local requirements, neglecting completely the interest of users from beyond their borders. This 'parochialism' in planning and investment was the main reason why, firstly, the SRAs were established to develop state-wide systems and, secondly, the national highway program was set up to develop a national system. It is also a major reason why SRAs have central planning staff to co-ordinate programs developed in the divisions.

A less well-recognised effect is produced by a combination of different perspectives and the institutional arrangements relating to resource allocation. By and large the funds for road investment are distributed among planning units in a relatively fixed pattern. The planner at the 'lower' levels generally has many more potential projects than he can fund and tends to spread the available resources as widely as possible. This tends to work against very large projects, which would soak up a large part of an annual budget, and for which the benefits are only really fully visible from a 'higher' planning level. Both the national highway program and the ABRD program have allowed major projects to proceed which might have been delayed for long periods if special funds had not been set aside at a 'higher' planning level.

Problems of an institutional nature may appear in other forms also. The distribution of funds among local government areas or among divisions within an SRA exhibit rigidities which complicate the planning process. Changes of circumstance may make it desirable to allocate resources in proportions different from those previously prevailing, but the 'bottom up' development of actual work programs and the low mobility of many physical resources (for example labour) place strong contraints on the speed of change.

At the local government level the planning problem is particularly acute. The legacy of extended sealing in the 1950s and 1960s is a mounting road maintenance task, while local pressures for new sealing and upgrading remain. The availability of local funds, and the proportion of road funds from outside (state and Commonwealth) sources varies widely between LGAs (BTE 1984b) leading to different emphasis on road works. Some local roads have been built to higher standards than state main roads in the same areas, reflecting different priorities and resource availability between different levels of government.

Long term structural change in the economy can also have a bearing on road planning and investment decisions. Overall priorities may change in a way and at a speed which places strain on existing institutional arrangements.

Changing priorities for roads and other works are reflected in actions of some local governments. Additional funds made available recently in the form of untied grants have been used either to hold down rates or to provide facilities such as libraries and swimming pools rather than to improve the road system; in other words there may be some degree of substitution of non-road projects. This does not mean that the road system in such areas is 'complete' or 'perfect', but that greater priority is being given to other issues. It does suggest that no really major deficiencies are present in such local road systems.

Given these conflicting pressures and constraints, it is clear that the road planner in Australia has much less discretion in application of resources in practice than appears, at first sight, to be the case. To a large extent, he is the captive of developments in the 1950s and 1960s, which will probably ensure that most available resources in the 1980s will go into maintaining the existing system, with a diminishing residue available for upgrading.

APPLICATION OF FUNDS

Table 3.5 shows the pattern of expenditure on different categories of work for national highways and rural arterial roads in 1980-81.

TABLE 3.5—EXPENDITURE PATTERN FOR NATIONAL HIGHWAY AND RURAL ARTERIAL ROADWORKS, 1980-81

(per cent)

State or Territory	National highways			Total	Rural arterial roads			Total
	Upgrading	*Restoration*	*Maintenance*		*Upgrading*	*Restoration*	*Maintenance*	
New South Wales	69	17	14	100	21	41	38	100
Victoria	68	17	15	100	14	43	43	100
Queensland	70	6	24	100	33	40	27	100
South Australia	73	8	19	100	26	6	67	100
Western Australia	70	6	23	100	25	40	36	100
Tasmania	68	20	14	100	55	11	33	100
Northern Territory	23	43	33	100	16	30	54	100
Australia	67	14	19	100	25	37	39	100

Source: BTE estimates based on data from NAASRA Roads Study 1984.

In the context of Table 3.5 the term 'upgrading' refers to projects whose primary purpose is to improve the standard of the road above that to which it was originally constructed. This may be to keep pace with traffic growth or to improve the level of service provided. It covers activities such as establishing new routes, duplicating existing roads, laying down a new seal or a new gravel surface, realignment of a road or road widening. It also includes major bridge works.

The term 'restoration' covers work aimed at restoring a road to original condition when it has deteriorated physically due to traffic or weather. It covers activities such as reconstruction of pavements and rehabilitation generally.

The term 'maintenance' covers regular activities such as resealing or resheeting, routine maintenance and bridge maintenance.

The figures presented in the table must be regarded as indicative rather than definitive because records of expenditure are not kept in precisely this form and because many actual projects contain an element of upgrading as well as restoration, or similar combinations of aims.

The pattern of expenditure on national highways appears fairly consistent across the country except for the Northern Territory. Some two-thirds of expenditure goes on upgrading with the remainder divided fairly evenly between restoration and maintenance. The high restoration and maintenance components in the Northern Territory may reflect the costs associated with maintaining the relatively old sealed Darwin to Alice Springs link, or may be the result of mis-classification of some works.

The pattern of expenditure on rural arterial roads is less consistent among states. Tasmania exhibits a high proportion of expenditure on upgrading projects while South Australia shows a high proportion applied to maintenance. In general, however, it is clear that a much higher proportion of funds is spent on restoring and maintaining arterial roads than is the case for national highways. The proportion of funds applied to restoration and maintenance is expected to increase in the future as roads upgraded in the 1950s, 1960s and 1970s require restorative action[1].

In the case of urban arterial roads the expenditure patterns for the five major capital cities were quite similar, as indicated in Table 3.6. However, Brisbane, Adelaide and Perth showed a slightly higher proportionate expenditure on major upgradings than did Sydney and Melbourne. A greater proportion was spent in the latter two cities on minor improvements and rehabilitation, while Adelaide applied a greater share to maintenance and operations than did the other cities. No city expenditure pattern was far from the average, however.

In practice major upgradings are few in number, but their very high cost ensures that they absorb a major proportion of funds available.

Data on expenditure patterns for local roads is less complete, but the results of a BTE survey of rural local governments indicated that the split of funds between construction and maintenance in 1979–80 averaged almost exactly 50:50 (BTE 1984b,

TABLE 3.6—EXPENDITURE PATTERN FOR URBAN ARTERIAL ROADWORKS; MAJOR CITIES, 1980-81

(per cent)

City	*Major upgrading*	*Minor upgrading and rehabilitation*	*Operations and maintenance*	*Total*
Sydney	56	26	17	100
Melbourne	56	30	14	100
Brisbane	64	21	15	100
Adelaide	62	16	22	100
Perth	68	20	12	100
Average	59	25	16	100

Source: BTE estimated based on data from NASSRA Roads Study 1984.

1. The use of expenditure as a measure of activity tends to mask the actual effort going into maintaining the road system since upgrading projects tend to involve much higher costs per kilometre than do restorative or maintenance works.

Chapter 6)[1]. Some significant differences among States were revealed. For example some 58 per cent of funds were applied to construction in Western Australia compared with only 29 per cent in Tasmania. It was postulated that the differences were due to a combination of economic, financial and climatic factors, but the reasons have not been explored in depth.

NAASRA sampled some 114 local government areas in the course of its study and produced figures consistent with the BTE survey. NASSRA found that funds for maintenance and rehabilitation of local roads in rural areas accounted for almost exactly half of total expenditure, while the corresponding figure for urban local roads was 62 per cent (NAASRA 1984a, Figure 11).

1. Note that, in this case, the term 'construction' includes refurbishment of pavement, heavy sealing, thick layers of gravel, etc, which would be classed as 'restoration' work in the case of arterial roads. The term 'maintenance' is limited to maintenance and simple resheeting or resealing.

CHAPTER 4—PAST AND CURRENT STATE OF THE ROAD SYSTEM

BACKGROUND

This chapter contains a brief general assessment of the state of the Australian road system and a commentary on the changes which have occurred over recent years. Emphasis is placed on the physical performance of the road system from a user point of view, addressing the question of how well the system performs the functions for which it has been built.

As indicated earlier in this report different classes of road are intended to serve different purposes and, hence, require different criteria for assessment of their performance. Also there are significant differences between the tasks performed by urban and rural roads of the same functional class, not only in terms of the type and volume of traffic which they carry, but also in relation to the social functions they perform. Major discussion in this Chapter is partitioned by road class (arterial and local) and by geographical area (rural and urban). National highways are treated as a separate category. This is in line with the classification procedure set out in Chapter 1 of this report.

In each case some material on the general characteristics and physical state of the particular set of roads is followed by discussion of its current and immediate past performance. Performance is assessed mainly on the basis of travel times, comfort and convenience, safety and vehicle operation. 'Comfort and convenience' covers a number of subjective characteristics of the road system which cannot be measured directly, so that surrogates such as surface type and width-to-volume relationships are used for this purpose. Vehicle operations are covered only briefly in this chapter, being a significant component of the economic assessment described in Chapter 7.

NATIONAL HIGHWAYS

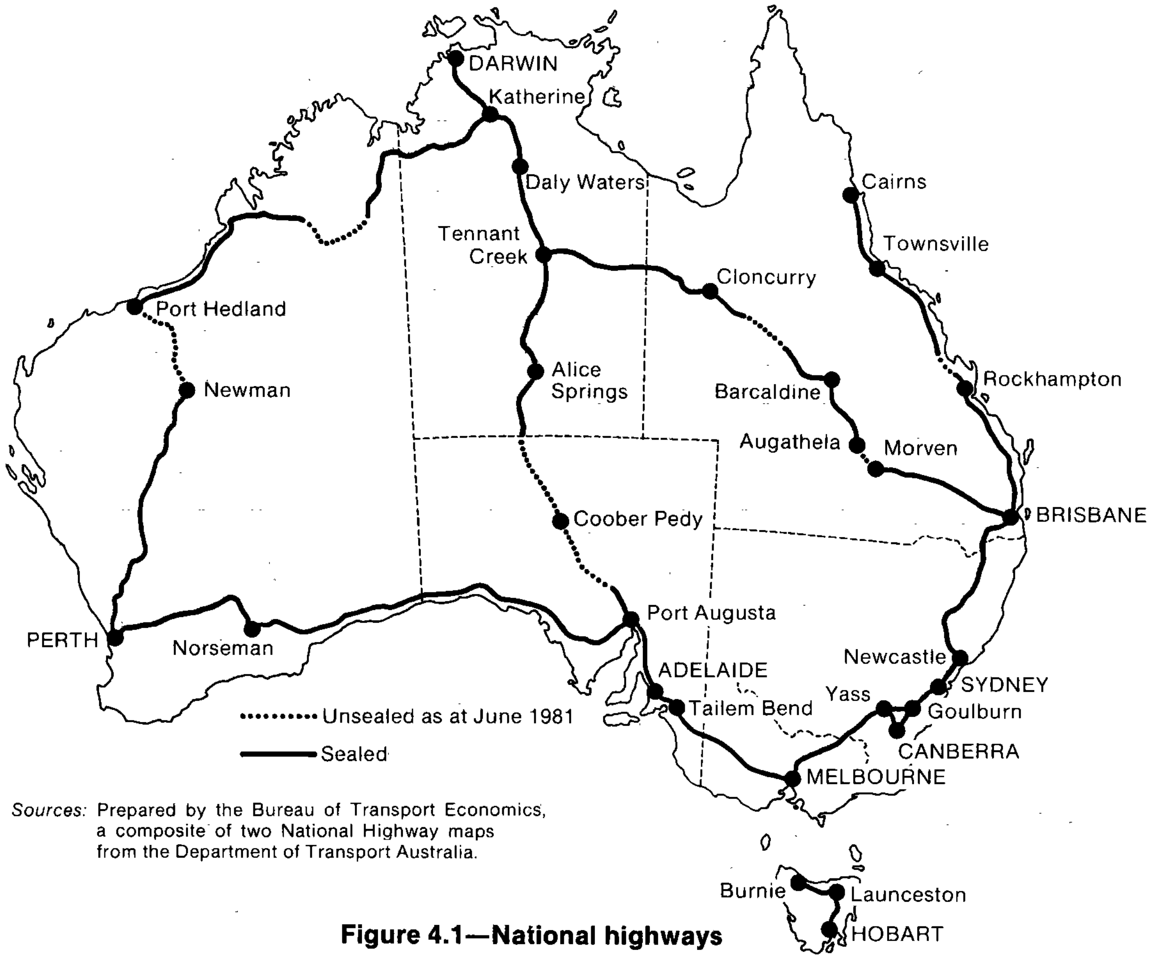
National highway system

The set of roads designated national highways was defined by the Commonwealth Government in 1974. It consists of the major links between capital cities plus the highways from Brisbane to Cairns and Hobart to Burnie, as shown in Figure 4.1. The Commonwealth Government committed itself to taking full responsibility for the funding of both construction and maintenance of national highways. It sets the design standards for these roads, although the actual work remains in the hands of state road authorities.

Although national highways form a relatively small proportion of total road length in Australia they serve to link together some 68 per cent of the total population, as indicated in Table 4.1.

Sealing of national highways

By 1972 all roads now designated national highways in New South Wales, Victoria and Tasmania were sealed. At that time something over 400 kilometres of national highway in the Northern Territory remained unsealed, but that length has now been sealed. In Queensland the unsealed length of national highway decreased from just over 600 kilometres (16 per cent) in 1972 to less than 350 kilometres (9 per cent)



Sources: Prepared by the Bureau of Transport Economics, a composite of two National Highway maps from the Department of Transport Australia.

Figure 4.1—National highways

TABLE 4.1—POPULATION OF URBAN CENTRES LINKED DIRECTLY BY NATIONAL HIGHWAYS, 1981

State or Territory	*Million*	*Per cent of total population*
New South Wales	3.41	67
Victoria	2.74	72
Queensland	1.40	61
South Australia	0.94	73
Western Australia	0.86	67
Tasmania	0.27	64
Northern Territory	0.08	68
Australian Capital Territory	0.02	100
Australia	9.93	68

Source: BTE estimate based on ABS Census 1981.

in 1981. Over the same period the unsealed length in South Australia decreased from just over 1500 kilometres (58 per cent) to just on 900 kilometres (35 per cent). Western Australia achieved a similar reduction from just on 1900 kilometres (40 per cent) in 1972 to just over 700 kilometres (15 per cent) in 1981. Taken altogether, by 1981 some 88 per cent of the 16 000 kilometres of national highway in Australia had been sealed.

Generally speaking the length of national highway remaining unsealed in 1981 carried low traffic volumes, but some sealed sections are comparatively narrow for the traffic volumes they carry. The NAASRA Roads Study results indicate that some 50 per cent of national highway travel in 1981 took place in conditions judged to be 'poor' or 'fair' under the criteria indicated in Table 3.1 of this report (NAASRA 1984b). The same study indicated that most national highway bridges (75 per cent) have a strength in line with existing maximum legal vehicle mass limits while some 82 per cent were assessed as 'good' on the basis of the width criteria set out in Chapter 3 of this report.

Traffic conditions on national highways

BTE investigations (BTE 1984a, Chapter 2) indicate that there has been a significant improvement in traffic conditions on national highways over the period 1972 to 1981. Time series data on national highway travel times are limited, being available only for New South Wales, Queensland and Tasmania, but does indicate a general improvement over the last decade (BTE 1984a, Chapter 2).

Over the period 1966 to 1981 travel times between Sydney and the Queensland border decreased by one hour five minutes (9 per cent) and between Liverpool and the Victorian border by 30 minutes (6 per cent). These times reflect the improvements made to the roads concerned, which have more than offset any deterioration in travel times due to increased traffic levels.

In Queensland travel times between Brisbane and Cairns decreased by approximately two hours (8 per cent) and between Brisbane and the Northern Territory border by about one and three quarter hours (6 per cent). Over the same period travel on Queensland National Highways increased by 61 per cent. Between 1969 and 1980 travel time between Hobart and Burnie decreased by almost one hour (17 per cent), the main saving occurring between Burnie and Devonport. These savings were obtained despite an increase in travel on Tasmanian national highways of 33 per cent between 1972 and 1981.

Clearly not all the savings can be attributed to road improvements, but it is apparent that the major works done on national highways over the last decade have produced significant results, which more than offset any increase in travel time due to the rise in traffic.

Accidents on national highways

Available data on road safety over the last decade is limited, but there appears to have been a decline in the number of fatal accidents per hundred million vehicle kilometres of travel on national highways in those states for which data is available (Victoria, Western Australia and Tasmania), (BTE 1984a, Figure 2.7). Fatality rates (as distinct from fatal accident rates) in South Australia show a similar trend.

Overview

Thus, although much remains to be done and many sections of national highway remain below the minimum standards set for such roads, investment over the last decade has been sufficient to generate a general improvement in operating conditions in spite of a steady growth in traffic.

RURAL ARTERIAL ROADS

Rural arterial road system

The set of arterial roads set discussed in this section is slightly larger than 'rural arterial roads' as defined by the Commonwealth Government for funding purposes. The set of roads discussed here corresponds to that used in the current NAASRA study, and more importantly, that for which comprehensive data is contained in the NAASRA Data Bank (NDB). The variation is slight, mainly the inclusion of some outer urban arterial roads, and does not significantly distort the general thrust of the analysis presented here.

The rural arterial road system comprises some 97 000 kilometres of which about 77 per cent was sealed by 1981 compared with some 70 per cent in 1972. The states with the less-developed road systems (Queensland, Western Australia and Northern Territory) exhibited the greatest rate in growth of percentages sealed (BTE 1984a, Tables III.20 to III.37).

Level of service in rural arterial roads

The NAASRA Roads Study results indicate that some 24 per cent of rural arterial roads rate only 'poor' or 'fair' in relation to the criteria indicated in Table 3.1 of this report (NAASRA 1984b) and that some 50 per cent of travel took place under such conditions (NAASRA 1984b) in 1981. NAASRA results also indicate that some 63 per cent of bridges on rural arterial roads may be classified as 'good' on strength grounds, with many of those classified 'poor' or 'fair' being relatively old timber bridges. Some 79 per cent of bridges were classified 'good' on width/traffic grounds (NAASRA 1984b) using the criteria discussed in Chapter 3 of this report.

In general unsealed arterial roads are located in areas of low population density and carry smaller traffic volumes than their sealed counterparts.

Table 4.2 shows the length of arterial road remaining unsealed in 1972 and in 1981 and, specifically, the length carrying more than 300 vehicles per day.

It may be observed that while the total length of unsealed rural arterial road has been reduced in all states there remain some 586 kilometres carrying more than 300 vehicles per day (twice the traffic which would qualify such roads for the classification 'poor' under the NAASRA criteria, Table 3.1). In both New South Wales and Victoria the length of road in this category actually increased between 1972 and 1981. Although overall travel on such roads is a small proportion (0.8 per cent for New South Wales and 0.4 per cent for Victoria in 1981) of total travel on rural

TABLE 4.2—UNSEALED ARTERIAL ROAD LENGTH AND TRAFFIC VOLUME, 1972 AND 1981

(km)

State or Territory	All traffic levels		>300 vehicles/day	
	1972	*1981*	*1972*	*1981*
New South Wales	10 174	8 787	288	388
Victoria	504	380	41	63
Queensland	7 076	4 652	119	71
South Australia	2 688	1 937	45	35
Western Australia	5 725	4 270	164	11
Tasmania	347	218	80	18
Northern Territory	2 041	1 697	0	0
Australian Capital Territory	1	0	1	0
Australia	28 456	21 941	738	586

Source: ARS (1972). NDB (1981).

arterial roads in these states, the figures do indicate a deterioration in travel conditions on that particular set of roads.

Figure 4.2 illustrates the change in distribution of traffic between rural arterial roads of different seal width over the period 1972 to 1981 (BTE 1984a, Tables III.20 to III.37). It is clear that over this period an improvement occurred in all three traffic ranges (0-299vpd, 300-999vpd and 1000+vpd) for the States of Victoria, South Australia, Western Australia and Tasmania. In New South Wales and Queensland improvement occurred in the higher two traffic ranges with virtually no change in the lowest range. Very little change occurred in the Australian Capital Territory and Northern Territory.

Travel times on rural arterial roads

Australia-wide travel conditions on the rural arterial road network appear to have improved slightly over the last decade with traffic tending to travel on wider pavements. This improvement is reflected also by change in travel times in those states for which this information is available; New South Wales, Queensland and Tasmania.

Travel time information for each of these states is presented in BTE 1984a, Chapter 3.

Routes for analysis in each state were selected to cover as wide an area as possible and encompass a variability in topography and traffic. The route lengths represent approximately 13 per cent, 20 per cent and 48 per cent of rural arterial road length in New South Wales, Queensland and Tasmania, respectively.

Travel times on the New South Wales routes showed a slight reduction overall, which appears to reflect the roadworks done on those routes, mainly reconstruction and maintenance.

Some larger reductions were experienced in Queensland which reflect the poor state of some of the road links in 1973. The sealing, widening and realignment work carried out on those routes would have contributed significantly to the travel time reductions.

All the Tasmanian routes examined experienced some widening and realignment work between 1969 and 1980 which would be expected to reduce travel times, but the actual percentage savings given in BTE 1984a should be treated with caution since they appear much greater than would be expected.

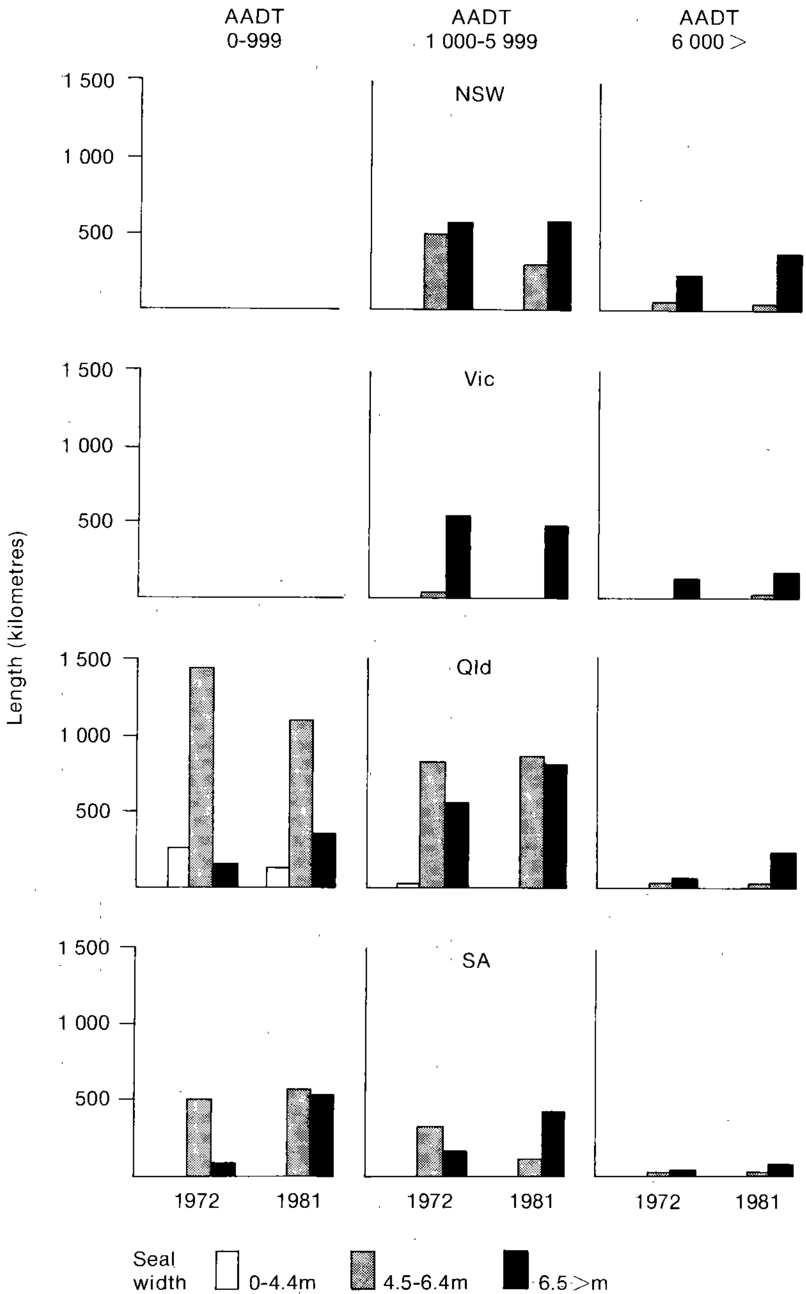
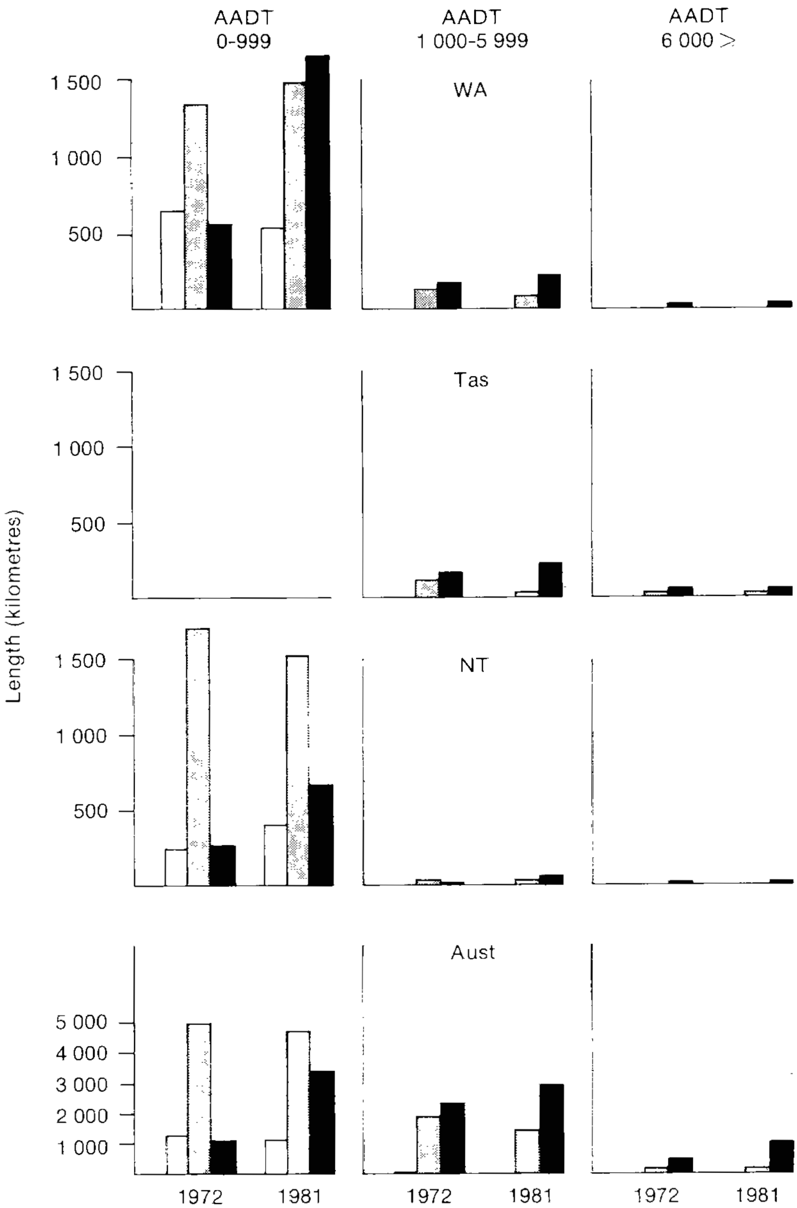


Figure 4.2—Length of seal width by AADT distribution for rural arterial roads, 1972 and 1981



Source: Tables II 2 to II.28

Figure 4.2(Cont)—Length of seal width by AADT distribution for rural arterial roads, 1972 and 1981

Accidents on rural arterial roads

Separate data on accidents on rural arterial roads were not available, but the number of fatal accidents per hundred million vehicle kilometres of travel on all rural roads (national highways, arterials and locals) generally declined over the period 1975 to 1981 for all states where such data was available (BTE 1984a, Tables III.39 to III.46).

Overview

Although not as clear-cut as in the case of national highways, it is apparent that, overall, investment in rural arterial roads over the last decade has been sufficient to generate some improvement in performance from a user point of view, more than compensating for increased traffic volumes.

EXTENT OF THE RURAL SEALED ROAD SYSTEM

One indicator of completeness of the basic rural road system is the extent to which small communities are directly served by sealed roads. An analysis was undertaken of the proportion of 'bounded rural localities'[1] in each state which were connected directly to the sealed road network. This approach gives some measure of the equality of provision of road facilities on the basis that the existence of a sealed road link to major urban centres provides community access to basic goods and services.

Table 4.3 shows the number of bounded rural localities in each state which lack direct links to the sealed road system and the proportion of the population of bounded localities not so served.

Victoria is the only state with all its bounded rural localities having direct access to the sealed road network. This, like the fact that Tasmania has only one such locality, may be attributed to a combination of geographical and historical factors. Each has a long history of settlement and relatively intensive land use. Together these have produced a road network characterised by relatively short links which have been sealed incrementally over time.

The relatively low proportion of bounded localities in South Australia unconnected to the sealed road network is explained by the concentrated nature of settlement in that state. Some 90 per cent of the population live in the 10 per cent of the land area in the vicinity of Adelaide while 70 per cent of the land furthest from the capital

TABLE 4.3—BOUNDED RURAL LOCALITIES AND POPULATION WITHOUT SEALED ROAD ACCESS, 1983

State or Territory	*Bounded Localities*		*Population of Bounded Localities*	
	Number	*Per cent*	*Number*	*Per cent of Total*
New South Wales	9	4.6	3 470	3.6
Victoria	0	0.0	0	0.0
Queensland	17	10.7	9 343	11.4
South Australia	1	1.2	402	1.0
Western Australia	11	11.3	5 134	10.0
Tasmania	1	1.6	365	1.1
Northern Territory	13	72.2	7 018	72.8

Source: BTE estimate from ABS data.

1. 'Bounded rural localities' are defined by the Australian Bureau of Statistics as population clusters of between 200 and 999 people.

is occupied by less than one per cent of the population (Holmes 1977, p335). Andamooka is the only bounded locality unconnected to the sealed road system. Coober Pedy, having a population just over 2000, is larger than a bounded locality and is also unconnected to the sealed road system, being 117 kilometres from Woomera.

Similarly the extension of sealed road links to the sparsely settled areas of western New South Wales has been slow due to the relatively small (in some cases declining) populations and the long distances involved. Most of the bounded localities east of the Blue Mountains have been served by sealed roads for some time. One larger centre, Brewarrina, is not connected to the sealed road system.

Western Australia exhibits some similarity to New South Wales. Many of its bounded rural localities are in the relatively densely populated south west of the state, while with its communities not connected to the sealed road system are located in the central and northern areas. Centres in the far north of the state tend to be connected to the North West Highway or have sealed road access to the Northern Territory. Significant differences between Western Australia and New South Wales are that while the numbers of unconnected bounded localities are similar, they represent a much high proportion in Western Australia and the distances from the nearest sealed road tend to be higher also. In Western Australia the average distance to the nearest sealed road is 185 kilometres compared with 45 kilometres in New South Wales. A further difference is that the unconnected centres in New South Wales tend to be static or declining in population, while those in Western Australia tend to be growing, mainly as a result of mining activity of one sort or another. Three larger centres in Western Australia (Pannawanica, Parraburdoo and Tom Price) are not connected to the sealed road network.

Queensland exhibits characteristics similar in some ways to New South Wales and in others to Western Australia. As in New South Wales many bounded localities are located in the more densely settled areas, particularly along the coastal plain, most of which are connected to the sealed road systems. Those localities lacking sealed road access tend to be in the remote inland or the far northern coastal areas along the Gulf of Carpentaria and the Cape York Peninsula. Most of the former are pastoral or mining communities while the latter are mainly aboriginal settlements. The only large Queensland centre not linked to the sealed road network is Weipa. In terms of distance of bounded rural localities from a sealed road Queensland averages 328 kilometres, which is greater than for Western Australia.

The Northern Territory differs from the other states in that it has no significant closely settled rural area. As a result a large proportion of its bounded localities has no access to the sealed road network, although the absolute numbers involved are approximately two thirds those in Queensland. Many of the unconnected localities are aboriginal settlements and the average distance from a sealed road is 173 kilometres, close to that for Western Australia. Only one larger centre (Gove) is not connected to the sealed road system.

This analysis has revealed a fairly consistent pattern of road system development in rural Australia, although it gives no guidance as to the quality of the links which exist and only a very rough guide to the degree of completeness of roads sytems and the associated access to goods and services.

URBAN ARTERIAL ROADS

Urban arterial roads in Australia are characterised by the large volumes of traffic carried daily. As indicated in Chapter 2 urban arterial roads carry on average 13 000 vehicles per day. Thus their performance must be judged primarily on their ability to carry high volumes of traffic over relatively short distances at relatively low speeds. This contrasts with national highways and other rural arterial roads which are required to carry much smaller volumes of traffic over greater distances at relatively high speeds.

Differences in physical, economic and demographic characteristics of cities produce differing demands on their arterial road systems, but it is possible to develop some simple indicators which may serve as a basis of assessing developments over time and differences between cities.

Demand for urban arterial road space

All other things being equal it is reasonable to assume that the number of trips made in an urban area will be proportional to the population, and that the length of each trip will be some function of the square root of the area inhabited. Thus the expression ((population) x (square root of area)) will provide an indicator of the potential travel demand. If this is adjusted to take account of the proportion of trips by modes other than the private car it provides an indicator of the potential load on the road system. The most appropriate factor for adjustment is the proportion of work trips by car (which can be obtained directly from ABS surveys) since these occur in peak periods and present the highest loading on the road system. This process has been applied to produce Indicators of Potential Demand (IDP) for the built up areas of the Australian capital cities with the results shown in Table 4.4.

From Table 4.4 it may be seen that the IPD for road space rose in all mainland capital cities over the period 1971 to 1981[1]. Adelaide demonstrated the slowest growth, Perth and Brisbane moved very much in concert and Melbourne closed with Sydney at the heavyweight end.

These figures provide an indication of the potential demand for road space *all other things being equal.* In fact all other things are not equal.

The pattern of residential and job distribution for each city is different, topographical features produce cities of different shape, and more importantly, the provision of road space is different, all of which would be expected to alter the relative ratings for the cities when potential demand is converted to realised demand.

Usage of urban arterial roads

Table 4.5 gives vehicle kilometres travelled per day on the arterial roads for each

TABLE 4.4—INDICATOR OF POTENTIAL DEMAND FOR ROAD SPACE IN SELECTED CAPITAL CITIES, 1971 AND 1981

City	*Year*	*Population (millions)*	*Area (000 km²)*	*Car use factor*	*IPD*
Sydney	1971	2.725	1.518	0.53	56
	1981	2.877	1.676	0.59	70
Melbourne	1971	2.408	1.320	0.58	51
	1981	2.579	1.645	0.66	69
Brisbane	1971	0.818	0.669	0.64	14
	1981	0.943	0.975	0.65	19
Adelaide	1971	0.809	0.606	0.70	14
	1981	0.883	0.696	0.67	16
Perth	1971	0.642	0.603	0.70	11
	1981	0.809	0.822	0.72	17
Hobart	1971	0.130	0.114	0.64	1
	1981	0.129	0.123	0.68	1

1. The indicator also showed a small rise in the case of Hobart, but this was less than the effect of rounding the final indicator.

TABLE 4.5—ROAD SPACE USAGE AND SUPPLY IN SELECTED CAPITAL CITIES, 1981

City	*Vehicle kilometres per day (millions)*	*Lane length of arterial roads (kilometres)*	*Vehicles per day per lane (000)*
Sydney	31.2	4 239	7.3
Melbourne	30.9	5 910	5.2
Brisbane	11.8	2 348	5.0
Adelaide	11.4	2 256	5.1
Perth	15.0	3 258	4.7

Source: 1981 NAASRA Survey.

mainland and capital city together with the total length of arterial lanes provided and the vehicles per day per lane length obtained from the 1981 NRS road inventory.

Table 4.6 shows similar figures obtained from the Australian Roads Survey, 1969–74. In that table two sets of figures are presented, the first based on an analysis of the total metropolitan area and the second based on analysis of the high density, inner urban areas. Neither of these sets of figures is directly comparable with those presented in Table 4.5 because of differences in the areas covered by the 1972 and 1981 surveys, but they do indicate that the relativities between the cities have remained fairly constant over the decade.

The 1981 indicator values in Table 4.4 and the vehicle kilometres per day and lane lengths in Table 4.5 have been normalised (using the Adelaide figures as a base) and plotted in Figure 4.3. The points marked 'P' in the figure represent the normalised IPD values while those marked 'U' represent the actual vehicle traffic data. The term 'Relative Supply' simply refers to the normalised arterial lane lengths available.

The difference between the points 'P' and 'U' for each city give an indication of the difference between the traffic density which would be expected based on population and area considerations and that which actually occurs in practice.

Of the two great conurbations, Sydney appears to have the poorer arterial road system in relation to the potential task.

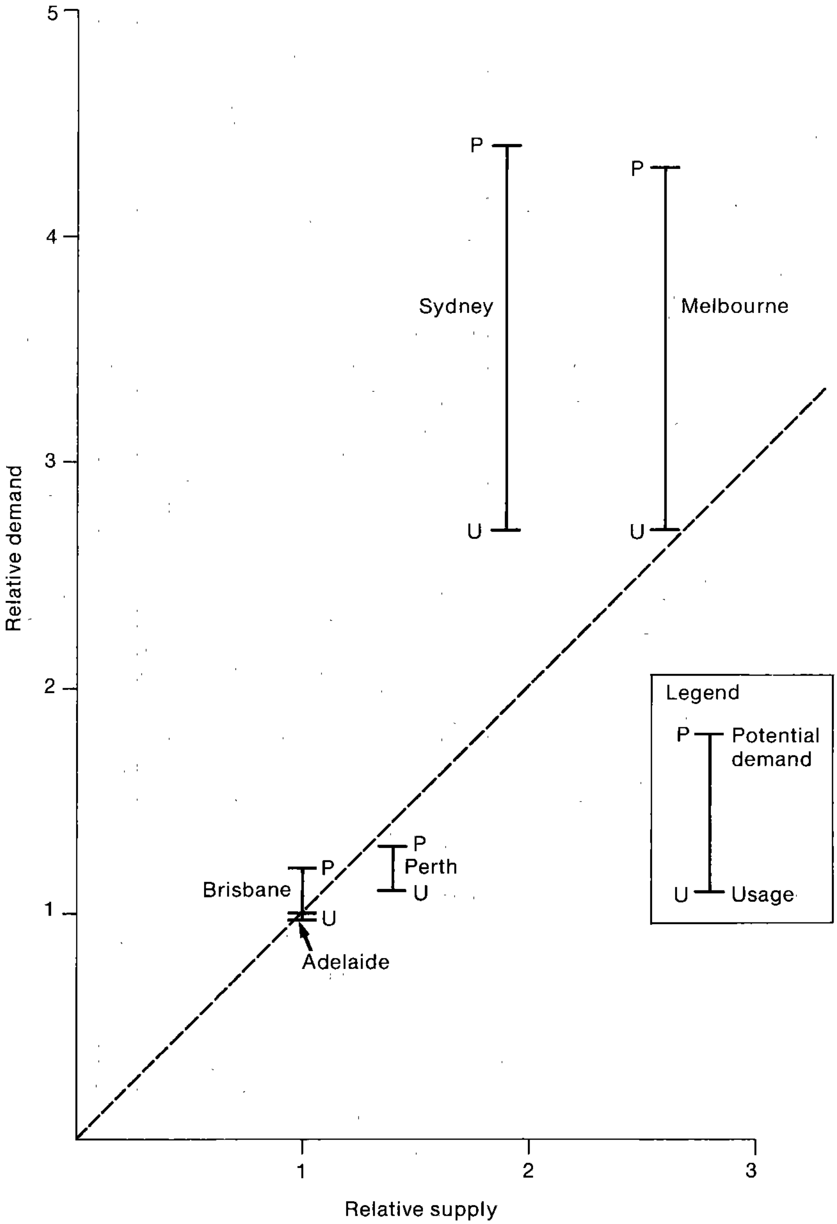
Of the three smaller mainland capitals, Perth and Adelaide appear to be rather better endowed with arterial road space than is Brisbane.

TABLE 4.6—ROAD SPACE USAGE AND SUPPLY IN SELECTED CAPITAL CITIES, 1972

	Overall urban area			*Inner urban area*		
City	*VKT per day (millions)*	*Lane length of arterial road (kilometres)*	*Vehicles per day per lane (000)*	*VKT per day (millions)*	*Lane length of arterial road (kilometres)*	*Vehicles per day per lane (000)*
Sydney	34.0	6 706	5.1	31.2	5 565	5.6
Melbourne	30.3	9 649	3.1	26.4	6 476	4.1
Brisbane	9.1	2 670	3.4	7.9	1 995	4.0
Adelaide	9.1	3 539	2.6	8.2	2 642	3.1
Perth	10.9	3 467	3.2	9.2	2 259	4.1
Hobart	na	na	na	1.5	467	3.2

na not available

Source: Australian Roads Survey. (1969–74).



Source: BTE analysis

Figure 4.3—Demand and supply of arterial road space in selected capital cities relative to Adelaide as base

These relativities are summarised well in Tables 4.5 and 4.6 which show that average traffic density in Sydney is significantly higher than in the other capital cities, which tend to group fairly closely together. This analysis supports the view that Sydney has an arterial traffic problem fundamentally more intractable than the other capital cities.

This broad conclusion is also supported by the more detailed road inventory analysis carried out in the course of the NAASRA Road Study (NAASRA 1984a, Chapter 3). Table 4.7 sets out the proportion of travel in each of the capital cities taking place in conditions judged 'poor', 'fair' and 'good' according to the criteria discussed briefly in Chapter 3 of this Report. Figures are presented for both mid-block flows and signalised intersection flows. The figures indicate that Sydney stands out as having problems with regard to mid-block flows, but that problems with intersection capacity are greater in other cities. This may be due to greater use of sophisticated signal linking in Sydney.

Changes in urban arterial road levels of service over time are difficult to establish because of the lack of coherent, comparable data sets, but some inferences may be drawn from available information.

As indicated previously journey to work traffic produces the peak loading in Australian capital cities and the proportion of work trips based on car use rose steadily over the period between 1970 and 1981 (BTE, 1984a, Figure 4.1). Taken together the rise was from about 48 per cent of work trips in 1970 to about 65 per cent in 1981. The percentage using cars rose in all capitals although Hobart experienced a temporary downturn between 1974 and 1976 as a result of the Tasman Bridge collapse.

The pattern of journeys to work has changed appreciably over the last two decades reflecting a trend towards decentralisation of work locations within urban areas (Neutze 1981). The proportion of work trips to the Central Business District (CBD) has fallen which means that the predominantly radial public transport services operating in the capital cities are less suited to serving the work journey than in the past. This, combined with higher relative levels of car ownership, explains to some extent the greater use of the private car for journeys to work.

Preliminary analysis of the recently released 1981 ABS journey to work data indicates that those basic trends continued over the period 1976 to 1981. Not only is the number of work trips by car increasing, but average trip length appears to be increasing also.

Travel times on urban arterial roads

Travel time surveys for major urban areas have generally concentrated on radial travel in weekday peaks, though some data for other routes are available.

TABLE 4.7—URBAN ARTERIAL TRAVEL UNDER DIFFERENT LEVELS OF SERVICE, 1981

(per cent)

City	*Mid block criteria*			*Intersection criteria*		
	Poor	*Fair*	*Good*	*Poor*	*Fair*	*Good*
Sydney	34	25	41	23	5	72
Melbourne	18	14	68	35	26	39
Brisbane	18	24	58	42	29	29
Adelaide	5	10	85	28	36	36
Perth[a]	17	12	71	48	20	22

a. Data derived by simulation process, different from other cities in table.

Source: NAASRA Roads Study, 1984.

In Sydney, the New South Wales Department of Main Roads (DMR) conducted major travel time studies in 1962, 1968 and 1981. The National Roads and Motorists Association (NRMA) also carried out travel time surveys for selected routes over the last decade. The DMR surveys indicated that travel times in the morning peak increased in the areas to the north west of Sydney CBD and decreased in the areas to the west, north and south east. The area to the north west of the CBD also experienced an increase in travel time in the afternoon peak, but the rest of the city experienced either little change or an improvement. Thus some areas experienced an increase in morning peak travel time and a decrease in evening peak travel time. A detailed analysis of this travel time data may be found in BTE 1984a (Chapter 4 and Appendix IV). The validity of these findings is supported by travel times obtained by NRMA studies (NRMA 1982). Mean speeds in the morning peak were found to vary between 15 and 34 kilometres per hour while those for the evening peak varied between 21 and 47 kilometres per hour. During off-peak periods the mean speeds were found to be in the range 31 to 52 kilometres.

Taken alone this material would suggest that conditions on the arterial roads of Sydney had not deteriorated significantly between 1962 and 1981, but this is not necessarily so. This particular analysis fails to pick up the probably increased spread of peak traffic conditions, that is, the fact that peak traffic volumes were maintained over a longer period each day in 1981 than in 1962. Peak travel times remain constant because much of the system was near to saturation during peak hours in 1962 and remained so in 1981.

The picture revealed by travel time analysis in Melbourne appears much the same, except that changes in morning and afternoon peak travel times followed a similar pattern. The results of surveys conducted by the Traffic Commission of Victoria and the Royal Automobile Club of Victoria indicate that between 1961 and 1976 there was little change in peak hour travel time over much of the city, the only area to experience a significant increase being the south west. More detailed analysis (BTE 1984a, Appendix IV) indicates that there were marked changes within particular corridors during the period 1961 to 1976 with travel times increasing and decreasing as a result of traffic growth and road improvements (particularly freeway construction).

Like Sydney, the overall pattern for Melbourne indicates that road development has been able to keep pace with traffic growth, but some caution is necessary in relation to this interpretation. As mentioned in relation to developments in Sydney traffic growth has caused some 'spread' of the peaks. Also the degree of demand suppression resulting from road congestion is not known, but may be significant.

Parking on urban arterial roads

Another factor to be considered is that during the last decade there has been a major effort in all large cities to alleviate traffic flow problems by means of traffic management methods. One aspect of traffic management is the restraint on parking on arterial roads, particularly during peak periods. Table 4.8 indicates the proportion of arterial road length over which parking restrictions apply (NAASRA 1984a, Figure 3.19).

Too much should not be read into figures in Table 4.8, but it does suggest that more scope for parking restraint, as a means of easing peak traffic congestion, exists in some cities than in others, and the figures are generally consistent with the broader indicators presented earlier in this chapter.

Accidents on urban arterial roads

Times series data on accidents for urban arterial roads are not available separately, but rates for all roads in urban areas give some guidance because of the high proportion of travel which takes place on arterial roads. Over the period 1975 to 1980 the number of fatal accidents per hundred million vehicle kilometres of travel

TABLE 4.8—PROPORTION OF ARTERIAL ROAD LENGTH SUBJECT TO PARKING RESTRICTIONS, 1981

(per cent)

City	All day		At peak	
	Undivided road	*Divided road*	*Undivided road*	*Divided road*
Sydney	8	5	28	17
Melbourne	10	1	20	12
Brisbane	9	4	17	5
Adelaide	3	8	13	14
Perth	24	13	26	14

Source: NAASRA (1984a).

in all urban areas[1] fell fairly evenly for New South Wales, Victoria, Queensland, Western Australia and the Australian Capital Territory (BTE 1984a, Figure 4.7). 1981 data indicated that this trend continued for Queensland, Western Australia and the Australian Capital Territory. Available data relating to Tasmania was limited to the period 1977 to 1980 and showed a general downward trend, but the trend was by no means as consistent as for the other states.

LOCAL ROADS

General

Local roads comprise some 85 per cent of the total road length in Australia, see Table 2.1. The primary function of such roads is to provide access to properties and businesses and to form 'feeder' links to the arterial road system. Traffic levels on local roads are roughly one-twelfth of that on arterial roads (BTE 1984a, Figure 6.3), averaging 1000 vehicles per day on urban local roads and 50 vehicles per day on rural local roads. Responsibility for building and maintaining local roads rests with local government authorities (LGAs), although significant funding is provided by Commonwealth and State Governments.

In some instances, the line between arterial and local roads has become blurred, with some local roads performing an arterial function. This generally results in higher traffic volumes and traffic of different types, for example, heavy trucks, and can be the cause of considerable local concern. A recent survey of rural local governments revealed that 160 out of 367 respondents were of the opinion that some roads in their areas required reclassification amounting to some 2.5 per cent of their network. The reasons advanced in support of the need for reclassification included the nature and volume of traffic, the fact that the road concerned provided access to an area outside the LGA and the presence of significant 'tourist' traffic (BTE 1984b, Chapter 5).

No similar survey of urban local government has been made, but the problem of use of local roads by arterial traffic is well known. During the course of the Australian Roads Survey 1969–74 a figure of 1500 vehicles per day was regarded as the upper limit of traffic acceptable on urban residential streets and it was found that 4 per cent of such streets experienced traffic above this level. No directly equivalent figures for more recent times are available, but the NAASRA Roads Study indicates that in 1981 something over 20 per cent of urban local roads carried traffic volumes of over 1000 vehicles per day (NAASRA 1984e, Figure 13). This suggests that conditions may have deteriorated in this respect. As a general rule such problems are localised, particularly in the inner areas of major cities, and have resulted in

1. All urban areas as classified by ABS, not just capital cities.

action by some councils or local community groups to close off certain streets to through traffic.

Local Area Traffic Management

Recent times have seen the introduction of a number of Local Area Traffic Management (LATM) measures to Australian cities directed towards the resolution of conflicts between traffic and social amenity on residential streets. In 1978 Brindle conducted a comprehensive survey of Australian practice in this regard (Brindle 1979). He surveyed some 352 urban LGAs with populations greater than 5000 and found that 78 per cent overall, and 82 per cent of metropolitan LGAs used LATM measures to reduce vehicle speed, reduce through traffic, reduce accidents (by reducing cross roads) or provide open space.

As a supplement to Brindle's work some 29 inner city LGAs and 14 outer urban LGAs in Melbourne were surveyed in relation to LATM measures (BTE 1984a, Appendix III). The results of that survey may be summarised as follows:

- 16 per cent reported no traffic problems on residential streets;
- 23 per cent reported use of isolated measures to solve problems at particular spots;
- 37 per cent claimed to have implemented area wide schemes for traffic management;
- 16 per cent were on the point of introducing schemes or else had the problem under study; and
- 7 per cent reported that arterial problems in their areas were more pressing than residential street problems.

In 1981 the Melbourne and Metropolitan Board of Works published the *Hierarchy of Roads Study* which provides the current framework for integrated planning of land use and road functions, and hence a basis for co-ordination of LATM measures. A less centralised approach has been adopted in Sydney with most individual LGAs commissioning studies of traffic/transportation problems on a localised basis. The consultants engaged for this work have usually recommended road hierarchies and the designation of certain areas as local traffic precincts to be protected from through traffic. This approach presents some problems of co-ordination between LGAs.

Adelaide has been the scene of significant developments of systematic area-wide schemes for residential street networks. Adelaide City, Woodville, Unley and Burnside all developed schemes for traffic control and street closures, the latter action causing considerable public reaction leading to replacement by roundabouts in some areas. Public participation exercises have not always been able to produce agreement between conflicting interest groups and many LATM measures remain contentious.

Perth was also well to the fore in adopting modern planning arrangements for residential areas, but found a lack of agreement between groups as to the desirability of such measures and, indeed, found that some residents changed their minds once street closures and the like were introduced.

In summary, the mechanism for establishment of residential precincts and the control of through traffic in residential areas are well established (SA Department of Transport, 1983), but the wider questions of overall system efficiency and equity between residents and travellers remain unresolved.

Provision of Roads in Local Government Areas

Detailed data on local roads are limited, but some analysis has been undertaken to explore the relative provision of roads between LGAs (BTE 1984d). This work was based on available ABS data relating road provision statistics with socio-demographic data for each LGA in Australia. The approach adopted was to use

Cluster Analysis to divide LGAs into fifteen clusters based (mainly) on:

- the density of the road system, relative to the area;
- the density of the road system, relative to the population; and
- composition of the roads by type, that is, sealed, paved, formed and unformed.

The LGAs falling within each clusters have broadly similar road provision characteristics based on these factors. The cluster formation is a multidimensional process, with the clusters forming a continuum with urban style LGAs at one extreme and sparse rural LGAs at the other. The allocation of LGAs to the various clusters is set out in Appendix II and Table 4.9 presents a summary of locational characteristics for the clusters.

As may be seen from Table 4.9 clusters one to four contain predominantly rural areas with some townships and regional centres. Clusters five to nine consist primarily of suburbs of major metropolitan areas, areas of overspill from these centres and rural municipalities and towns, while clusters ten to fifteen are dominated by the suburbs of the major metropolitan areas with a few regional centres. The individual clusters form reasonably large 'peer groups' except in the cases of cluster seven (which contains only Torres consisting of the Torres Straits Islands and a small portion of the northern tip of Cape York Peninsula), cluster fifteen (which contains four inner urban areas of Melbourne and Sydney) and cluster twelve (which contains four inner suburbs of Melbourne and one of Adelaide).

Demographic variables which give some indication of the potential load placed on a road system in a given area (employment in different industries, number of schools, number of vehicles parked at dwellings, etc) were then examined to explore how well each LGA fitted the cluster it was assigned to on the basis of road provision variables. This was done by Discriminant Analysis which identified 'outliers' in each cluster, that is, LGAs which appeared more like LGAs from another cluster *with respect to the demographic variables* than like the members of its own cluster. As a result of this analysis 8 per cent of LGAs were identified as having road systems which appear to be anomalies, given their demographic characteristics. These outliers are listed in Tables 4.10 and 4.11 showing the clusters to which they belong on the basis of their existing road system and the cluster to which they would belong on the basis of the discriminant analysis. Also shown in the tables is the number of the Road Study Region (RSR) to which the LGA belongs.

Tables 4.10 and 4.11 do not, of themselves, imply that 'outlier' LGAs have a better or worse road system than they should have, but simply identify anomalies worthy

TABLE 4.9—LOCATIONAL CHARACTERISTICS OF LGA CLUSTERS

(number)

	Locational characteristic					
Cluster number	*Suburbs*[a]	*Metropolitan overspill satellite*[b]	*Regional centres*[c]	*Rural municipality/ town*	*Rural shires*	*Rural Total town*
1– 2	0	0	10	20	354	384
3– 4	3	14	12	21	131	181
5– 6	19	19	2	33	8	81
7– 9	31	7	0	42	3	83
10–15	99	1	6	0	0	106
Total	152	41	30	116	496	835

a. Suburbs of major metropolitan areas.

b. Overspill and satellite areas, that is, ie LGAs which are separated from the continuous built-up area (of the metropolis) by open space and which are within or adjacent to the Metropolitan Statistical Division.

c. Major regional centres, that is, non-metropolitan LGAs with a population exceeding 40 000.

of exploration. An initial examination has been undertaken which revealed the apparent reasons for some of the anomalies and the way in which authorities are responding to them.

For example, the group of LGAs in cluster four with more developed road systems than would be expected are primarily areas which were subject to intensive farming in the past, but which have been losing population in recent times. They have been left with a road system more suited to more densely settled areas. The Australian

TABLE 4.10—LOCAL GOVERNMENT AREAS WHICH APPEAR TO HAVE A MORE DEVELOPED ROAD SYSTEM THAN WOULD BE EXPECTED ON THE BASIS OF DEMOGRAPHIC VARIABLES

LGA	*Cluster number for*		*State*	*RSR number*
	Supply	*Demand*		
Holbrook (S)	4	1	NSW	205
Junee (S)	4	2		205
Snowy River (S)	4	2		204
Belfast (S)	4	2	Vic	304
Dundas (S)	4	2		304
Hampden (S)	4	2		304
Minhamite (S)	4	1		304
Mortlake (S)	4	2		304
Mt Rouse (S)	4	2		304
Pyalong (S)	4	2		304
Wannon (S)	4	2		304
Warnambool (S)	4	2		304
Mirani (S)	4	1	Qld	404
Campbelltown (M)	4	1	Tas	702
Renmark (M)	5	3	SA	503
Koroit (B)	6	4	Vic	304
Mulgrave (S)	6	4	Qld	405
Queenstown (M)	6	4	Tas	703
Sale (C)	8	5	Vic	306
Sebastopol (B)	8	6		304
Port Lincoln (C)	8	5	SA	504
Broken Hill (C)	9	4	NSW	205
Moe (C)	9	6	Vic	302
Traralgon (C)	9	6		302
Cairns (C)	9	6	Qld	405
Ipswich (C)	9	6		401
Devonport (M)	9	5	Tas	703
Croydon (C)	10	5	Vic	301
Mt Gambier (C)	10	5	SA	503
Dandenong	11	9	Vic	301
Mackay (C)	11	8	Qld	404
Waverley (C)	13	9	Vic	301
Marion (C)	13	11	SA	501
Woodville (C)	13	11		501
Holroyd (M)	14	11	NSW	201
Chelsea (C)	14	11	Vic	301
Moorabbin (C)	14	11		301
Nunawading (C)	14	9		301
Bayswater (S)	14	10	WA	601

Source: BTE analysis.

Municipal Information System (AMIS) records indicate that these LGAs have spent less per kilometre of road than other LGAs in cluster four over the period 1968 to 1980, that is, an expenditure pattern more in keeping with a road system of a less densely settled area. This situation may be expected to result in a decline in road condition over time.

The groups of larger rural towns, from cluster nine which have a more developed road system than would be expected, seem to have characteristics more aligned to those of smaller towns in rural areas, for example a low number of administrative workers. In this case, however, expenditure per kilometre of roads has been higher than for other members of their cluster and has increased over recent years. This suggests that authorities have been consciously developing a road system comparable with towns of larger population.

At this stage no common factors have been determined to explain the unexpected

TABLE 4.11—LOCAL GOVERNMENT AREAS WHICH APPEAR TO HAVE A LESS DEVELOPED ROAD SYSTEM THAN WOULD BE EXPECTED ON THE BASIS OF DEMOGRAPHIC VARIABLE

LGA	*Cluster number for*		*State*	*RSR number*
	Supply	*Demand*		
Burke	1	7	Qld	403
Mornington	1	7	Qld	403
Cooma Monaro (S)	2	5	NSW	204
Yarrowlumla (S)	2	10		205
Mansfield (S)	2	8	Vic	303
Pirie (DC)	2	8	SA	502
Katanning (S)	2	8	WA	602
Merredin	2	8	WA	602
Wagga (C)	3	6	NSW	205
Noosa (S)	3	8	Qld	402
Kadina (DC)	3	8	SA	502
Meadows (DC)	3	5		501
Mt Barker (DC)	3	5		503
Lilydale	3	6	Tas	702
Bega Valley (S)	4	8	NSW	204
Wyong (S)	5	9	NSW	201
Warragul (S)	5	8	Vic	302
East Torrens (DC)	5	13	SA	501
Stirling (DC)	5	13		501
Kingborough (M)	5	10	Tas	701
Gosford (M)	6	11	NSW	201
Hornsby (S)	6	10		201
Charters Towers (C)	6	8	Qld	404
Port Melbourne (C)	8	11	Vic	301
Gawler (M)	8	10	SA	501
Newcastle (C)	9	14	NSW	202
Hobart (C)	9	13	Tas	701
Adelaide (C)	10	12	SA	501
Manly (M)	11	14	NSW	201
Willoughby (M)	11	14		201

Source: BTE analysis.

level of development in the group of LGAs from clusters ten to fourteen. Some areas are older suburbs with declining populations, but this is not the case in general. All tend to spend less per kilometre of road than do others in their clusters, but some (Mackay, Marion, Holroyd, Chelsea and Bayswater) have shown a slow increase in expenditure over the period 1960 to 1980.

Many of the areas where the road systems appear less developed than would be expected are areas where development tends to outstrip the existing road system. In some of the rural areas the development of 'hobby farms' may well be a factor while some more developed areas (eg Wyong, Gosford, Hornsby) reflect the population pressure of large metropolitan areas in their immediate vicinity. Many of these areas have levels of expenditure per kilometre of road below that of others in their clusters which suggests that the existing road system in those areas is likely to decline in quality in the immediate future.

Overall, this statistical analysis has revealed that the provision of roads for LGAs with similar characteristics is fairly consistent across the nation and that most anomalies seem to be related to areas where some form of structural change is taking or has taken place.

CHAPTER 5—ROAD FINANCING

HISTORICAL

Figure 5.1 shows the overall level of expenditure on Australian roads over the period 1920–21 to 1980–81 expressed in constant 1981–82 values. The amounts shown are not precise because of the differences in definitions used in different data sets and similar problems, but the curve does serve to indicate the very rapid growth in real expenditure in the post Second World War period, associated with the rise in motor vehicle ownership and usage.

Trends in expenditure over the last decade, broken down by level of government, are illustrated in Figure 5.2. The expenditure shown for local government in 1979–80 is higher than in published statistics. The latter are known to be in error, although the extent of the error has not been established. For the purpose of illustrating the trend in expenditure over time it has been assumed that 1979–80 expenditure was the mean of 1978–79 and 1980–81. The sharp rise in Commonwealth expenditure since 1981–82 reflects the impact of the Australian Bicentennial Road Development (ABRD) program and the Jobs on Local Roads (JOLOR) program.

Figure 5.3 presents the variation in total expenditure for each road category over the period 1972–73 to 1981–82. Together, Figures 5.1, 5.2 and 5.3 serve to illustrate the general trends in levels and patterns of road expenditure in recent times.

RECENT TRENDS

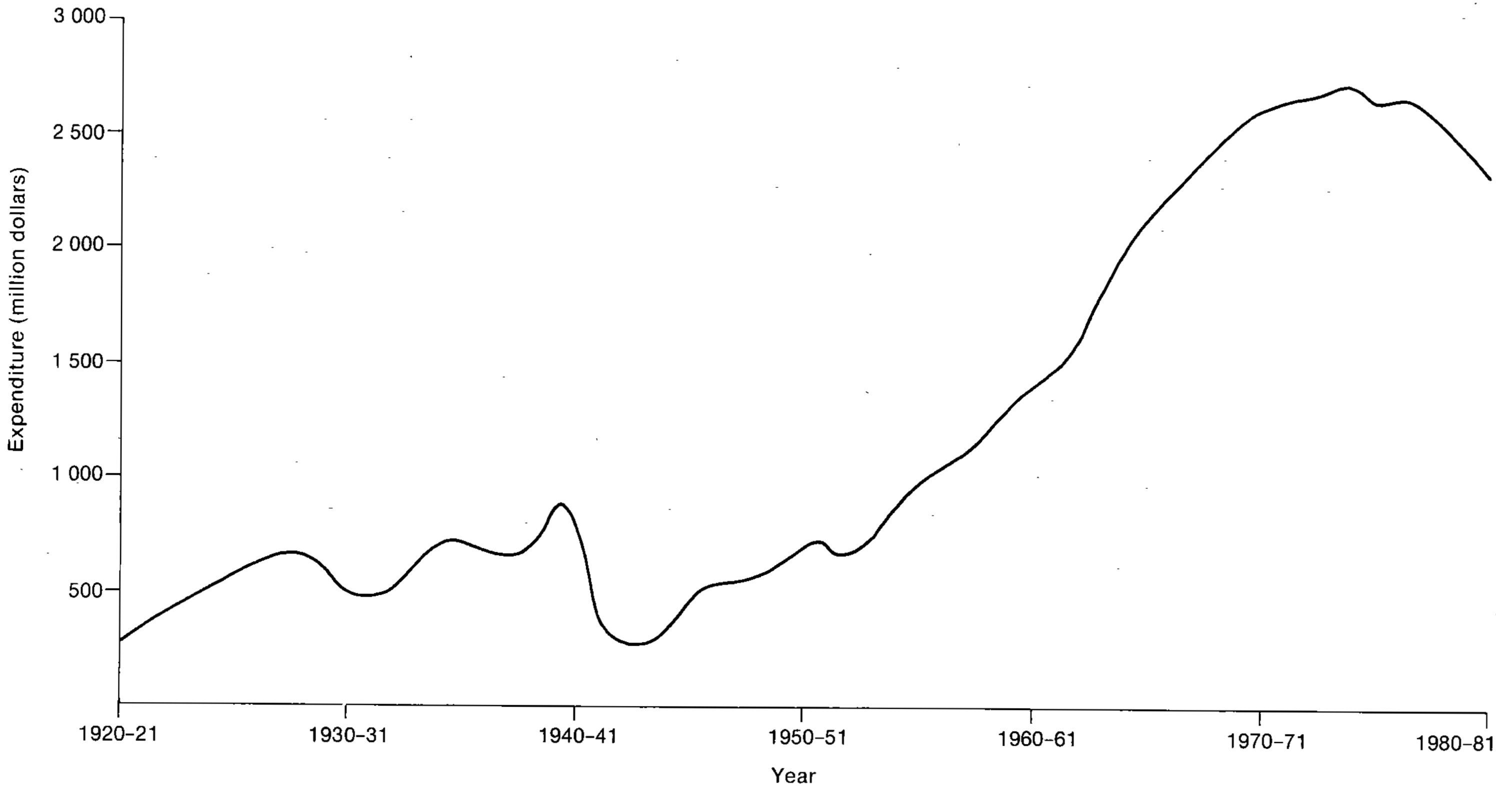
Details of total expenditure by level of government and by state over the period 1972–73 to 1981–82 are presented in Table 5.1. Expenditure by local government in New South Wales in 1979–80 has been adjusted to remove a known error (mentioned previously) in the statistical collection on which these data are based.

Commonwealth expenditures on roads fell steadily in real terms over the decade from 1972–73, the 1981–82 expenditure being some 34 per cent less than that in 1972–73. Significant additional grants under the ABRD and JOLOR programs are expected to largely counter-balance this fall, although 1983–84 expenditures are still expected to be slightly below 1972–73 levels in real terms.

State government expenditure on roads reached a peak in real terms in 1978–79 and then declined slowly, although the 1981–82 level remained slightly above the 1972–73 level. The various states reached peak expenditure at different times during the period 1976 to 1981 (SA in 1976–77, Victoria in 1977–78, Tasmania in 1978–79, WA and NT in 1979–80, NSW in 1980–81 and Queensland in 1981–82). A steep rise in state government expenditure on roads during the period 1975–76 to 1978–79 largely compensated for the fall in Commonwealth expenditure, but the period 1978–79 to 1981–82 saw a fall of 10 per cent in state contributions.

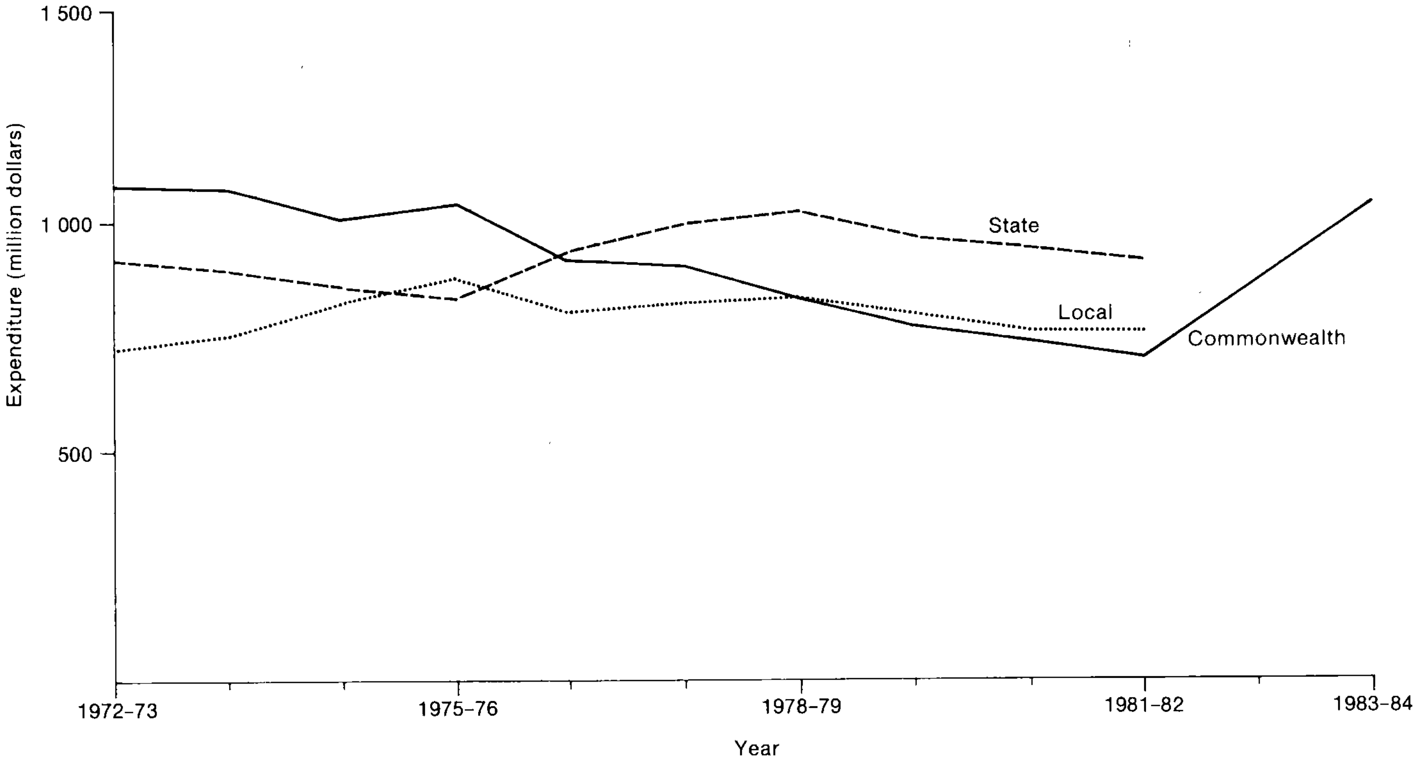
Expenditure on roads by local government reached a peak in 1975–76, due in part to the expenditure of funds under the Regional Employment Development Scheme, and has followed a downward trend since that year, though in 1981–82 real expenditure remained slightly above the 1972–73 level.

The introduction of Personal Income Tax Sharing (PITS) arrangements in 1976 had no discernable effect on the pattern of local government expenditure on roads and it is doubtful if any significant amount from that source has been directly applied to roadworks (BTE 1984g).



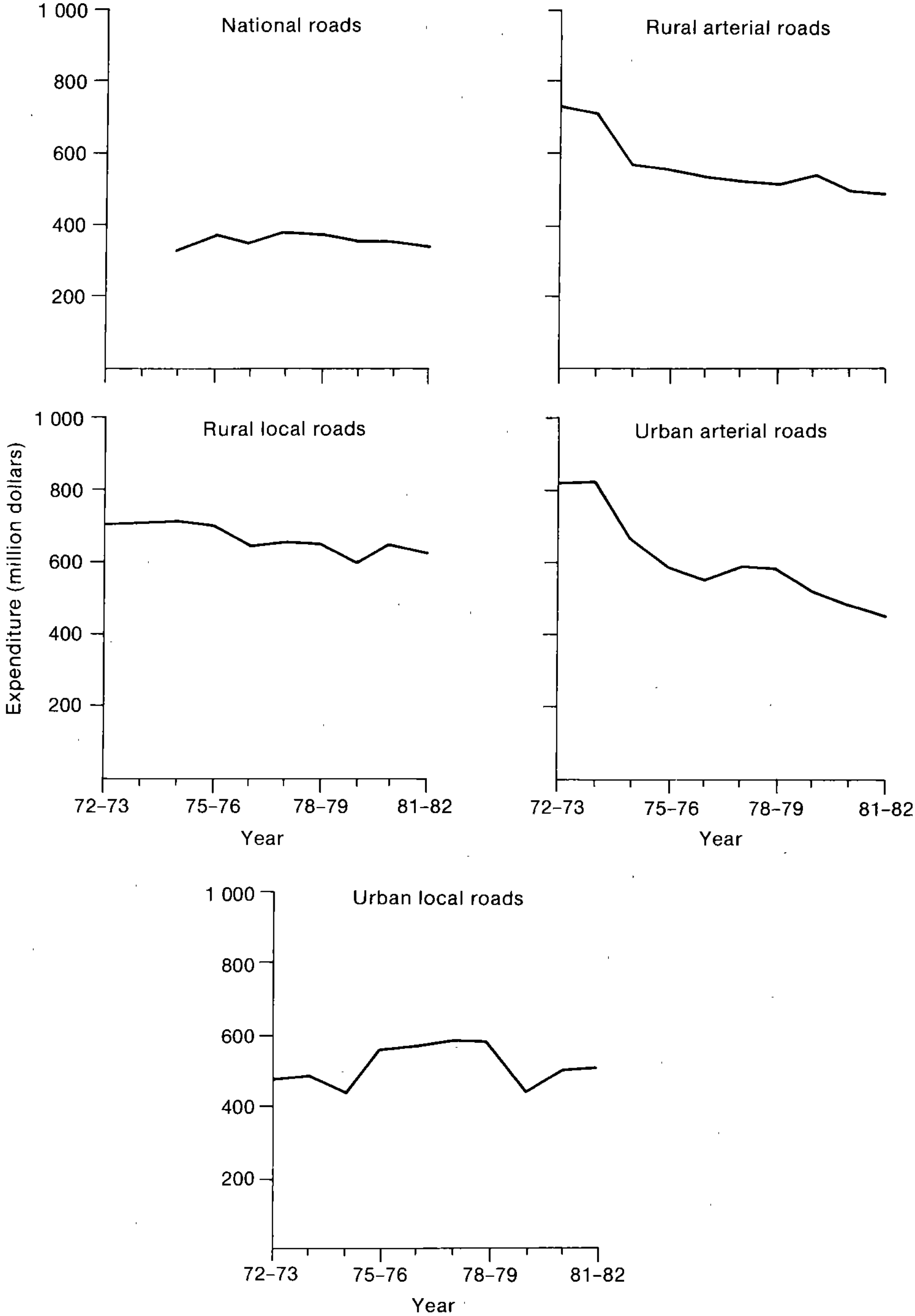
Source: BTE (1979) and (1984f).

Figure 5.1—Total annual expenditure on roads in Australia, 1920–21 to 1980–81 (constant 1981–82 values)



Source: BTE (1984f).

Figure 5.2—Commonwealth, State and local government annual expenditure on roads, 1972–73 to 1983–84 (constant 1981–82 values)



Source: BTE (1984f).

Figure 5.3—Total annual expenditure by road category, 1972–73 to 1981–82 (constant 1981–82 values)

TABLE 5.1—TOTAL ANNUAL ROAD EXPENDITURE, BY STATE, YEAR AND LEVEL OF GOVERNMENT, 1972-73 TO 1981-82 (CONSTANT 1981-82 VALUES)

($million)

	New South Wales	*Victoria*	*Queensland*	*South Australia*	*Western Australia*	*Tasmania*	*Northern Territory*	*Australian Capital Territory*	*Total Australia*
1972-73									
Commonwealth	292.9	195.3	196.5	98.9	153.0	41.4	55.6	53.6	1087.2
State	357.8	236.6	146.3	74.7	85.3	33.0	0.0	0.0	933.7
Local	331.7	142.5	152.5	55.9	20.7	29.1	3.5	0.0	735.9
Total	982.4	574.3	495.4	229.5	259.0	103.5	59.1	53.6	2756.7
1973-74									
Commonwealth	298.8	197.7	193.9	96.1	148.4	42.0	46.0	56.7	1079.7
State	352.0	255.1	129.0	66.3	83.0	27.8	0.0	0.0	913.2
Local	334.3	155.1	142.3	56.1	50.0	25.7	3.4	0.0	766.8
Total	985.2	607.9	465.3	218.5	281.3	95.4	49.4	56.7	2759.7
1974-75									
Commonwealth	279.4	205.8	202.4	75.2	121.9	47.4	39.6	54.8	1026.3
State	334.2	256.8	131.5	68.8	65.1	22.7	0.0	0.0	879.2
Local	350.2	176.0	157.9	59.5	52.7	28.8	2.6	0.0	827.8
Total	963.8	638.7	491.8	203.6	239.7	98.9	42.1	54.8	2733.3
1975-76									
Commonwealth	293.1	198.1	191.3	84.0	126.2	65.9	44.5	57.1	1060.1
State	332.6	241.4	126.0	61.5	69.9	24.8	0.0	0.0	856.1
Local	441.2	160.8	153.6	52.6	57.3	28.9	3.4	0.0	897.8
Total	1066.9	600.2	470.9	198.0	253.4	119.6	48.0	57.1	2814.1

TABLE 5.1(Cont)—TOTAL ANNUAL ROAD EXPENDITURE, BY STATE, YEAR AND LEVEL OF GOVERNMENT, 1972-73 TO 1981-82 (CONSTANT 1981-82 VALUES)

($million)

	New South Wales	*Victoria*	*Queensland*	*South Australia*	*Western Australia*	*Tasmania*	*Northern Territory*	*Australian Capital Territory*	*Total Australia*
1976-77									
Commonwealth	259.7	166.5	174.7	70.9	104.9	64.8	42.1	53.7	937.3
State	324.6	246.0	161.5	79.1	89.0	44.0	0.0	0.0	944.2
Local	367.8	172.5	131.6	55.7	59.0	27.6	4.5	0.0	818.6
Total	952.0	585.0	467.9	205.7	252.9	136.4	46.6	53.7	2700.2
1977-78									
Commonwealth	266.0	164.9	168.9	66.9	103.4	46.5	41.7	66.0	924.4
State	385.0	263.1	156.3	69.8	87.6	44.9	0.0	0.0	1006.7
Local	388.3	164.8	128.2	62.7	60.1	29.0	4.4	0.0	837.3
Total	1039.3	592.8	453.4	199.4	251.0	120.4	46.1	66.0	2768.4
1978-79									
Commonwealth	253.0	162.0	166.4	65.9	98.7	35.3	0.0	61.8	843.1
State	365.5	240.5	156.6	74.5	101.5	47.0	54.7	0.0	1040.2
Local	394.7	169.3	125.2	61.9	67.0	29.9	0.9	0.0	848.9
Total	1013.3	571.8	448.2	202.2	267.2	112.2	55.6	61.8	2732.1
1979-80									
Commonwealth	233.9	150.2	153.6	61.2	92.7	33.5	24.7	40.9	790.6
State	376.5	215.4	151.5	63.2	107.6	42.6	41.0	0.0	997.8
Local	356.7	175.0	141.5	56.2	53.6	24.6	2.6	0.0	810.2
Total	967.1	540.6	446.5	180.6	254.0	100.7	68.3	40.9	2598.7

TABLE 5.1(Cont)—TOTAL ANNUAL ROAD EXPENDITURE, BY STATE, YEAR AND LEVEL OF GOVERNMENT, 1972-73 TO 1981-82 (CONSTANT 1981-82 VALUES)

($million)

	New South Wales	*Victoria*	*Queensland*	*South Australia*	*Western Australia*	*Tasmania*	*Northern Territory*	*Australian Capital Territory*	*Total Australia*
1980-81									
Commonwealth	224.5	145.6	149.8	58.7	88.9	41.1	23.8	21.6	754.0
State	376.9	198.6	148.7	62.2	98.7	39.0	38.1	0.0	962.3
Local	318.7	190.1	138.2	56.4	50.5	21.4	0.8	0.0	776.1
Total	920.1	534.3	436.7	177.3	238.1	101.6	62.7	21.6	2492.3
1981-82									
Commonwealth	214.2	138.5	140.6	56.4	84.1	46.5	23.0	15.0	718.3
State	329.8	203.8	174.2	58.2	89.5	35.6	37.9	0.0	929.0
Local	353.2	177.4	114.6	56.3	56.5	20.5	2.7	0.0	781.2
Total	897.2	519.7	429.4	170.9	230.1	102.6	63.6	15.0	2428.5

Note: Figures may not add to totals due to rounding.

Source: BTE (1984f).

Road expenditure as a component of total expenditure has declined throughout the last decade for all levels of government. In the case of the Commonwealth, road expenditure was about 3.06 per cent of total expenditure in 1972-73 declining to 1.75 per cent in 1981-82. Equivalent figures are 6.72 per cent and 4.68 per cent for state government and 34.13 per cent and 25.41 per cent for local government. This trend reflects the changing pattern of priorities perceived by governments, with all three levels giving relatively higher priority to other programs.

Table 5.2 shows the expenditure per motor vehicle on register for all states over the period 1972-73 to 1981-82. Since almost all state expenditure on roads comes from hypothecation of revenue raised mainly from road users this represents a fair indicator of state effort.

The values in Table 5.2 indicate a fairly wide disparity between states and that the general relativities have remained fairly constant, although all show a decline over the decade. Northern Territory values reveal a very high expenditure per vehicle since it attained self government. The expenditure per vehicle for 1978-79 was inflated by the fact that all expenditure in that year was ascribed to the Northern Territory Government, rather than being split between Commonwealth and Northern Territory in the ratio approximately 0.6:1 as was the case for later years when the arrangements had settled down. If the Commonwealth funds for roads in the Northern Territory over the period 1972-73 to 1977-78 were split into notional Commonwealth/State in the same ratio, then an expenditure per vehicle of the order of $800 per annum would be obtained, which is in line with the expenditure in later years.

Among the other states Tasmania has the highest annual expenditure on roads per vehicle, while South Australia has the lowest.

It should be noted that the quota requirements in the ABRD legislation may tend to perpetuate the differences in effort, since state expenditure must be maintained at the five year average to 1981-82, although differential growth in vehicle registrations may produce some marginal change.

Expenditure on roads by local government shows a similar variation between states, as may be observed from Table 5.3. The reason for a low expenditure by Northern Territory local government lies in the fact that much of the road system is in unincorporated areas and so comes under state government expenditure. In fact the state government is undertaking part of the role of local government, which also helps to explain the high expenditure indicated in Table 5.2.

TABLE 5.2—STATE EXPENDITURE ON ROADS PER MOTOR VEHICLE ON REGISTER, 1972-73 TO 1981-82 (CONSTANT 1981-82 VALUES)

($)

Year	*New South Wales*	*Victoria*	*Queensland*	*South Australia*	*Western Australia*	*Tasmania*	*Northern Territory*
1972-73	184	156	176	136	174	194	a
1973-74	173	158	145	114	160	154	a
1974-75	155	149	143	111	116	120	a
1975-76	152	134	125	96	129	124	a
1976-77	144	134	151	118	137	210	a
1977-78	165	137	138	103	125	204	a
1978-79	152	122	133	108	141	204	1 094
1979-80	149	110	120	89	144	185	820
1980-81	143	97	109	85	128	163	762
1981-82	119	94	121	71	113	142	632

a. Prior to self government in 1978, all road expenditure in Northern Territory was by the Commonwealth.

Source: BTE (1984g), Table 4.1.

Table 5.4 shows the expenditure by all three levels of government combined on different categories of roads over the period 1972–73 to 1981–82. The figures for 1979–80 have been adjusted by a small amount to correct the error in New South Wales local government expenditure. The introduction of the national highway category in 1974–75 produced no significant change in total levels of funding, being simply a split of the rural arterial roads category.

Expenditure on urban arterial roads fell sharply after 1973–74. This represents the reversal of a sharp rise which occurred in 1969–70 under the *Commonwealth Aid Roads Act* 1969 (CAR). The real level of funding for national highways has been maintained despite an overall reduction in Commonwealth road funding, reflecting the Commonwealth commitment to a national highway system.

The pattern of distribution of Commonwealth road funds among the states has changed only slowly over time, and hardly at all since 1977–78, as shown in Table 5.5. Prior to 1969, Commonwealth funds were distributed under a formula which gave five per cent of funds to Tasmania, with the remainder distributed among the other states on the basis of one third according to population, one third according to area and one third according to vehicles on register. This formula tended to give higher proportions of total Commonwealth funding to South Australia and Western Australia and smaller shares to New South Wales, Victoria and Queensland, compared with shares based upon Commonwealth Bureau of Roads (CBR) and BTE analyses which have influenced distributions since 1969. Over the whole period covered by Table 5.5, the proportion of funds going to the three most populous states has risen from 67.4 per cent to 74.3 per cent.

The slow rates of change indicated in Table 5.5 illustrate the relatively long periods required for intergovernmental adjustment even when an adjustment has been established as desirable on economic efficiency grounds.

ROAD FUNDING ARRANGEMENTS

Basic features of the legislation covering Commonwealth funding of roads enacted over the last twenty years are set out in Table 5.6.

Prior to 1969 distribution of Commonwealth funds among the states was on the basis of established formulae. States were free to allocate Commonwealth funds between road categories, but the distribution between urban and rural areas was fixed.

TABLE 5.3—LOCAL GOVERNMENT EXPENDITURE ON ROADS PER HEAD OF POPULATION, 1972–73 TO 1981–82 (CONSTANT 1981–82 VALUES)

($)

Year	*New South Wales*	*Victoria*	*Queensland*	*South Australia*	*Western Australia*	*Tasmania*	*Northern Territory*
1972–73	69	39	80	46	19	73	33
1973–74	69	42	73	46	45	65	31
1974–75	72	47	79	48	47	71	29
1975–76	89	43	75	42	49	71	33
1976–77	74	45	63	44	50	68	51
1977–78	78	43	60	49	50	70	39
1978–79	78	44	57	48	55	72	9
1979–80[a]	70	45	63	43	43	60	27
1980–81	62	49	61	43	40	47	9
1981–82	64	44	48	42	42	49	23

a. BTE estimate.

Source: BTE (1984f). and *Commonwealth Yearbook* 1982.

TABLE 5.4—ANNUAL ROAD EXPENDITURE BY ROAD CATEGORY, 1972-73 TO 1981-82 (CONSTANT 1981-82 VALUES)
($million)

Categories	*1972-73*	*1973-74*	*1974-75*	*1975-76*	*1976-77*	*1977-78*	*1978-79*	*1979-80*	*1980-81*	*1981-82*
Construction										
National roads	0.0	0.0	263.0	319.8	311.4	329.1	318.4	298.7	297.7	266.9
Rural arterial roads	500.0	468.9	339.1	339.3	327.6	317.3	318.3	334.4	294.4	289.3
Rural local roads	484.2	478.4	420.4	397.6	389.3	388.1	381.1	344.8	362.0	376.8
Urban arterial roads	759.2	758.0	575.1	511.9	464.0	489.5	472.4	433.6	398.4	370.7
Urban local roads	279.0	290.0	259.2	326.6	355.7	351.0	341.0	339.2	272.9	261.3
Total	2022.3	1995.6	1856.7	1895.1	1847.8	1874.7	1830.3	1750.6	1625.5	1564.9
Maintenance										
National roads	0.0	0.0	57.5	51.8	51.0	57.2	61.1	56.8	59.2	61.4
Rural arterial roads	226.4	241.7	235.0	218.0	214.5	212.4	203.7	205.0	192.4	195.1
Rural local roads	227.6	236.4	295.6	304.0	255.7	268.4	267.0	255.6	286.4	258.8
Urban arterial roads	68.4	70.9	89.0	86.9	91.6	98.5	107.1	88.7	86.3	79.4
Urban local roads	193.3	196.4	177.3	228.9	215.3	230.4	239.0	220.4	221.3	254.1
Total	715.3	745.0	854.4	889.4	827.9	867.0	877.9	825.9	845.6	848.8
Total construction and maintenance	2737.8	2740.7	2710.7	2784.6	2674.8	2741.6	2708.1	2576.5	2471.1	2413.8
Planning and research	19.0	18.9	22.6	29.5	25.3	26.9	23.9	22.4	21.4	14.8
Total	2756.7	2759.7	2733.3	2814.1	2700.2	2768.4	2732.1	2599.6	2492.3	2428.5

Source: BTE (1984f).

TABLE 5.5—DISTRIBUTION OF COMMONWEALTH ROAD GRANTS AMONG THE STATES, 1969-70 TO 1981-82

(per cent)

Year	*New South Wales*	*Victoria*	*Queensland*	*South Australia*	*Western Australia*	*Tasmania*
1969-70	29.6	19.8	18.0	10.9	17.1	4.7
1970-71	29.8	19.9	18.1	10.8	16.6	4.7
1971-72	30.4	20.3	18.6	10.4	16.0	4.4
1972-73	30.7	20.5	18.7	10.0	15.7	4.4
1973-74	31.0	20.7	18.9	9.8	15.7	4.4
1974-75	31.5	20.6	20.5	8.7	13.7	5.0
1975-76	30.8	20.8	20.4	9.4	14.1	4.5
1976-77	31.2	21.0	20.9	8.9	13.2	4.7
1977-78	32.6	20.7	20.9	8.5	12.8	4.5
1978-79	32.4	20.8	21.1	8.5	12.7	4.6
1979-80	32.4	20.8	21.1	8.5	12.7	4.6
1980-81	32.4	20.8	21.1	8.5	12.7	4.6
1981-82	32.4	20.8	21.1	8.5	12.7	4.6

a. Grants to Northern Territory have been excluded from this table to provide a consistent basis for comparison.

Source: BTE (1984g), Table 4.5.

The *CAR Act* 1969 represented a movement away from funds allocation based on a formula approach towards one based on assessed needs and economic efficiency. The *CAR Act* 1969 also saw a significant shift in allocation of Commonwealth funds between road categories. Before that Act was introduced some 80 per cent of Commonwealth road funds had been allocated to rural areas, but the Act allocated some 50 per cent of funds to urban arterial roads.

The *National Roads Act* 1974 saw the establishment of a number of rural arterial roads as national highways, with the Commonwealth Government accepting full financial responsibility for their construction and maintenance. That Act also saw funds allocated specifically for urban local roads for the first time.

The Commonwealth Government of the day in 1976 expressed concern about the fact that funding of national highways had been at the expense of other rural roads and, in the *State Grants (Roads) Act* 1977, increased expenditure on rural arterial and local roads at the expense of urban arterial. The increased funding for local roads was the result of government concern about the financial capacity of local government to sustain its roadworks programs, rather than concern about the efficient allocation of funds for local roads.

The *Roads Grants Acts* 1980-82 saw a continuation of the process of reducing Commonwealth involvement in the detailed administration of road programs begun in 1977. The number of road categories for grants was reduced, and program approval for arterial roads was abolished as was the urban/rural split requirement for local road funds. A formula approach was introduced for the allocation of funds for local roads between local governments. After 1981 only three categories of roads (national, arterial and local) existed for Commonwealth funding purposes.

The introduction of the *ABRD Trust Fund Act* 1982 represented a divergence from the course followed in the various recent road assistance acts. The main aim of the Act was to significantly improve the standard of national highways by 1988, using funds obtained by hypothecation of a levy on road transport fuels. Commonwealth control over the expenditure of funds under the ABRD program is much tighter than under the general Road Grants Acts with the re-introduction of

TABLE 5.6—BASIC FEATURES OF COMMONWEALTH ROAD FUND LEGISLATION, 1964-1982

Road legislation	*Arrangements*				
	Allocation procedures				
	States	*Categories*	*Categories*[a]	*Quotas*	*Program approval procedures*
CAR Act 1964 (1964-65 to 1968-69)	Formula	States free to allocate	Rural roads (c & m) Urban roads (c & m)	None on basic grant. $ for $ on supplementary grant	None
CAR Act 1969 (1969-70 to 1973-74)	50% previous formula 50% needs as per CBR 1969 report	Guided by 1969 CBR report	Urban arterial roads (c) Rural arterial roads (c) Rural roads other than arterial (c & m)	Base amount set with annual increase based on motor vehicle registrations	None
Road Grants Act 1974 National Roads Act 1974 (1974-75 to 1976-77)	Basically needs as per CBR report	Guided by 1973 CBR Report, except full funding of national roads and less for other categories	National highways (c) National highways (m) Export & major commercial roads (c & m) Rural arterial roads (and development roads) (c) Rural local roads (c & m) Urban arterial roads (c) Urban local roads (c) MITERS Beef roads (c)	Based on 1973 CBR report (mainly motor vehicle registrations)	National roads—project approval. Urban arterial roads—project approval but with controls also over state expenditure on urban arterials. All other road categories—program appoval

TABLE 5.6(Cont)—BASIC FEATURES OF COMMONWEALTH ROAD FUND LEGISLATION, 1964-1982

Road legislation	*Arrangements*				
	Allocation procedures				*Program approval procedures*
	States	*Categories*	*Categories*[a]	*Quotas*	
States Grants (Roads) Act 1977 (1977-78 to 1979-80)	Basically pro rata increase on 1976-77 (±4 per cent)	Commonwealth Government's own announced objectives	National highways (c) National highways (m) National commerce roads (c) Rural arterial roads (c) Rural local roads (c & m) Urban arterial roads (c) Urban local roads (c) MITERS	Pro rata increase to increase in grants	National roads same as for 1974 Act. Establishment of planning committees as alternative to approval procedures for all categories. Alternative program of allocations for local roads.
Roads Grants Act 1980 (1980-81)	Pro rata increase on 1977 Act	Pro rata increase on 1977 Act except MITERS grants allocated to national roads	National roads (c & m) rural arterial roads (c) Urban arterial roads (c) Local roads (c & m)	Based on achieving equal effort per vehicle over 6 years	Procedures same as those in 1977 Act but with program of allocations only for local roads. Provision for development of formula for local roads.

TABLE 5.6(Cont)—BASIC FEATURES OF COMMONWEALTH ROAD FUND LEGISLATION, 1964-1982

Road legislation	*Arrangements*				
	Allocation procedures				
	States	*Categories*	*Categories*[a]	*Quotas*	*Program approval procedures*
Roads Grants Act 1981 (1981-82 to 1984-85)	Pro rata increase on 1980 RGA	Pro rata increase on 1980 RGA	National roads (c & m) Arterial roads (c) Local roads (c & m)	Abolished	Abolition of approval procedures for arterial roads.
ABRD Trust Fund Act 1982 (1982-83 to Dec 1988)	Pro rata to 1981 RGA except national highways	Commonwealth Government's own objectives	National roads (c) Rural arterial roads (c) Urban arterial roads (including UPT) (c) Local roads (c)	Annual maintenance in real terms of base amounts (based on average real expenditure over previous five years)	Detailed project approval procedures introduced

a. Excluding planning and research.
c construction
m maintenance

Source: Commonwealth of Australia (1964-82).

project approval processes and an increase in the number of categories. Distribution of funds among the states is generally the same as that under the Roads Grants Acts, but distribution among categories is significantly different. Distribution between categories for the first two years of ABRD is shown in Table 5.7. It may be observed from Table 5.7 that a much higher percentage of ABRD funds are being directed towards arterial road works than is the case for RGA funds. This shift is in the direction of increased economic return as indicated in analyses presented in previous CBR and BTE roads studies.

An important feature of the ABRD program is that it applies to construction only, that is, none of the funds may be applied to road maintenance. This is in line with the general objectives of the ABRD program which is to improve the road system.

Currently, Commonwealth funds for local roads are distributed to local government on the basis of formulae worked out separately for each state. The formulae vary widely between the States, reflecting differing circumstances, and details are presented in Appendix III to BTE (1984g). The formulae used seem to have no consistent basis across the states, and seem to result in continuation of the distribution of funds which pertained 1981.

REVENUE FOR ROADS

Commonwealth funds for roads under the *Roads Grants Act* 1981 are taken from consolidated revenue with no separately identifiable source of revenue. ABRD programs are funded by hypothecation of a levy of two cents per litre on road fuels. Thus the amount of revenue raised by this levy determines the size of ABRD programs.

Details of state revenue sources for road funds are given in BTE (1982), but in general they are vehicle registration and driver licence fees and business (fuel) franchise schemes. All states except Queensland have a business (fuel) franchise scheme introduced to replace[1] road maintenance charges, which were abolished in June 1979. The schemes produce revenue from motor spirit and automotive distillate sales with all except Tasmania having a higher rate on automotive distillate. The rates applying in February 1984 are given in Table 5.8.

In all states except New South Wales these funds are hypothecated to road works (specifically to road maintenance in Victoria). In New South Wales, only the income from automotive distillate is hypothecated.

TABLE 5.7—COMPARISON OF ALLOCATIONS TO DIFFERENT ROAD CATEGORIES OF FUNDS UNDER THE RGA 1981 AND THE ABRD 1982-83 AND 1983-84 PROGRAMS

(per cent)

Category	*RGA 1981*	*ABRD 1982-83*	*ABRD 1983-84*
National roads	44	40	42
Arterial roads			
Urban		30	30
Rural		15	16
Total	32	45	46
Local roads	24	15	12
Total	100	100	100

Source: BTE (1984g). Table 2.3

1. Tasmania never had a road maintenance charge.

In states which use fuel franchise, revenues have grown rapidly while revenue from registration and license fees have declined in real terms.

Loans are a significant source of revenue for road works in New South Wales constituting almost 30 per cent in 1980–81.

Table 5.9 presents a summary of revenue for roads raised by the states over the period 1972–73 to 1981–82. Although state government expenditure on roads peaked in 1978–79 (see Figure 5.2) road revenue continued to increase.

Apart from tied grants received by local government specifically for roads, welfare, etc, the main sources of local government revenue are rates, borrowings, grants (eg PITS) and fees and charges, none of which are hypothecated to roads. Overall local government revenues grew in real terms at about 7.5 per cent per year in the early 1970s and at a slower rate of about 1.4 per cent per year after 1975–76 as shown in Table 5.10. Revenue from taxes and charges (including rates) grew in real terms at about 5.1 per cent per year to 1975–76 and at about 2.3 per cent per year since then, while expenditure peaked in 1975–76 (see Figure 5.2).

TABLE 5.8—COMPARISON OF STATE GOVERNMENT (FUEL) FRANCHISE SCHEME RATES, FEBRUARY 1984

(cents per litre)[a]

State	*Motor spirit*		*Automotive*
	Super	*Standard*	*distillate*
New South Wales	3.53	3.45	3.57
Victoria	3.47	3.39	5.02
South Australia	2.51	2.51	3.49
Western Australia	2.10	2.10	3.85
Tasmania	2.71	2.65	2.69

a. Calculations for *ad valorem* rates based on capital city wholesale prices for all states except Western Australia, which has a fixed fee per litre.

Source: Petroleum Products Pricing Authority (1984).

TABLE 5.9—STATE GOVERNMENT NET ROAD REVENUE, 1972–73 TO 1981–82 (CONSTANT 1981–82 VALUES)

($million)

Year	*Motor taxes*		*Loans*	*Other*[a]	*Total*[b]
	Fuel franchise	*Other*			
1972–73	..	759	33	138	930
1973–74	..	703	26	131	860
1974–75	..	680	34	178	892
1975–76	..	691	44	179	915
1976–77	..	717	67	182	964
1977–78	..	747	63	229	1038
1978–79	..	755	90	187	1032
1979–80	79	646	161	177	1062
1980–81	113	628	157	212	1110
1981–82	145	697	113	192	1147

a. Includes revenues from other authorities, special grants, etc.
b. Figures may not add to total due to rounding.
.. not applicable

Source: BTE (1984f), Table I.7.

TABLE 5.10—COMPONENTS OF LOCAL GOVERNMENT RECEIPTS, 1972-73 TO 1981-82 (CONSTANT 1981-82 PRICES)

($million)

	1972-73	*1973-74*	*1974-75*	*1975-76*	*1976-77*	*1977-78*	*1978-79*	*1979-80*	*1980-81*	*1981-82*	*Average annual growth rate 1972-73 to 1975-76*	*Average annual growth rate 1975-76 to 1981-82*
Taxes and charges	1 369.6	1 380.4	1 461.8	1 592.0	1 676.4	1 698.7	1 700.9	1 698.9	1 759.0	1 821.0	5.1	2.3
Public enterprise income	289.4	251.8	201.4	240.5	283.9	274.2	250.3	237.1	229.3	243.5	-6.0	0.2
State and Commonwealth grants	491.3	382.3	663.3	789.2	668.4	715.7	713.7	734.6	779.9	776.7	17.1	-0.3
Net borrowing	425.7	342.3	429.0	499.7	519.0	449.1	448.6	438.1	344.0	290.2	5.5	-8.7
Other[a]	120.1	306.6	343.4	224.9	59.6	227.9	304.8	319.5	396.4	515.0	22.0	14.8
Total	2 696.7	2 663.4	3 099.0	3 346.3	3 207.3	3 356.6	3 418.3	3 428.2	3 508.6	3 646.4	7.5	1.4

a. Includes property income, depreciation allowances and funding items other than net borrowings.

Notes: 1. Price deflator used was the ABS implicit price deflator for expenditure on Gross Domestic Product.
2. Figures may not add to totals due to rounding.

Source: BTE (1984g), Table I.6.

CHAPTER 6-VEHICLE NUMBERS AND ROAD USAGE

GENERAL

As indicated in Chapters 3 and 4 traffic volume is an important factor in assessing the adequacy of an existing road or in determining the standard to which it should be built or upgraded. In addition, the direct economic benefits from road investments are heavily dependent on traffic volume (see Chapter 7). It is necessary, therefore, to estimate future traffic levels in order to assess likely future conditions of the Australian road system and the returns to be obtained from road investment. Forecasts of vehicle numbers and vehicle kilometres of travel in Australia over the period 1985 to 2000 have been prepared and are summarised in this chapter. Full details of the forecasts and the process used to obtain them are given in BTE (1984c).

Forecasts have been prepared of future vehicle numbers and their usage based on econometric analysis of past data and assumed future values of a number of economic variables. Separate forecasting models were developed for cars and station wagons on one hand and for commercial vehicles on the other, with the latter also being further subdivided into light commercial vehicles, rigid trucks, articulated trucks, other truck type vehicles, and buses. In each case the number of vehicles on register for a particular year was forecast and this was combined with forecast average annual usage to produce a forecast of vehicle kilometres of travel (VKT).

Separate forecasts were made for each state and for both high and low values of the economic parameter values in the models.

In order to provide a perspective on the forecasts, Figure 6.1 shows the growth in annual travel by vehicles of all types on roads in Australia over the period 1971 to 1982. The figure indicates sustained growth throughout the period, in spite of increases in real fuel costs and the effects of economic recession, although the growth was not evenly spread over time or among the states.

PASSENGER CARS AND STATION WAGONS

For the high growth scenario for cars and station wagons it was assumed that:

(a) real average personal income would increase at about the same rate experienced in 1980–81 to 1985 and then at a rate slightly lower;

(b) the real purchase price of vehicles would fall at a rate of 2 per cent per annum to 1985, at 1 per cent per annum between 1985 and 1995 and then remain steady;

(c) population would increase according to ABS (Series C) forecasts;

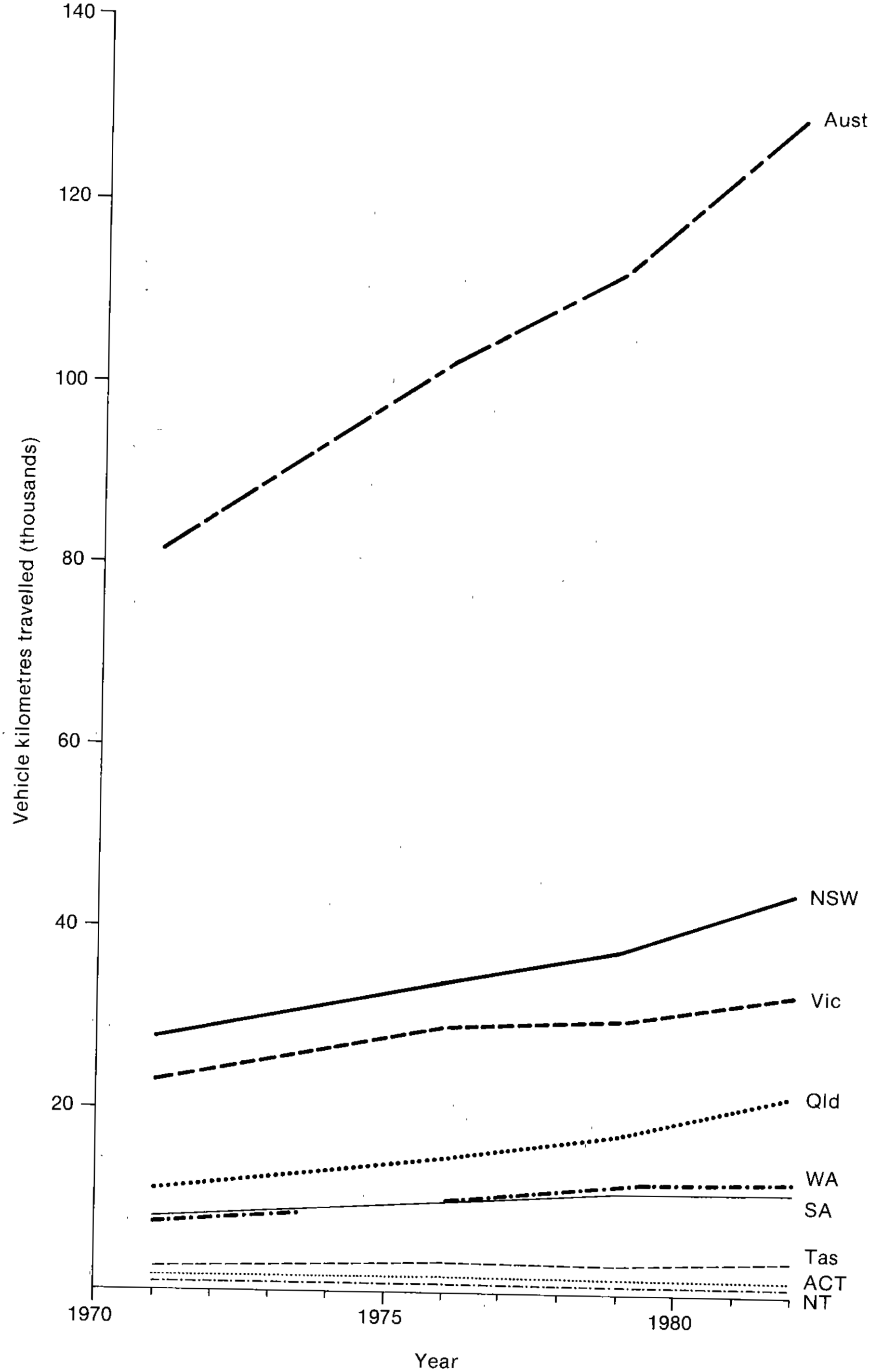
(d) petrol price would remain constant in real terms; and

(e) petrol cost would continue to constitute about 60 per cent of total running costs.

Based on these assumptions Table 6.1 shows the projected number of cars and station wagons registered in each State and the ratio of cars to population for the period 1981 to 2000. Table 6.2 shows the annual total vehicle kilometres of travel under the same assumptions.

For the low growth scenario it was assumed that:

(a) real personal income would increase at 1.5 per cent per annum throughout the period;



Source: ABS, *Surveys of Motor Vehicle Usage.*

Figure 6.1—Annual VKT on Australian roads, 1971–82

TABLE 6.1—PROJECTED NUMBER OF CARS AND STATION WAGONS REGISTERED AND RATIO TO POPULATION; HIGH GROWTH SCENARIO, 1981-2000

Year ending 30 June	*New South Wales*[a]		*Victoria*		*Queensland*		*South Australia*[b]		*Western Australia*		*Tasmania*		*Australia*	
	Vehicles (000)	*Ratio*	*Vehicles (000)*	*Ratio*	*Vehicles (000)*	*Ratio*	*Vehicles (000)*	*Ratio*	*Vehicles (000)*	*Ratio*	*Vehicles (000)*	*Ratio*	*Vehicles (000)*	*Ratio*
1981[c]	2 111.4	0.39	1 632.5	0.41	946.2	0.40	564.9	0.39	552.6	0.43	183.4	0.43	6 021.0	0.40
1985	2 645.8	0.46	2 016.5	0.48	1 315.1	0.50	718.2	0.48	755.3	0.52	239.0	0.54	7 690.0	0.48
1990	3 341.3	0.53	2 617.9	0.59	1 752.9	0.59	934.9	0.59	1 013.0	0.63	302.1	0.64	9 962.2	0.58
1995	4 190.0	0.63	3 381.2	0.72	2 308.2	0.70	1 208.9	0.72	1 343.4	0.75	382.3	0.79	12 814.2	0.69
2000	4 963.3	0.70	4 132.4	0.84	2 802.2	0.77	1 407.5	0.81	1 652.2	0.84	499.6	0.90	15 407.4	0.77

a. Figures for the Australian Capital Territory are included in New South Wales.
b. Figures for the Northern Territory are included in South Australia.
c. Actual.

Source: BTE (1984c).

TABLE 6.2—PROJECTED TOTAL ANNUAL VEHICLE KILOMETRES TRAVELLED BY CARS AND STATION WAGONS; HIGH GROWTH SCENARIO, 1982-2000

(millions)

Year ending 30 June	*New South Wales*[a]	*Victoria*	*Queensland*	*South Australia*[b]	*Western Australia*	*Tasmania*	*Australia*
1982[c]	33 783.6	25 813.5	15 690.7	9 231.3	8 861.6	2 728.1	96 108.9
1985	41 258.6	30 380.6	20 578.7	10 678.2	11 707.2	3 432.5	118 035.8
1990	52 889.4	39 441.2	27 843.1	13 900.1	15 701.5	4 338.8	154 114.1
1995	67 324.9	50 941.1	37 217.4	17 973.0	20 822.7	5 490.6	199 769.7
2000	80 951.4	62 258.7	45 863.6	20 926.7	25 609.1	6 457.2	242 066.7

a. Figures for the Australian Capital Territory are included in New South Wales.
b. Figures for the Northern Territory are included in South Australia.
c. Actual.

Source: BTE (1984c).

(b) the real purchase price of vehicles would remain constant;

(c) population would grow in accordance with ABS (Series A) projections;

(d) petrol price would remain constant in real terms to 1985 and then rise by 2 per cent per annum; and

(e) petrol cost would continue to represent about 60 per cent of running costs.

Table 6.3 shows the projected number of cars and station wagons registered in each state and the ratio of cars to population for the period 1981 to 2000 based on a low growth scenario. Table 6.4 shows the annual total vehicle kilometres of travel under the same assumptions.

It may be observed from Tables 6.1 and 6.3 that the number of cars and station wagons in Australia is projected to rise to between 0.8 and 0.5 per head of population by the end of this century depending upon whether high or low growth conditions are assumed. Current figures for the United States of America vary between 0.7 and 0.4, with California at the higher end of the spectrum.

Tables 6.2 and 6.4 indicate that total annual travel by cars and station wagons is projected to increase between 151 per cent and 40 per cent by the end of the century. Clearly projections of vehicle kilometres of travel are very sensitive to assumptions about economic developments, although the differences between the scenarios, for the period to 1990 produce much closer percentage increases, 60 and 16 per cent respectively.

COMMERCIAL VEHICLES

A process similar to that used to forecast numbers of motor cars and station wagons and their average annual travel was used to make projections for commercial vehicles. However, it was found early in the analysis that the relationship between numbers of vehicles on register and annual travel on one hand and various economic indicators on the other was quite complex. In fact different classes of commercial vehicle were found to relate to different sets of economic indicators and the relationships were not constant among states. Factors such as the value of retail trade, the value of production of mining and construction materials, the value added in manufacturing, value of work on dwellings and the value of work on other buildings were found to correlate differently for different classes of vehicle in different states so that no simple relationship could be developed which would be applicable to all commercial vehicles over all states. Hence, an indicator of the level of economic activity relevant to road transport was developed for each state and each vehicle type.

Models were developed for each state to forecast separately the number of light commercial vehicles, rigid trucks, articulated trucks, other truck types and buses. A similar set of models was developed to forecast average annual travel for each vehicle type and total annual vehicle kilometres of travel. In each case high and low projections were obtained by assuming that the various economic indicators used in the models changed in a manner favourable or unfavourable to increasing use of commercial vehicles. The projected number of vehicles of different types over the period 1982 to 2000 is given in Table 6.5 for the high growth scenario and in Table 6.6 for the low growth scenario. It should be noted that only one set of projections was produced for other truck type vehicles and buses because of data limitations.

Projected total vehicle kilometres travelled by vehicle type and state for high and low growth scenarios are presented in Tables 6.7 and 6.8.

The figures reflect the different use made of different vehicle types. For example the high average annual travel of articulated trucks reflects their main use as long distance haulage vehicles. On the other hand the relatively low average travel by

TABLE 6.3—PROJECTED NUMBER OF CARS AND STATION WAGONS REGISTERED AND RATIO TO POPULATION; LOW GROWTH SCENARIO, 1981-2000

Year ending 30 June	New South Wales[a]		Victoria		Queensland		South Australia[b]		Western Australia		Tasmania		Australia	
	Vehicles (000)	Ratio	Vehicles (000)	Ratio	Vehicles (000)	Ratio	Vehicles (000)	Ratio	Vehicles (000)	Ratio	Vehicles (000)	Ratio	Vehicles (000)	Ratio
1981[c]	2 111.4	0.39 1	632.5	0.41	946.2	0.40	564.9	0.39	552.6	0.43	183.4	0.43	6 021.0	0.40
1985	2 316.2	0.40	1 799.9	0.44	1 083.0	0.42	613.5	0.41	628.4	0.45	200.5	0.45	6 641.5	0.42
1990	1 587.3	0.43	2 000.5	0.47	1 267.8	0.44	673.9	0.43	717.9	0.46	222.4	0.48	7 469.6	0.44
1995	2 871.7	0.45	2 208.2	0.49	1 469.2	0.46	735.5	0.45	813.0	0.48	240.2	0.50	8 337.9	0.47
2000	3 169.4	0.48	2 424.2	0.52	1 687.0	0.48	797.6	0.48	913.1	0.50	262.3	0.53	9 253.6	0.49

a. Figures for the Australian Capital Territory are included in New South Wales.
b. Figures for the Northern Territory are included in South Australia.
c. Actual.

Source: BTE (1984c).

TABLE 6.4—PROJECTED TOTAL ANNUAL VEHICLE KILOMETRES TRAVELLED BY CARS AND STATION WAGONS; LOW GROWTH SCENARIO, 1982-2000

(millions)

Year ending 30 June	New South Wales[a]	Victoria	Queensland	South Australia[b]	Western Australia	Tasmania	Australia
1982[c]	33 783.6	25 813.5	15 690.7	9 231.2	8 861.6	2 728.1	96 108.9
1985	35 794.6	26 552.1	16 795.2	8 958.3	9 623.9	2 879.6	100 603.7
1990	39 984.1	28 493.1	19 661.0	9 548.5	10 776.4	3 194.1	111 657.2
1995	44 379.3	30 364.9	22 784.3	10 112.3	11 961.6	3 449.8	123 052.2
2000	48 979.9	32 186.1	26 161.9	10 641.6	13 167.9	3 767.2	134 904.6

a. Figures for the Australian Capital Territory are included in New South Wales.
b. Figures for the Northern Territory are included in South Australia.
c. Actual.

Source: BTE (1984c).

rigid trucks reflects their use in high intensity operations (eg urban distribution) and in an ancillary role (for example, farm vehicles).

Figure 6.2 shows the projected growth in total vehicle kilometres of travel for the two scenarios. It may be seen that the projections for the high growth scenario are well above actual growth rates for recent years while that for the low growth case is slightly below.

The forecasts developed here may be compared with those from other sources. The ATAC Committee on Motor Vehicle Emissions developed forecasts for the number

TABLE 6.5—PROJECTED NUMBER OF COMMERCIAL VEHICLES BY VEHICLE TYPE AND STATE; HIGH GROWTH SCENARIO, 1982-2000

(000)

Vehicle type	*New South Wales*[a]	*Victoria*	*Queensland*	*South Australia*[b]	*Western Australia*	*Tasmania*	*Australia*
Light commercial							
1982[c]	339.2	181.4	266.8	91.4	117.3	32.7	1 028.7
1985	377.9	200.6	306.3	97.7	136.4	35.0	1 153.9
1990	468.7	245.1	394.6	111.8	183.3	39.6	1 443.1
1995	571.1	294.6	505.9	126.8	238.8	44.3	1 781.5
2000	675.7	348.5	627.8	141.6	295.5	48.8	2 137.9
Rigid truck							
1982[c]	165.6	149.5	56.6	44.7	64.1	12.4	492.9
1985	190.7	163.6	62.9	46.4	75.8	13.2	552.6
1990	250.8	200.8	76.4	50.0	105.3	14.7	698.0
1995	322.6	242.4	92.4	53.7	141.3	16.3	864.7
2000	400.2	288.0	109.0	57.1	179.1	17.8	1 051.2
Articulated truck							
1982[c]	17.4	12.2	8.8	5.1	4.8	1.5	49.8
1985	19.7	13.4	10.1	5.3	5.6	1.6	55.7
1990	25.1	16.4	13.1	5.8	7.7	1.9	70.0
1995	31.5	19.7	16.8	6.3	10.2	2.2	86.7
2000	38.1	23.4	20.9	6.8	12.8	2.4	104.4
Other truck type							
1982[c]	13.3	11.7	4.4	5.9	6.2	2.2	43.7
1985	15.0	14.5	5.5	7.1	7.3	2.7	52.1
1990	18.0	19.5	7.7	9.2	9.3	3.7	67.4
1995	21.3	25.0	10.2	11.5	11.5	4.7	84.1
2000	24.7	30.8	13.0	13.9	14.0	5.7	102.0
Bus							
1982[c]	17.0	11.5	6.7	3.9	5.1	2.1	46.3
1985	19.6	13.3	8.0	4.3	6.2	2.3	53.7
1990	24.4	16.7	10.5	5.0	8.2	2.7	67.5
1995	29.5	20.3	13.3	5.6	10.6	3.2	82.5
2000	35.0	24.1	16.5	6.3	13.2	3.7	98.7

a. Figures for the Australian Capital Territory are included in New South Wales.
b. Figures for the Northern Territory are included in South Australia.
c. Actual.

Source: BTE (1984c).

of passenger vehicles to the end of the century and arrived at figures slightly above the BTE forecasts under low growth assumptions for the period beyond 1985 (BTE 1984c, Table 4.11). The Institute of Applied Economic and Social Research developed long term forecasts of car ownership arriving at levels higher than the high BTE forecast for 1985, but between the BTE high and low cases for the remainder of the century (BTE 1984c, Chapter 4).

Table 6.9 shows forecast average annual growth rates in vehicle kilometres of travel in the states to the end of the century under low and high growth assumptions.

TABLE 6.6—PROJECTED NUMBER OF COMMERCIAL VEHICLES BY VEHICLE TYPE AND STATE; LOW GROWTH SCENARIO, 1982-2000

(000)

Vehicle type	*New South Wales*[a]	*Victoria*	*Queensland*	*South Australia*[b]	*Western Australia*	*Tasmania*	*Australia*
Light commercial							
1982[c]	339.2	181.4	266.8	91.4	117.3	32.7	1 028.7
1985	362.0	195.0	291.1	93.6	130.3	33.9 1	105.9
1990	418.3	227.1	344.5	100.0	162.3	36.3	1 288.5
1995	474.7	260.3	405.9	105.7	195.9	38.5	1 481.0
2000	522.9	293.6	462.6	110.1	224.5	40.1	1 653.8
Rigid truck							
1982[c]	165.6	149.5	56.6	44.7	64.1	12.4	492.9
1985	180.8	158.9	60.5	45.3	72.0	12.8	530.3
1990	217.8	186.0	68.9	47.0	92.0	13.6	625.3
1995	265.5	213.6	78.1	48.5	113.4	14.4	724.5
2000	291.2	241.6	86.3	49.6	132.0	14.9	815.6
Articulated truck							
1982[c]	17.4	12.2	8.8	5.1	4.8	1.5	49.8
1985	18.7	13.0	9.6	5.2	5.4	1.6	53.5
1990	22.1	15.1	11.4	5.8	6.8	1.7	62.5
1995	25.5	17.4	13.4	5.6	8.3	1.8	72.0
2000	28.5	19.7	15.3	5.8	9.6	1.9	80.8
Other truck type							
1982	13.3	11.7	4.4	5.9	6.2	2.2	43.7
1985	15.0	14.5	5.5	7.1	7.3	2.7	52.1
1990	18.0	19.5	7.7	9.2	9.3	3.7	67.4
1995	21.3	25.0	10.2	11.5	11.5	4.7	84.1
2000	24.7	30.8	13.0	13.9	14.0	5.7	102.0
Bus							
1982[c]	17.0	11.5	6.7	3.9	5.1	2.1	46.3
1985	19.6	13.3	8.0	4.3	6.2	2.3	53.7
1990	24.4	16.7	10.5	5.0	8.2	2.7	67.5
1995	29.5	20.3	13.3	5.6	10.6	3.2	82.5
2000	35.0	24.1	16.5	6.3	13.2	3.7	98.7

a. Figures for the Australian Capital Territory are included in New South Wales.

b. Figures for the Northern Territory are included in South Australia.

c. Actual.

Source: BTE (1984c).

Also shown in the table are the growth forecasts used by NAASRA in the course of the NAASRA Roads Study (NAASRA 1984c).

It may be observed from Table 6.9 that the NAASSRA forecasts in all cases except Tasmania fall between the BTE high and low estimates. Relativity between states is roughly the same for both sets of forecasts. BTE forecasts under low growth assumptions and the NAASRA forecasts fall well below those made in 1979 (BTE 1979, Table 3.6) although the current BTE forecasts under high growth assumptions are higher than those used in the 1979 roads study.

TABLE 6.7—PROJECTED TOTAL ANNUAL AVERAGE VKT BY VEHICLE TYPE AND STATE; HIGH GROWTH SCENARIO, 1982–2000

(000)

Vehicle type	*New South Wales*[a]	*Victoria*	*Queensland*	*South Australia*[b]	*Western Australia*	*Tasmania*	*Australia*
Light commercial							
1982[c]	6 182	3 012	3 887	1 557	2 041	557	17 237
1985	6 946	3 357	4 511	1 673	2 401	600	19 488
1990	8 761	4 167	5 927	1 935	3 302	685	24 777
1995	10 841	5 081	7 748	2 216	4 391	773	31 050
2000	12 997	6 090	9 779	2 497	5 525	858	37 746
Rigid truck							
1982[c]	3 432	2 666	1 112	637	1 185	199	9 231
1985	4 052	2 964	1 259	665	1 443	214	10 597
1990	5 594	3 773	1 582	727	2 125	243	14 044
1995	7 522	4 708	1 979	790	3 004	274	18 277
2000	9 694	5 767	2 404	850	3 970	304	22 989
Articulated truck							
1982[c]	1 110	802	458	391	304	92	3 157
1985	1 319	914	555	416	380	103	3 687
1990	1 847	1 210	796	471	588	126	5 038
1995	2 533	1 561	1 125	528	869	153	6 769
2000	3 300	1 983	1 524	585	1 191	180	8 763
Other truck type							
1982[c]	211.5	124.0	54.6	85.0	76.3	19.1	570.4
1985	238.5	153.4	68.6	102.2	89.5	23.8	676.1
1990	286.2	206.7	95.1	132.9	114.0	32.0	867.0
1995	338.7	264.8	126.0	165.5	141.6	40.5	1 077.0
2000	392.7	326.7	161.1	199.4	172.1	49.3	1 301.3
Bus							
1982[c]	447.6	260.5	174.5	150.9	141.7	44.0	1 219.2
1985	500.9	292.8	201.7	159.3	165.0	47.7	1 367.3
1990	595.5	350.9	251.6	174.6	207.8	55.0	1 635.5
1995	696.4	413.0	307.4	189.7	255.8	62.6	1 925.0
2000	803.3	478.0	369.0	204.6	308.7	70.0	2 233.5

a. Figures for the Australian Capital Territory are included in New South Wales.
b. Figures for the Northern Territory are included in South Australia.
c. Actual.

Source: BTE (1984c).

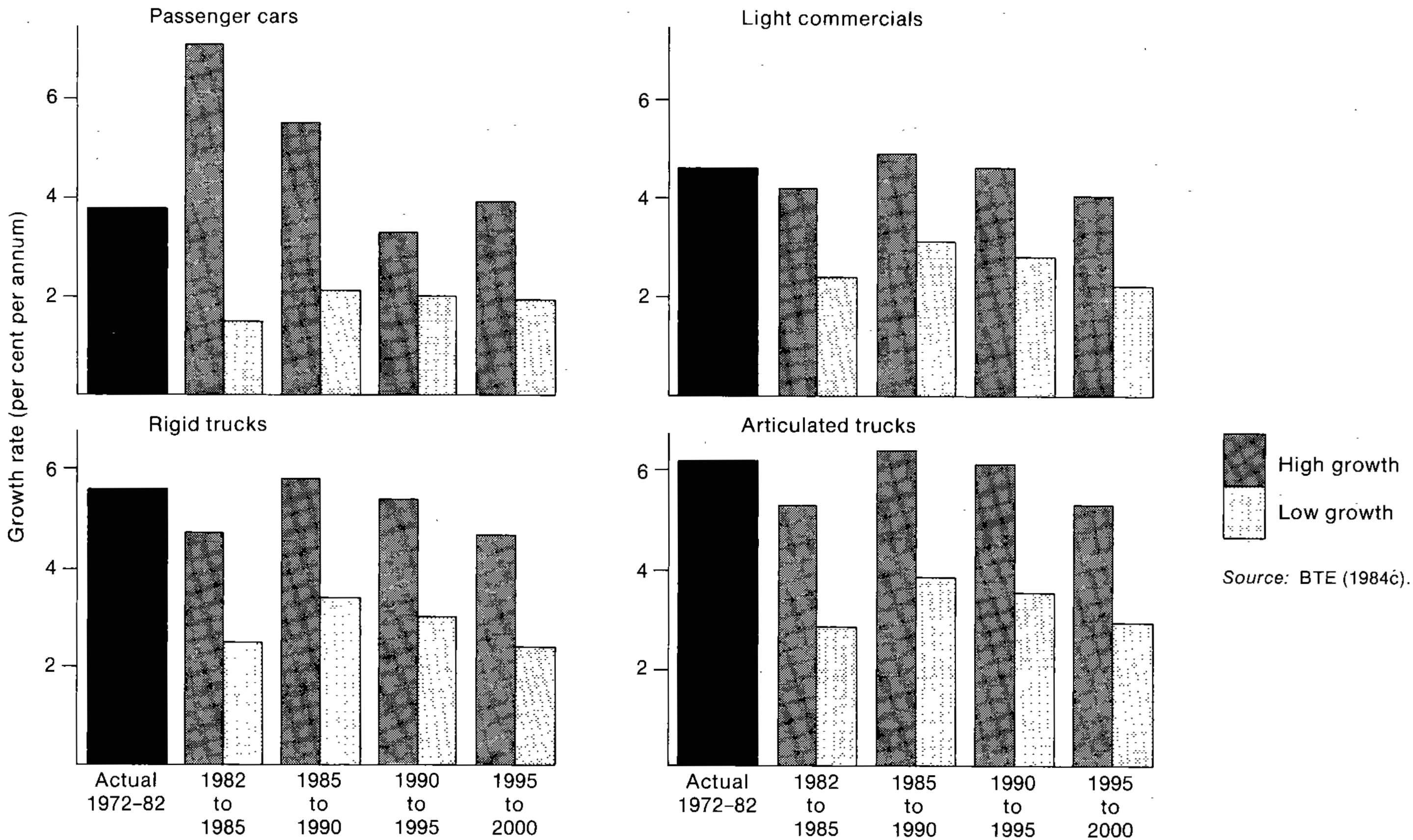
TABLE 6.8—PROJECTED TOTAL ANNUAL AVERAGE VKT BY VEHICLE TYPE AND STATE; LOW GROWTH SCENARIO, 1982-2000

(000)

Vehicle type	*New South Wales*[a]	*Victoria*	*Queensland*	*South Australia*[b]	*Western Australia*	*Tasmania*	*Australia*
Light commercial							
1982[c]	6 182	3 012	3 887	1 557	2 041	557	17 237
1985	6 588	3 237	4 250	1 591	2 267	576	18 509
1990	7 613	3 770	5 030	1 700	2 824	617	21 554
1995	8 640	4 321	5 926	1 797	3 409	655	24 748
2000	9 517	4 874	6 754	1 872	3 906	682	27 605
Rigid truck							
1982[c]	3 432	2 666	1 112	637	1 185	199	9 231
1985	3 743	2 828	1 186	645	1 332	205	9 939
1990	4 508	3 310	1 350	670	1 702	218	11 758
1995	5 310	3 802	1 531	691	2 098	230	13 662
2000	6 028	4 300	1 691	707	2 442	238	15 406
Articulated truck							
1982[c]	1 110	802	458	391	304	92	3 157
1985	1 213	865	509	400	347	97	3 431
1990	1 482	1 033	626	423	458	107	4 129
1995	1 768	1 222	764	443	584	117	4 898
2000	2 035	1 419	903	460	700	125	5 642
Other truck types							
1982[c]	211.5	124.0	54.6	85.0	76.3	19.1	570.4
1985	238.5	153.4	68.6	102.2	89.5	23.8	676.1
1990	286.2	206.7	95.1	132.9	114.0	32.0	867.0
1995	338.7	264.8	126.0	165.5	141.6	40.5	1 077.0
2000	392.7	326.7	161.1	199.4	172.1	49.3	1 301.3
Buses							
1982[c]	447.6	260.5	174.5	150.9	141.7	44.0	1 219.2
1985	500.9	292.8	201.7	159.3	165.0	47.7	1 367.3
1990	595.5	350.9	251.6	174.6	207.8	55.0	1 635.5
1995	696.4	413.0	307.4	189.7	255.8	62.6	1 925.0
2000	803.3	478.0	369.0	204.6	308.7	70.0	2 233.5

a. Figures for the Australian Capital Territory are included in New South Wales.
b. Figures for the Northern Territory are included in South Australia.
c. Actual.

Source: BTE (1984c).



Source: BTE (1984c).

Figure 6.2—Projected total VKT growth rates for passenger cars, light commercial vehicles, rigid trucks and articulated trucks, 1985–2000

TABLE 6.9—PROJECTIONS OF AVERAGE ANNUAL GROWTH IN TOTAL VEHICLE KILOMETRES OF TRAVEL, 1982 TO 2000

(per cent)

State	*Years*	*BTE (low)*	*BTE (high)*	*NAASRA*[a]
New South Wales[b]	1982-85	2.1	6.3	2.7
	1985-90	2.5	5.2	
	1990-95	2.3	5.0	
	1995-2000	2.1	3.9	
Victoria	1982-85	1.3	6.1	2.3
	1985-90	1.8	4.7	
	1990-95	1.7	5.1	
	1995-2000	1.5	5.2	
Queensland	1982-85	2.5	8.3	4.1
	1985-90	3.3	6.1	
	1990-95	3.1	5.9	
	1995-2000	1.9	4.4	
South Australia[c]	1982-85	-0.8	4.1	2.2
	1985-90	1.3	4.8	
	1990-95	1.2	4.7	
	1995-2000	1.0	2.9	
Western Australia	1982-85	3.1	8.7	3.9
	1985-90	3.1	6.4	
	1990-95	2.8	6.0	
	1995-2000	2.3	4.5	
Tasmania[d]	1982-85	1.7	6.7	0.0
	1985-90	2.0	4.4	
	1990-95	1.5	4.4	
	1995-2000	1.6	3.1	
Australia	1982-85	1.8	6.7	2.9
	1985-90	2.4	5.3	
	1990-95	2.2	5.2	
	1995-2000	1.8	4.3	

a. NAASRA rates of growth cover period 1981-1991.
b. Figures for the Australian Capital Territory are included in New South Wales.
c. Figures for the Northern Territory are included in South Australia.
d. Tasmania data does not include Hobart.

Source: BTE (1984c). NAASRA (1984c).

CHAPTER 7—ECONOMIC ASSESSMENT OF ROAD INVESTMENTS

BACKGROUND

In Chapter 3 it was suggested that historically the provision of roads has been directed towards two sets of objectives. They are, firstly, the provision of a basic infrastructure and, secondly, the raising of the standard of the basic system to provide an economically justified level of service in response to increasing demand.

In economic terms, the basic road system may be regarded as a 'merit good'. That is, the provision of roads of an appropriate standard in all parts of the country is regarded by the community at large as being justified even where a road of the particular standard may not be warranted by the benefits accruing to the few people who use it. This concept is important in relation to the provision of many roads in rural areas which often carry very low traffic volumes. Even at relatively low design standards such roads often show poor returns relative to the capital and maintenance costs involved, but are regarded as providing the minimum socially acceptable level of service and so are funded by government authorities. For such roads it is inappropriate to base expenditure decisions entirely on the results of simple benefit cost analysis. It remains important, however, that improvements above the socially acceptable minimum standard in any particular circumstances should be subjected to such analysis.

At the other end of the scale the concept of national highways is based, at least in part, on considerations of national prestige. Taplin (1980) suggested that a nation might feel ashamed if all of its more important places were not linked by good roads. In this case it is suggested that standards slightly higher than those justified by analysis of the costs and benefits accruing to road users might be appropriate. Thus, although benefit cost analysis clearly *is* appropriate in this case, the final decision on the design standards to be applied may well be influenced by considerations of national prestige.

Although almost all economic assessment of road investments has been based on evaluation of strings of individual projects, it should be recognised that the actual planning and building process is based on a more holistic assessment of long road links or portions of networks. In reality a 'general' standard will be chosen for a particular road link which reflects the function and nature of the road and the type and volume of traffic carried over its whole length. Thus the trade-off between standards, costs and benefits is made in the context of the total road length and not on the basis of individual projects within that length.

These factors must be kept in mind when interpreting the results of particular analyses.

In this chapter costs and benefits for different types of road investment under different conditions are presented and discussed. In addition to the calculation of benefit cost ratios (BCRs) for these projects an indication is given of the 'toll' which would be required to recover the cost of each project directly from road users. This provides a useful perspective on the results required from an investment in that willingness to pay such a toll is an indication of the worth of a project as perceived by the road user.

In the case of roads, the benefits arising from an investment usually fall into two groups; those accruing to road users through reduced travel time, reduced operating costs for vehicles, reduced accident rates, etc, and those accruing to road building and maintaining authorities through reduced road maintenance costs, etc. Additional benefits may accrue to third parties, where, for example, a by-pass may reduce hazards to pedestrians or disruption of social contact in a community or where road improvements may reduce dust or other pollutants affecting local communities. These latter groups of benefit are very difficult to quantify and are generally merely identified as being present without full inclusion in the benefit cost analysis. Some additional costs, referred to as dis-benefits to distinguish them from construction costs, may result from road investments. They range from easily identifiable and quantifiable effects such as increased maintenance costs to less tangible effects such as community division. Where quantifiable, dis-benefits are subtracted from benefits to provide net benefits for use in the calculation of BCRs.

The results of evaluations of total rural arterial road investment programs for each state are presented. The distribution of returns for different project types is explored and related to the programs likely to be undertaken at different total funding levels.

An evaluation of anticipated urban arterial road investment is presented, based on the work programs explored by the NRS Team (NAASRA 1984a).

Separate comment is made on the economic returns obtained from the National Highway and ABRD Programs.

COSTS

The cost of a road project may vary substantially depending upon the location, topography, soil type and condition, etc and also upon the specific standards applied in the project design and construction. The initial state of the road may also have a major influence on the cost of any particular project. For example, the cost of simply widening an existing seal strip may vary widely depending upon whether or not significant pavement work is required to accommodate the change. Thus, it is not feasible to attach a single cost to a particular type of project which will apply in a majority of cases, rather it is necessary to think in terms of ranges of costs which may apply to such a project. Table 7.1 gives an indication of road upgrading costs in rural Australia.

As may be observed from Table 7.1 the cost ranges are very wide. The values used in Table 7.1 were derived mainly from cost data provided by State Road Authorities for use in the NIMPAC planning model[1], but some adjustment has been made to

TABLE 7.1—TYPICAL RANGES OF COST PER KILOMETRE FOR ROAD UPGRADING PROJECTS IN RURAL AREAS, 1981

($000)

Final standard	*Original standard*			
Sealed	*Unsealed*	*Sealed, one lane*	*Sealed narrow, two lane*	*Sealed, wide two lane*
One lane	30– 80	a	a	a
Narrow two lane	35– 85	10– 60	a	a
Wide two lane	40–115	20–100	10– 75	a
Three lane	a	a	85–230	80–220
Four lane	a	a	a	200–600

a. Indicates that transition is infeasible or highly unlikely.

Source: SRA cost data.

1. NAASRA Improved Model for Project Assessment and Costing.

allow for known variations from those values. The ranges in Table 7.1 are consistent with estimates in work programs submitted to the Commonwealth by the states over the period 1979-80.

The definitions of narrow seal, wide seal, etc used in Table 7.1 are the same as those used in the NAASRA Roads Study. Briefly, a road is regarded as single lane if it is less than 4.5 metres wide. Seal width between 4.6 and 6.4 metres is regarded as a narrow two lane road while a seal width between 6.5 and 9.1 metres is defined as wide two lane. A three lane road is taken to have a seal width between 9.2 and 11.6 metres while a four lane road is taken to have a seal width greater than 11.6 metres.

Capital costs may be expressed as an equivalent annual cost using the standard formula:

$$A=\frac{Ci(1+i)^n}{(1+i)^n-1}$$

where A is the equivalent annual cost;
C is the capital cost;
i is the interest rate assumed; and
n is the life of the asset

assuming that the asset has no residual value at the end of n years. In the case of a road upgrading the annualised cost may be divided by the annual traffic to give an equivalent 'toll' which would need to be charged to recover the capital cost per vehicle for various traffic volumes. Two curves are shown in Figure 7.1 giving the range of costs resulting from different assumptions for project life and interest rate.

Figure 7.1 indicates, for example, that if a million dollars was spent on upgrading a particular road with a traffic volume of 3000 vehicles per day a toll of between five and ten cents per vehicle would need to be imposed if the cost was to be recovered from users. If the traffic level was only 300 vehicles per day then the toll would need to be between fifty cents and one dollar.

Table 7.2 shows the range of annualised costs per vehicle corresponding to the project cost ranges given in Table 7.1 and based on the traffic volumes indicated. The traffic volumes used are commensurate with 'fair' to 'poor' ratings under the NAASRA level of service indicators (see Table 3.1) and are reasonably consistent with upgrading criteria used in practice.

TABLE 7.2—COSTS PER VEHICLE KILOMETRE FOR TYPICAL ROAD UPGRADING PROJECTS IN RURAL AREAS, 1981

(cents)

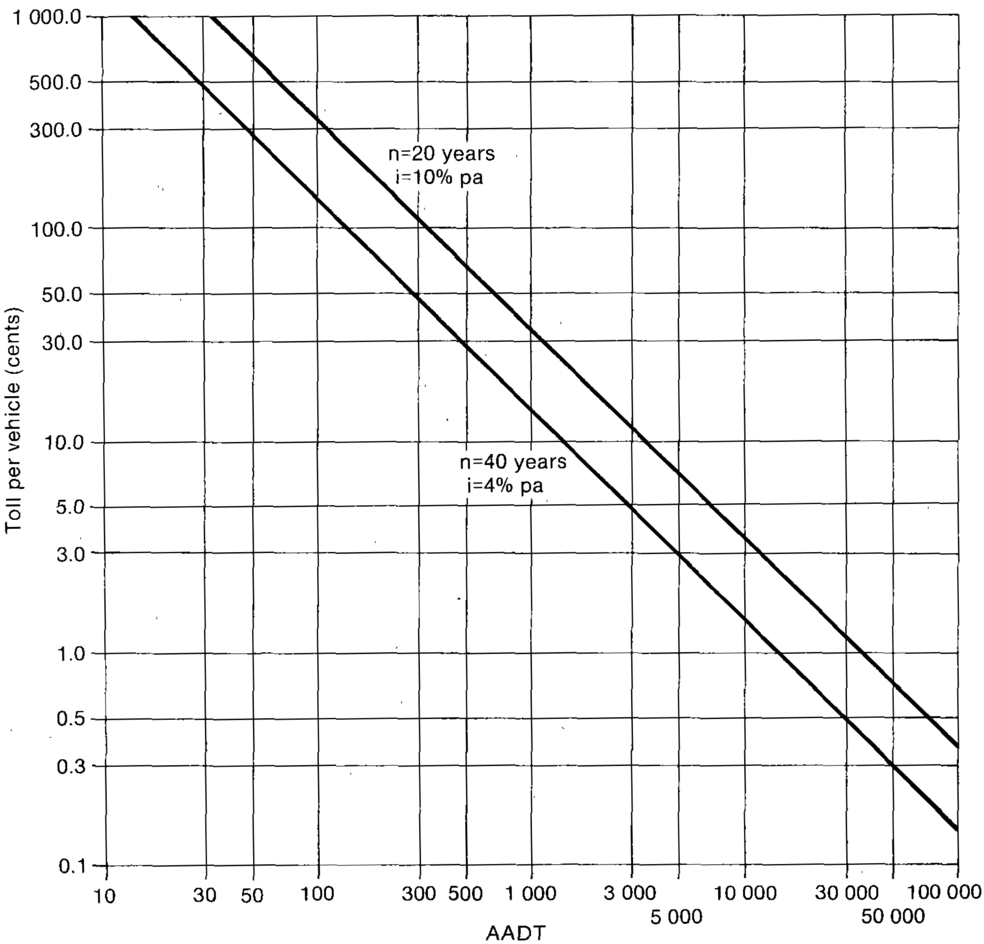
Final standard	*Original standard*			
Sealed	*Unsealed (AADT=120)*	*Sealed, one lane (AADT=400)*	*Sealed, narrow two lane (AADT=1500)*	*Sealed, wide two lane (AADT=5000)*
One lane	6–15	a	a	a
Narrow two lane	7–17	0.5–3.5	a	a
Wide two lane	8–22	1.1–5.5	0.1–1.1	a
Three lane	a	a	1.3–3.5	0.4–1.0
Four lane	a	a	a	1.0–2.7

a. Indicates that transition is infeasible or highly unlikely.

Source: Table 7.1 and Figure 7.1.

The costs per vehicle values in Table 7.2 are inversely proportional to the AADT and so the table may be used to produce a quick estimate of cost per vehicle for different traffic volumes. If, for example, a wide two lane road was to be upgraded to four lanes at 10 000 vehicles per day rather than at 5000 vehicles per day then the cost per vehicle would fall from between 1.0 and 2.7 cents to between 0.5 and 1.4 cents per kilometre.

Clearly, in assessing the economics of such investments the benefits to other parties as well as road users must be considered, but the question remains as to whether or not road users would be prepared to pay at something like the rates indicated in Table 7.2 for the particular upgradings indicated.



Source: BTE analysis.

Figure 7.1—Notional toll per vehicle for each million dollars of investment

BENEFITS

In the analysis presented in this report benefits resulting from road improvements have been calculated only for road users and road construction authorities. The benefits quantified include reductions in travel time, reductions in vehicle operating costs, reductions in accident costs and reductions in road maintenance[1] costs. In some instances the latter appears as an additional cost, that is a negative benefit.

The value to be placed on travel time savings is particularly difficult to establish (BTE 1981b). No entirely satisfactory way of estimating the value of time for studies of a very general nature, such as the present one, has been found. Thus the values used in the present analysis have a fairly arbitrary component.

For the purposes of the present analysis it was assumed that 30 per cent of cars were business cars and that the occupancy rates for private and business cars were 2 and 1.6 respectively. The value of time ascribed to occupants of private cars was 90 cents per hour and to occupants of business cars was $11.50 per hour. Light commercial vehicles were assumed to have an occupancy rate of 1.3 persons per vehicle each with a value of time of $5.60 per hour. Rigid trucks and semi trailers were assumed to carry the driver only and to have a value of time of $6.60 per hour. This produced a value of time for each vehicle type of:

- Cars $6.78/hr
- Light commercials $7.28/hr
- Trucks $6.60/hr

For the purposes of this general analysis traffic mix was taken as cars 80 per cent, light commercials 15 per cent and trucks 5 per cent, giving a mean value of travel time of $6.85 per vehicle per hour. Because the values of time ascribed to the vehicle types are very similar the results of the analysis are relatively insensitive to traffic composition. Only in those cases where the mix of business to private cars is very different from 30 per cent (say in predominantly tourist areas) or where there is a very high proportion of heavy trucks (for example, in areas where numerous road trains operate) would the results be significantly different.

For the calculation of vehicle operating cost savings from road improvements use was made of the algorithms used in the NIMPAC planning model. Details of these algorithms have been given elsewhere but, broadly speaking, they define relationships between vehicle fuel consumption, tyre wear, maintenance cost, etc and road type and condition (particularly roughness). In addition, vehicle operating costs include an allowance for depreciation, interest payments, etc which are related to travel time.

Changes in accident rates for different road standards and traffic volumes were included in the analysis, again using the basic algorithms and parameter values used in the NIMPAC model. Benefits accruing to road construction authorities appear in the form of changes in routine maintenance requirements and periodic resealing and reconstruction costs. In most instances, the benefits to the road authority of the types of upgrading covered here are small and negative. That is the upgrading increases the costs of the authority in maintaining the road over time. Benefits to the road users tend to be much larger and positive.

In the case of sealing an unsealed road benefits to the road authority depend heavily on traffic volumes. At low volumes (less than about 80 vehicles per day) the costs of maintaining a gravel road are less than that for a sealed road. At high traffic volumes (more than about 140 vehicles per day) the situation is reversed. At traffic levels in between, the maintenance cost of a gravel road may be higher or lower

1. The term 'maintenance' is used here in a generalised sense to include all work required to keep a road in good condition, that is, it includes costs of resealing, etc.

than that of a sealed road, depending on frequency of grading and resheeting, which may vary considerably in practice. At about 100 vehicles per day the NIMPAC model produces maintenance costs about equal for the two road types when resealing costs are included.

Approximately 58 per cent of road user benefits are the result of reduced vehicle operating costs and about 39 per cent, the result of time savings. Only some 3 per cent of benefits are the result of reduced accident costs. This distribution is consistent with the results of previous roads studies in 1975 and 1979 and indicates that BCRs for arterial road improvements will be quite sensitive to changes in assumed vehicle operating costs and to values of travel time, but insensitive to assumed accident costs.

BENEFIT COST RATIOS

BCRs for the set of project types under discussion have been calculated on the basis of a 2 per cent per annum growth in traffic and a discount rate of 7 per cent, and are presented in Table 7.3.

The range of BCR values in Table 7.3 reflects the range of capital cost values given in Table 7.1. In the case of road sealing projects the high cost elements on the capital side reflect themselves in the high benefits to road authorities at the specified traffic level, and so the spread of BCRs is less than would, at first, be expected.

It would be unwise to rely too heavily upon the general analysis presented in Table 7.3, but the results do appear to be consistent with established SRA practice. Sealing an unsealed road when traffic volumes exceed 120 vehicles per day appears to provide a positive return and provides support for the practice of going straight to a two lane seal. Widening narrow two lane roads once traffic volumes rise much over 1000 vehicles per day appears to be warranted and adding a third lane at about 5000 vehicles per day also seems to provide a satisfactory return, particularly where short lengths can provide overtaking opportunities at relatively low cost. General practice seems to be to duplicate a two lane road once traffic volumes rise significantly above 5000 vehicles per day and this is supported by the results of the present analysis.

The only exception to agreement with established practice seems to be in relation to widening existing single lane sealed roads. Under NAASRA criteria the level of service is said to be poor on such a road when traffic reaches about 300 vehicles per day whereas analysis indicates that a volume of around 500 vehicles per day

TABLE 7.3—RANGE OF BENEFIT COST RATIOS FOR TYPICAL ROAD UPGRADING PROJECTS IN RURAL AREAS[a]

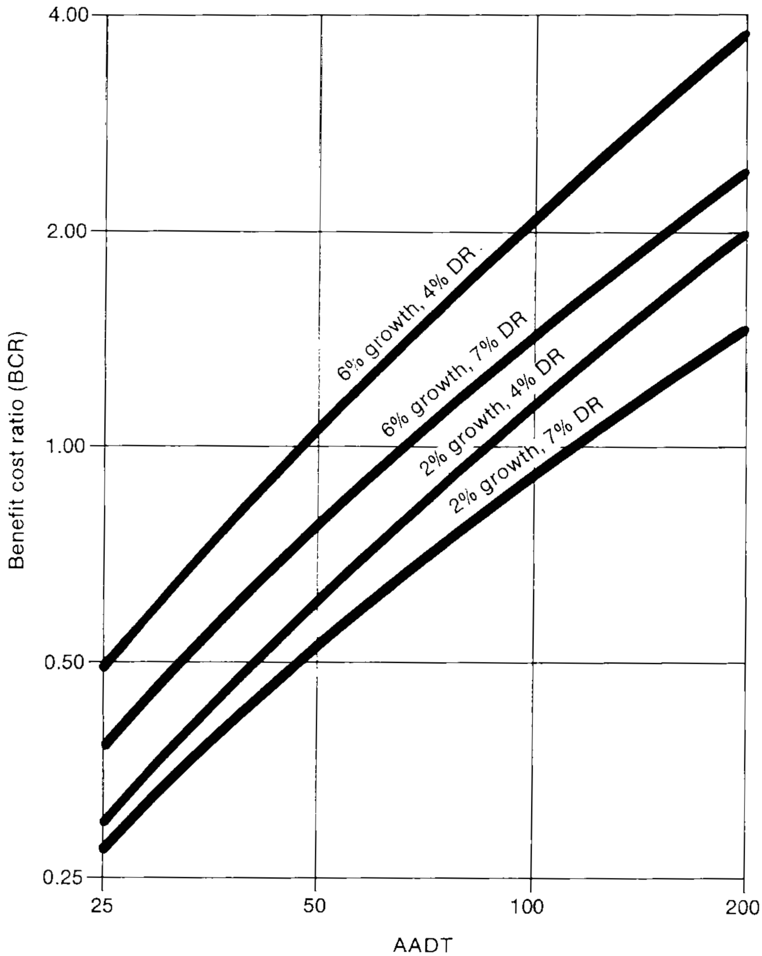
Final standard	*Original standard*			
Sealed	*Unsealed (AADT=120)*	*Sealed, one lane (AADT=400)*	*Sealed, narrow two lane (AADT=1500)*	*Sealed, wide two lane (AADT=5000)*
One lane	0.8–1.0	b	b	b
Narrow two lane	0.8–1.0	0.9–1.4	b	b
Wide two lane	0.7–0.8	0.3–0.8	0.6–2.6	b
Three lane	b	b	0.1–0.3	0.8–3.8
Four lane	b	b	b	0.8–2.3

a. Based on traffic growth rate of 2 per cent per annum and discount rate of 7 per cent per annum.
b. Indicates that transition is infeasible or highly unlikely.

Source: BTE calculation.

may be required to produce a satisfactory economic return on the investment. Obviously the state of the shoulders and the cost of widening would have a major effect on any decision in any specific case.

Figures 7.2 to 7.7 indicate the anticipated economic return on different upgradings as a function of traffic volume. BCRs have been calculated on the basis of 2 and 6 per cent per annum traffic growth rates and a 7 per cent per annum discount rate. The effect of using a 4 per cent per annum discount rate is shown in Figures 7.2. and 7.3. In the remainder of the figures the effects of construction unit cost changes are indicated. Since unit construction costs vary widely even within individual states, it is clear that a blanket application of particular standards is inappropriate.



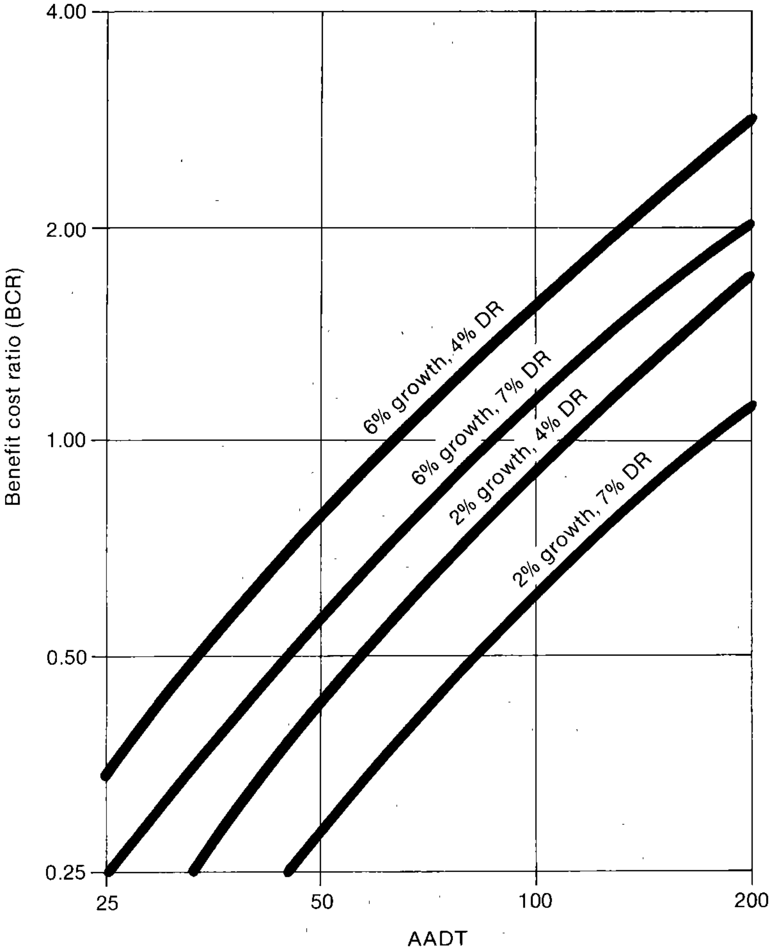
Source: BTE analysis.

Figure 7.2—Return on upgrading a gravel road to narrow two lane sealed road at low construction costs for different traffic growth and discount rates

Such an approach could result in unwarranted projects being undertaken in high cost areas while warranted projects were not undertaken in low cost areas.

The very steep slope of the curves at high traffic volumes (6000vpd) indicates the sensitivity of BCR to timing of a project. If traffic volume is high and growth rate is high then a delay of a few years in undertaking a project can result in an exceptionally high BCR when it is finally undertaken.

The effects of different final road widths is clear from the figures which illustrate the importance of matching final design standards to traffic levels. Slight reductions in road width can, in appropriate circumstances, produce considerably enhanced BCRs for the same traffic characteristics.



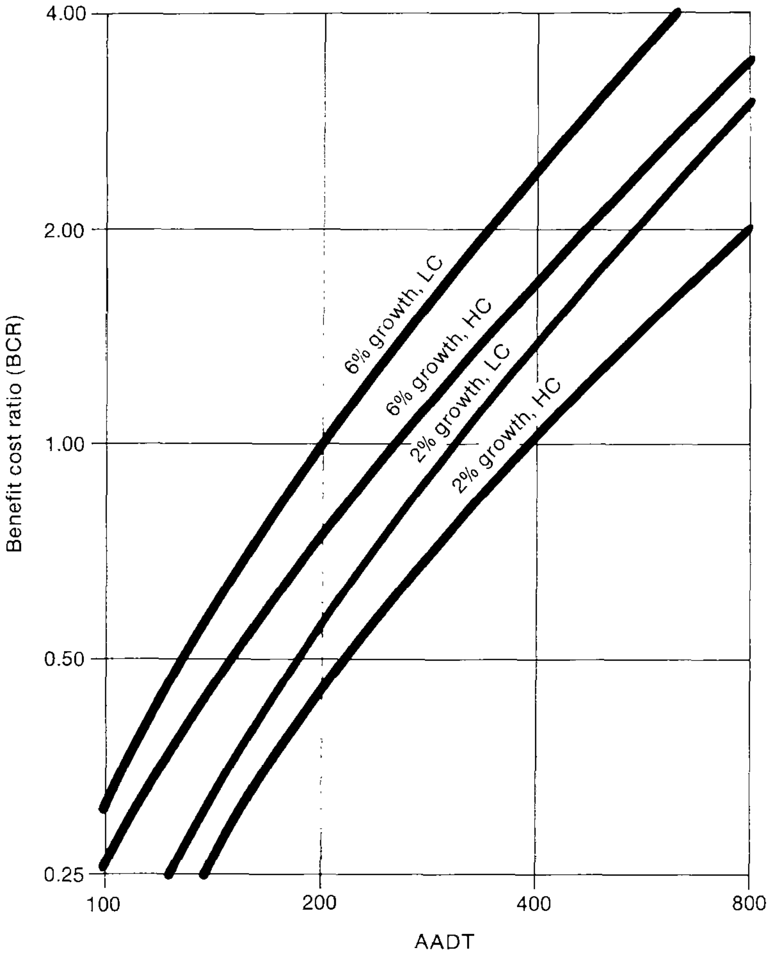
Source: BTE analysis.

Figure 7.3—Return on upgrading a gravel road to broad two lane sealed road at low construction costs for different traffic growth and discount rates

BRIDGES

No attempt has been made to undertake a formal evaluation of program expenditure on bridge works. This is because bridges need to be evaluated in the context of the actual road link on which they are situated rather than as an individual item, which implies a much greater degree of disaggregation than is possible in the context of this report.

The material presented in the earlier part of this chapter may be used to provide an initial evaluation of a particular link if this is desired. This could be done by including costs of bridge works with general widening works for the link and applying the appropriate curves in Figures 7.2 to 7.7. Alternatively a notional toll could be calculated for any particular bridge using Figure 7.1.

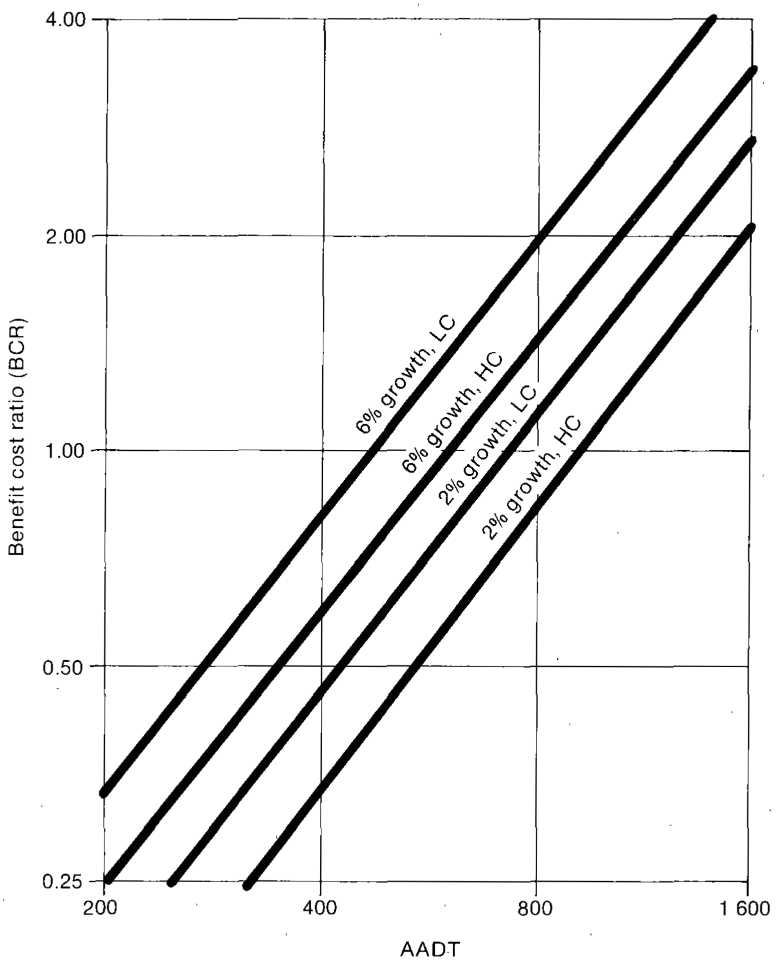


Source: BTE analysis.

Figure 7.4—Return on upgrading single lane sealed road to medium width two lanes at 7 per cent pa discount rate for different traffic growth and high and low construction costs

As indicated in Chapter 4 single lane bridges are regarded by NAASRA as providing a 'poor' traffic level of service when AADT exceeds 300 vehicles per day. At this level of daily traffic the probability of vehicles meeting on or in the vicinity of the bridge is about one in twenty in peak conditions. The implication is that widening is warranted at about this traffic volume, but that is an engineering judgement not the result of an economic evaluation.

Similarly a number of bridges are built or replaced each year to overcome problems of flooding with associated delays of hours, days or, occasionally, weeks. Again no general evaluation is possible, each individual case should be examined on its merits, taking account of costs, frequency of flooding, length of delays, costs of diversion, traffic volume and traffic value.



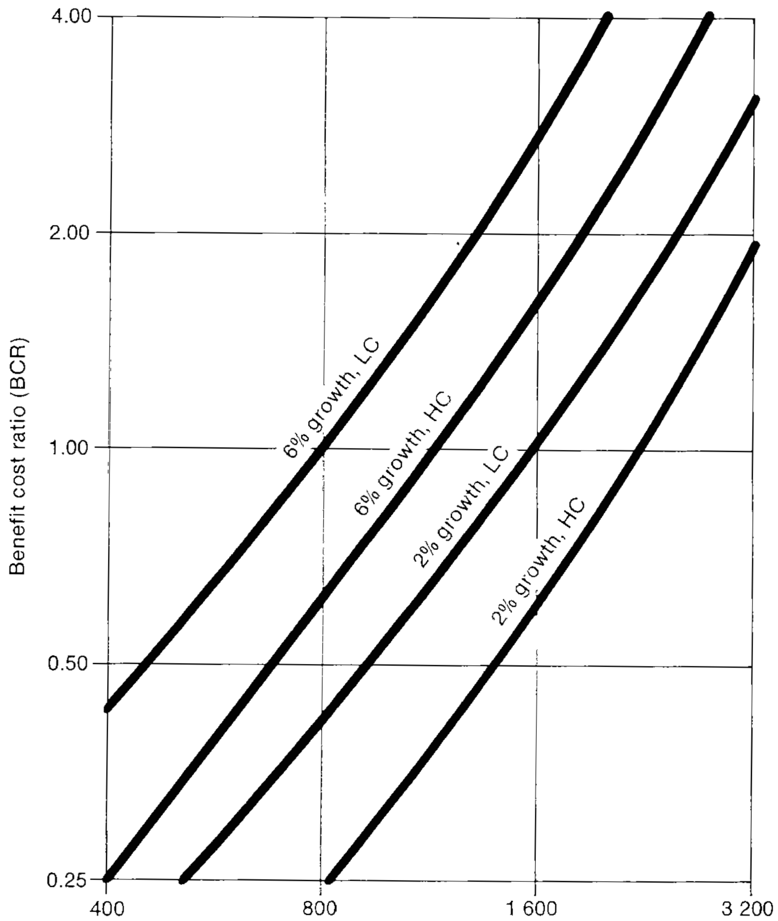
Source: BTE analysis.

Figure 7.5—Return on upgrading narrow two lane sealed road to medium width two lanes at 7 per cent pa discount rate for different traffic growth and high and low construction costs

RURAL ARTERIAL ROAD PROGRAMS

Whereas the preceding section of this chapter was concerned with the returns to be expected from typical projects, this section is concerned with the returns from total programs of work on rural arterial roads. The procedure followed is similar to that used by CBR/BTE in previous roads studies in that notional road upgrading programs were developed using a deficiency approach and BCRs were calculated for the projects contained in the programs. The process was undertaken using an extended version of the NIMPAC model, which is a successor to the assessment and costing models developed by CBR.

Basically, the NIMPAC model takes a section of road from a computerised inventory

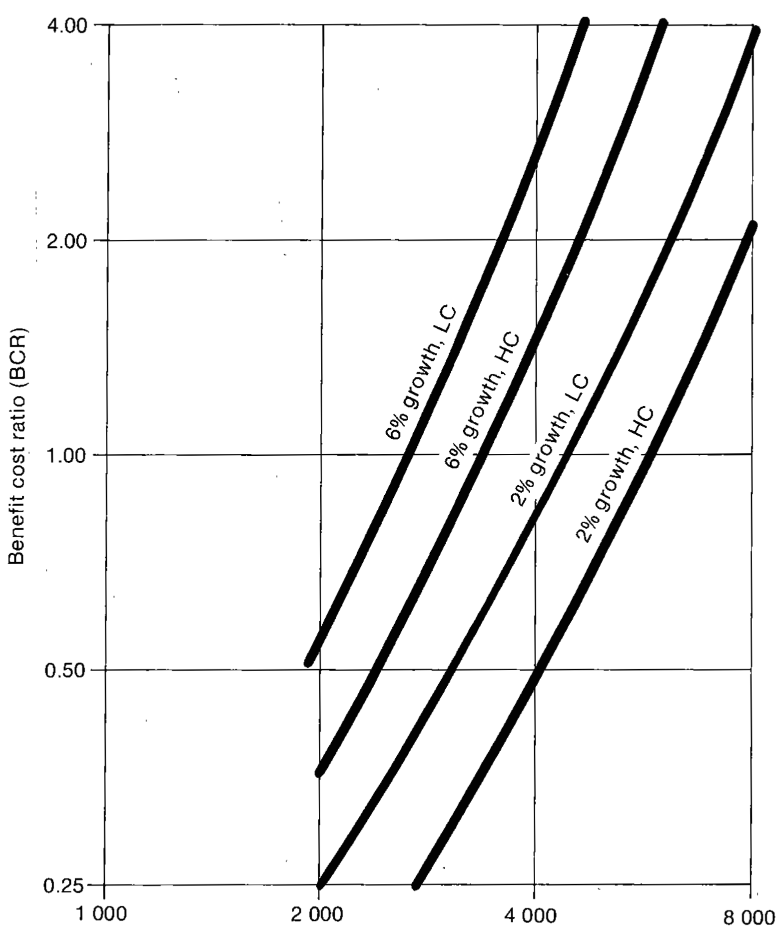


Source: BTE analysis.

Figure 7.6—Return on upgrading narrow two lane sealed road to broad two lanes at 7 per cent pa discount rate for different traffic growth and high and low construction costs

(the NAASRA Data Base), applies a set of assessment standards to determine if any upgrading is required, costs such upgradings and then combines the results for individual sections to give a total road upgrading program. By varying the assessment and design standards used it is possible to develop upgrading programs with different total expenditures and with different mixes of project types.

This process was used in the NAASRA Roads Study to produce programs for four different funding levels and to ensure that the programs produced were a realistic approximation of what relevant road engineers judged to be likely in practice. For each State four different sets of standards were used to produce programs requiring annually approximately 75 per cent, 100 per cent, 125 per cent and 150 per cent



Source: BTE analysis.

Figure 7.7—Return on upgrading broad two lane sealed road to dual carriageway (four lanes) at 7 per cent pa discount rate for different traffic growth and high and low construction costs

of the expenditure applied to rural arterial roads in 1980-81. These standards/ programs are referred to as F75, F100, F125 and F150 respectively and formed the basis of BTE analysis of rural arterial road investment programs for the budgetary period 1985-86 to 1989-90.

The NIMPAC model calculates road user costs associated with the road sections and BTE extended this capability for determination of BCRs for the work programs. The extended model was applied to a sample of road sections in each state to estimate the expected returns on levels of funding provided by application of the F75, F100, F125 and F150 assessment standards. The application of the model in this way gave an indication of the way different levels of funding were likely to be applied in practice by State Road Authorities.

The funding levels produced by the application of the four sets of assessment standards differed sharply from those produced by the NAASRA analysis for a number of reasons.

Firstly, money for bridge works was excluded from the analysis, but is included in the expenditure totals in the NAASRA analysis.

Secondly, the NAASRA analysis covered rural and outer urban arterial roads whereas the BTE analysis was limited to rural roads only.

Thirdly, and most importantly, the BTE analysis relates to expenditure in the period 1985-86 to 1989-90, whereas the NAASRA work covers the total period from 1981-82 to 1991-92. For the BTE analysis the road inventory was updated to 1985-86 by assuming that projects generated by NIMPAC in the period 1981-82 to 1984-85 under F100 standards were undertaken.

When allowance is made for these differences the expenditure patterns produced by the BTE sample analysis correspond closely to those produced by the NAASRA analysis. The BTE analysis is described in detail in BTE (1984e).

Figure 7.8 shows the cumulative distribution of BCR by expenditure for the various States based on use of the F100 assessment standards and a discount rate of 7 per cent per annum. Figure 7.9 presents similar data, but showing the proportion of expenditure in each State producing a particular BCR. The very wide variation in distribution of BCRs between states is shown in Figure 7.10. New South Wales exhibits a relatively even distribution whereas Victoria and Queensland show strong bi-modal characteristics (with many projects showing a low BCR while others show a high BCR). South Australia and Western Australia have fewer projects with very high returns, while Tasmania and Northern Territory have hardly any at all.

The differences in returns between the states reflect a variety of factors including differing costs of construction, traffic levels, growth rates and project types. These same factors influence the returns on investment in different States as total funding levels are increased or decreased. Table 7.4 shows the percentage of projects with BCR greater than unity and the average BCR for each state at four funding levels corresponding to the total programs produced by applying the F75, F100, F125 and F150 standards as indicated above.

If road authorities used economic efficiency as the only criterion in program development then as more or less funds were available programs would move along the curves presented in Figures 7.8 and 7.9. That is, at lower funding levels average BCRs would be higher and the proportion of expenditure on projects with BCRs greater than unity would also be higher, while at higher funding levels average BCRs would be lower and the proportion of funds expended on projects with BCRs greater than unity would also be lower. As may be seen from Table 7.4 this appears not to be the case in practice. This is because the program development process is multi-dimensional with maximisation of overall BCR being only one facet. Factors such as reducing accidents on particular roads may be important, even though accident savings may be only a minor component of road benefits. Maintaining the existing system of roads to an 'acceptable' standard may take priority even though allowing parts of the system to fall below these standards may be economically optimal. Response to local community expectations may be a significant factor as may be the need to maintain a steady flow of work in each region. Completion of the basic network to an 'appropriate' standard may involve upgrading roads with low traffic volumes (to provide all weather access for example) which may produce projects with a low BCR, but which would take priority over other projects with higher BCRs.

Table 7.4 indicates that the average return on rural arterial road investment in each state will not change very greatly if the funding level rises or falls by any reasonable amount. At low funding levels the main emphasis tends to be on maintaining the system. All states tend to spend a high proportion of funds on rehabilitation work (including resheeting of gravel roads) which has a fairly low BCR. Queensland is an exception to this as that state maintains a significant program of sealing unsealed roads even at low total funding levels which accounts for the high average BCR under funding level 1 in Table 7.4.

At higher funding levels more projects related to widening of existing roads, adding lanes and duplication appear in work programs. Where traffic volumes are high (in

TABLE 7.4—RETURNS ON ALTERNATIVE RURAL ARTERIAL ROAD INVESTMENT PROGRAMS, 1985-86 TO 1989-90

	Funding level[a]			
State/Item	*1*	*2*	*3*	*4*
New South Wales				
Per cent warranted[b]	78.7	73.9	69.4	68.0
Average BCR[c]	3.1	2.6	2.6	2.8
Victoria				
Per cent warranted	50.9	62.9	67.0	63.4
Average BCR	3.7	3.6	3.0	3.1
Queensland				
Per cent warranted	88.3	61.4	61.0	59.3
Average BCR	4.9	3.2	3.1	2.6
South Australia				
Per cent warranted	55.1	79.2	82.1	79.1
Average BCR	2.2	1.8	2.3	2.2
Western Australia				
Per cent warranted	41.4	44.7	46.2	40.3
Average BCR	1.1	1.5	1.9	1.7
Tasmania				
Per cent warranted	d	56.9	d	d
Average BCR	d	1.1	d	d
Northern Territory				
Per cent warranted	85.7	24.0	12.2	12.0
Average BCR	1.1	0.7	0.5	0.5

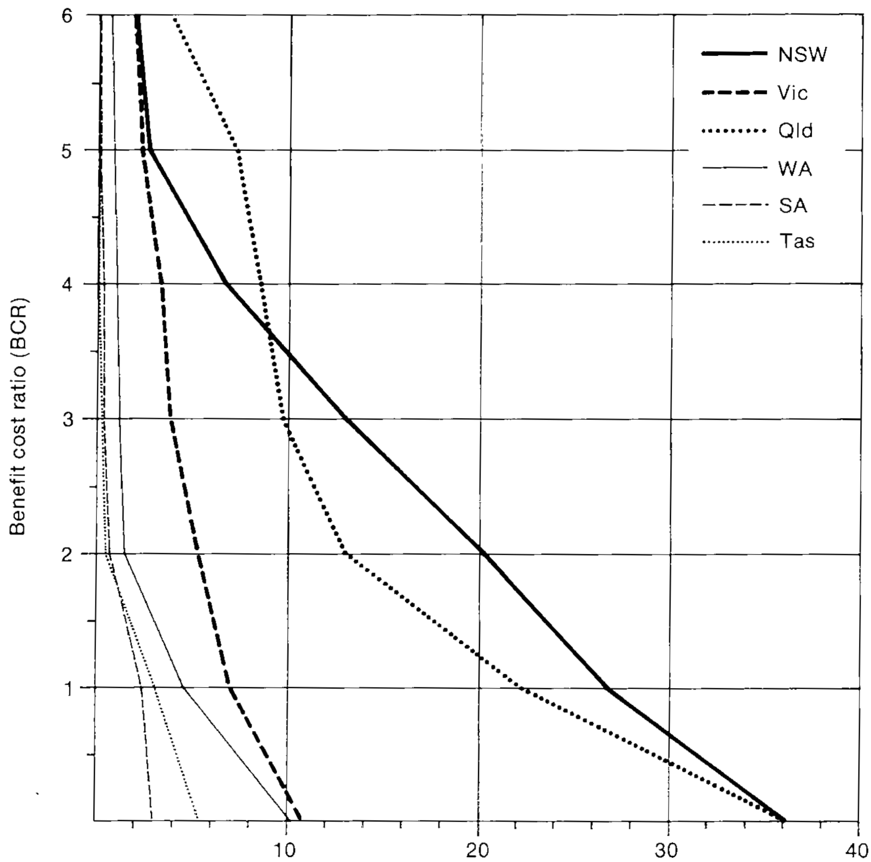
a. Funding levels based on F75, F100, F125 and F150 standards.
b. Per cent of expenditure with BCR >1.
c. Discount rate 7 per cent per annum.
d. Not available.

Source: BTE analysis.

New South Wales and Victoria for example) these projects show a relatively high return and so the average BCR is maintained as overall funds are increased.

It is interesting to note that the percentage of expenditure on projects with BCRs greater than unity is higher in New South Wales than in Victoria and yet the average BCR for Victoria is higher than for New South Wales. This paradox is explained by the fact that the Victorian programs contain a greater proportion of projects with a very high BCR than do the New South Wales programs, although the latter have many more projects with BCRs a little above unity.

Changing the discount rate used in BCR calculation affects the net present value



Notes: 1. Cumulative project expenditure, 1985-86 to 1989-90 in 1980-81 prices (per cent).

2. The expenditure at each BCR value is the cumulative expenditure for all projects with a BCR greater than the given BCR value.

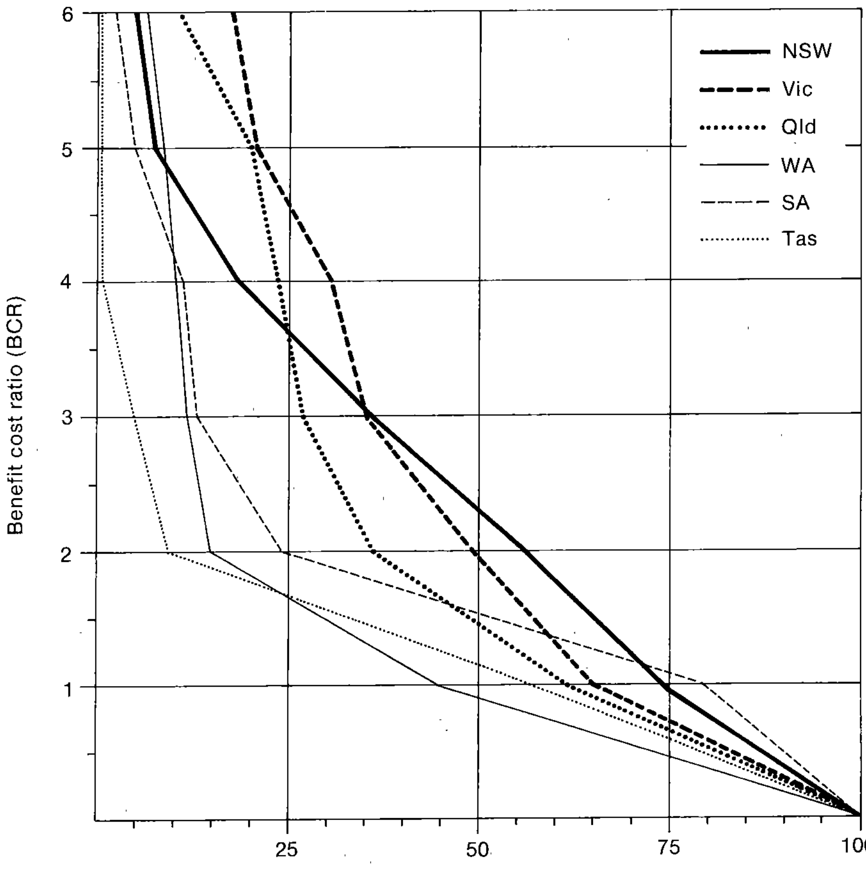
Source: BTE (1984e).

Figure 7.8—Distribution of BCR by total program expenditure 1985-90, all states (F100 standards 7 per cent pa discount rate)

of the returns on investment by different amounts for different states. Programs for New South Wales, Western Australia, Tasmania and the Northern Territory are least affected, which suggests that benefits are accrued earlier than in Victoria, Queensland and South Australia where the average BCR changes more rapidly in response to changes in discount rate.

The distribution of benefits varies between the states as indicated in Table 7.5.

Time savings represent a higher proportion of total savings in the case of Victoria than elsewhere probably reflecting the higher traffic densities experienced in that state. The very low densities over much of Western Australia mean that time savings



Notes: 1. Cumulative project expenditure, 1985-86 to 1989-90 in 1980-81 prices (thousand dollars).
2. The expenditure of each BCR value is the cumulative expenditure for all projects with a BCR greater than the given BCR value.

Source: BTE (1984e).

Figure 7.9—Distribution of BCR by proportion of program expenditure 1985-90, all states (F100 standards 7 per cent pa discount rate)

make up a much smaller percentage of the total. The relatively high proportion of time savings in Queensland reflects the result of road sealing projects.

The negative benefits in relation to accidents from upgrading of Northern Territory roads is the result of additional lengths of single lane seal and gravel roads to which the model ascribes high accident rates. This effect also occurs in other states, but the losses on these particular road types are more than matched by accident reductions on other road types. The low traffic volumes general in the Northern Territory and the predominance of gravel roads means that there is an overall increase expected in accident costs.

Table 7.6 gives an indication of the variation of returns on rural arterial road investments by region over the period 1985–86 to 1989–90. The figures are based on application of upgrading standards appropriate to an overall expenditure equivalent to 1980–81 levels.

NATIONAL HIGHWAYS

An analysis of national highway programs for the period 1985–90, similar to that for rural arterial roads, was undertaken, but the results are not regarded as definitive. A major cause for reservation is that a significant component of work on national highways involves construction on totally new alignments (including town bypass roads). Such projects are not generated by the NIMPAC model and so the program developed is not representative of the work program likely to be undertaken in practice. Nevertheless the modelling process did produce results which indicate that average BCRs for national highway projects (excluding work on new alignment) in Queensland and the Northern Territory are likely to be higher than for arterial roads generally in those states. In the other states the average BCR for national highway projects were found to be much the same as for rural arterial road projects generally.

To supplement this work analysis was undertaken of recently completed road projects and projects currently on the national highway work program.

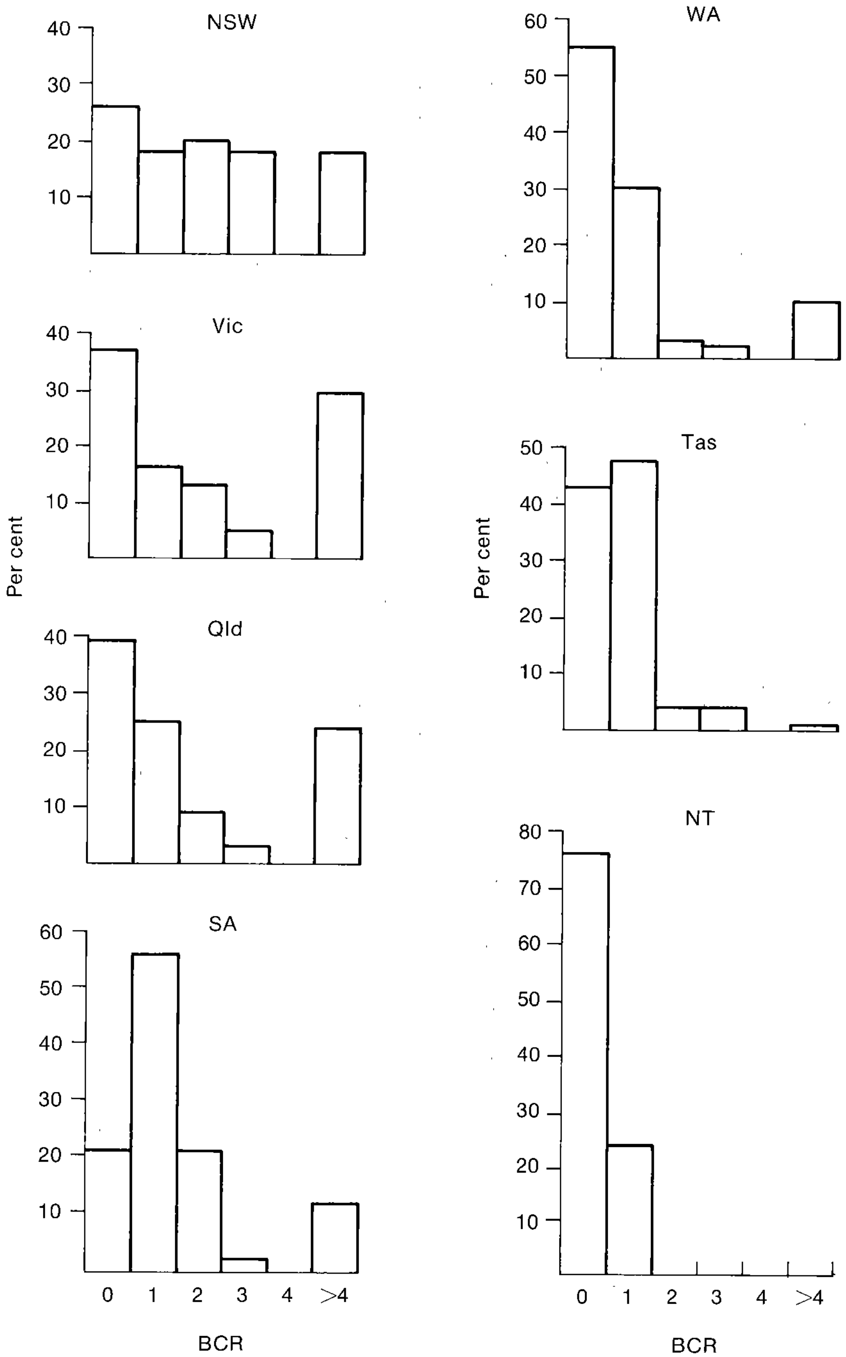
TABLE 7.5—DISTRIBUTION OF DISCOUNTED BENEFITS FROM RURAL ARTERIAL ROAD PROGRAMS, 1985–86 TO 1989–90[a]

(per cent)

State	*Time savings*	*Vehicle operating cost savings*	*Accident cost savings*	*All user savings*	*SRA savings*
New South Wales	42.2	55.3	2.1	99.6	0.4
Victoria	54.6	42.1	3.9	100.6	-0.6
Queensland	48.2	47.8	2.5	98.5	1.5
South Australia	37.7	57.0	1.6	96.3	3.7
Western Australia	26.7	67.7	3.0	97.4	2.6
Tasmania	35.5	59.4	3.9	98.8	1.2
Northern Territory	29.9	72.2	-1.1	101.0	-1.0
Australia	45.2	51.3	2.6	99.0	1.0

a. Percentage of total discounted benefits (Funding level 2. 7 per cent discount rate).

Source: BTE analysis.



Source: BTE (1984e).

Figure 7.10—Distribution of expenditure by BCR for rural arterial roads, 1985–90 (F100 standards 7 per cent pa discount rate)

TABLE 7.6—RETURNS ON RURAL ARTERIAL ROAD INVESTMENT PROGRAMS BY REGION, 1985-86 TO 1989-90

State	*Region*[a]	*Location*	*Region expenditure as percentage of state total*	*Percentage of regional expenditure with BCR >1*
New South Wales	201	Sydney area	0.0	0.0
	202	Hunter	2.2	75.6
	203	North Coast	36.4	74.9
	204	Illawarra and South Coast	6.3	98.0
	205	West	55.1	70.4
	All	..	100.0	73.9
Victoria	301	Melbourne area	6.7	98.9
	302	South Gippsland	14.9	76.2
	303	North	16.7	62.5
	304	Murray and the West	31.8	84.3
	305	Geelong	9.9	28.1
	306	East Gippsland	20.0	24.7
	All	..	100.0	62.9
Queensland	401	Brisbane and Gold Coast	2.9	100.0
	402	Darling Downs and Wide Bay	21.3	56.3
	403	South West	13.1	40.2
	404	Mid-North Coast	45.5	65.9
	405	North	17.2	65.5
	All	..	100.0	61.4
South Australia	501	Adelaide area	15.7	100.0
	502	Mid-North	57.7	73.9
	503	Murray and South East	20.6	79.5
	504	Eyre	6.1	100.0
	505	North	0.0	0.0
	All	..	100.0	79.2

TABLE 7.6(Cont)—RETURNS ON RURAL ARTERIAL ROAD INVESTMENT PROGRAMS BY REGION, 1985-86 TO 1989-90

State	*Region*[a]	*Location*	*Region expenditure as percentage of state total*	*Percentage of regional expenditure with BCR >1*
Western Australia	601	Perth area	4.3	100
	602	South West	44.7	56.6
	603	Pilbara	37.7	33.1
	604	Kimberley	7.5	15.7
	605	Goldfields and Midlands	5.8	25.6
	All	..	100.0	44.7
Tasmania	701	South	45.8	69.2
	702	North	26.9	45.7
	703	West	27.3	47.3
	All	..	100.0	56.9

a. Regions are given in Appendix I.
.. not applicable

Note: Northern Territory is a single region in this analysis.

It was found that duplication projects in the immediate vicinity of Melbourne, Sydney and Brisbane all produced BCRs of the order of two or more, as did similar projects in the Sydney-Goulburn and Burnie-Launceston corridors. Duplication in the Albury-Wodonga area also produced high BCRs.

In other parts of the national highway system, however, duplication projects produced poor economic returns. Projects north of Adelaide and south of Darwin produced particularly low returns, while those around Rockhampton, between Yass and Albury and in northern Victoria produced BCRs only in the vicinity of 0.5.

Reconstruction and widening projects produced a more even distribution of BCRs. Good returns (BCRs greater than two) were generated for projects in the Rockhampton-Cairns, Sydney-Brisbane, Melbourne-Sydney, Launceston-Hobart and Adelaide-Melbourne corridors and in the more populous regions around Perth.

In the north of Western Australia, in the Northern Territory and in Western Queensland, however, upgrading to even the lowest national highway standards produces BCRs significantly less than 1. This is basically the result of very low traffic volumes. It would appear that upgrading in these areas can be justified only on grounds of national prestige or similar considerations.

Similar comment applies in relation to duplication in some of the less heavily utilised sections of the national highway network in south eastern Australia where a wide two lane road (with passing lanes) would be more appropriate on economic grounds. An additional factor in this case is the desirability of maintaining a consistent standard along individual links, primarily for safety reasons.

Overall, however, the economic returns on national highway investment show the same basic pattern as for rural arterial roads generally. Although they are built to a higher standard than are equivalent rural arterial roads they also tend to be the roads with the highest traffic volumes (with a couple of notable exceptions) and so produce a similar range of BCRs.

ABRD PROGRAM

The ABRD Program came into operation only in 1982–83 and so it has not as yet settled down to a consistent pattern. Some tentative analysis has been undertaken, however, on the projects submitted to the Commonwealth to date, although lack of details available on traffic volumes, etc make the results somewhat speculative.

Only projects involving sealing or widening similar to those covered by Figures 7.2 to 7.7 have been analysed to date. Results indicate that, for arterial road projects, average BCRs of around 1.5 are being obtained in Queensland and Victoria and of around 1.0 in the other states. For projects on local roads average BCRs in the vicinity of 1.0 are being obtained in all states except South Australia where a slightly lower return has been indicated.

It is emphasised, however, that this analysis is based on the earliest programs put forward under ABRD and that these BCRs may well be increased once state and local governments have developed their programs further.

An interesting point about the ABRD program is the high proportion of expenditure on bridge works, as shown in Table 7.7. This appears to reflect the fact that bridge works are easily identifiable and could be brought forward quickly in response to the call for project proposals. It is to be expected that the proportion of funds spent on bridges will gradually align with current overall expenditure patterns as time passes.

URBAN ARTERIAL ROADS

No equivalent of the NIMPAC models exists to generate and cost programs for urban arterial roads. This is mainly because of the strongly interative nature of urban road systems, with changes to one link producing significant effects on others. For the same reason the development for urban roads of curves of the type presented in Figures 7.2 to 7.5 is not feasible.

The usual approach in such circumstances is to codify the road network under consideration and simulate the changes over time in traffic conditions resulting from different assumptions about traffic growth, improvements to the road system, etc. From these simulations formal BCRs may be calculated for various upgrading alternatives. However, such an approach was clearly beyond the resources of the BTE and an alternative course of action was sought. Advantage was taken of work being undertaken in the course of the NAASRA Roads Study (NAASRA (1984a and1984c)), which included a detailed analysis of urban arterial roads in the major Australian capital cities and the likely effects of different funding levels over the period 1981 to 1991.

For each city an arterial road network was identified and traffic service measures (lane volumes, peak travel speeds, volume/capacity ratios, etc) were calculated for 1981 conditions. Major and minor road upgrading project sets were identified (taking into account committed projects, candidate future projects and established policies/ strategies) and grouped into work programs assuming funding levels over the period 1981 to 1991 equivalent to maintaining:

- expenditure 50 per cent below that of 1980-81;
- expenditure at the 1980-81 level; and
- expenditure 50 per cent above that 1980-81 level.

Table 7.8 contains a breakdown of how funds would be expended over the period 1981 to 1991 for the different funding levels. The figures exclude land acquisition cost. Table 7.8 shows the slight differences in strategy adopted for the various cities as funding levels are changed. In almost all cases the 'core' activities of service, operation and rehabilitation are maintained at a constant level; only in Perth is this component expected to change and then only at the lowest funding level.

The number and location of trips on the arterial road system in 1991 was estimated

TABLE 7.7—EXPENDITURE ON BRIDGES AS PROPORTION OF TOTAL ROAD EXPENDITURE, RURAL ARTERIAL ROADS

(per cent)

	Expenditure from all sources			*ABRD 1982-83*			*ABRD 1983-84*		
State	*Bridges*	*Other*	*Total*	*Bridges*	*Other*	*Total*	*Bridges*	*Other*	*Total*
New South Wales	13	87	100	87	13	100	91	9	100
Victoria	6	94	100	76	24	100	61	39	100
Queensland	9[a]	91	100	30	70	100	na	na	100
South Australia	3	97	100	13	87	100	7	93	100
Western Australia	4	96	100	43	57	100	39	61	100
Tasmania	3	97	100	0	100	100	na	na	100
Northern Territory	na	na	100	0	100	100	na	na	100

a. Large bridge projects only.
na not available

Source: NAASRA records, Department of Transport Report on ABRD Expenditure (1982-83). ABRD Program (1983-84).

for each city and assigned to the upgraded road network using standard urban transport planning models. Equivalent traffic service measures were calculated for 1991 conditions and total road user costs calculated for both 1991 and 1981.

Having calculated total user costs in 1991 for the different funding levels in each city NAASRA subtracted the total user costs at one funding level from those at another to establish an incremental 'benefit' to road users resulting from the additional expenditure. By making assumptions about the future growth in benefits beyond 1991 and by applying discount rates NAASRA was then able to estimate incremental benefit cost ratios by dividing the difference in discounted benefits by the difference in capital costs. These are not marginal benefit cost ratios in a technical sense, but do provide an indication of the economic return obtained from the additional expenditure.

Some adjustment of these results was necessary before BTE could make use of them. The 'raw' BCRs were not comparable across cities because the analysis in each case was undertaken by the relevant State Road Authority using its own particular transport planning package and, in many cases, its own specific parameter values. This meant that the results had to be adjusted to bring them to a common base. Land costs were treated differently in the various analyses and these also required adjustment. All the analyses used a single trip generation matrix for the three levels of funding, that is, they assumed no interaction between supply and demand at the different funding levels. This produced particularly high volume to capacity ratios in some cases which, in turn, produced unrealistically high benefit cost ratios and

TABLE 7.8—PROGRAM EXPENDITURE FOR MAJOR CITIES; ARTERIAL ROADS, 1981-1991 (CONSTANT 1981 VALUES)

($million)

Funding level and work type	*Sydney*	*Melbourne*	*Brisbane*	*Adelaide*	*Perth*
50 per cent of 1980-81 level					
Service and operation	227	127	60	70	45
Rehabilitation	131	172	15	40	10
Minor projects	146	50	21	16	18
Major projects	119	103	76	35	121
Total	623	453	172	161	194
100 per cent of 1980-81 level					
Service and operation	227	127	60	78	45
Rehabilitation	131	173	15	40	10
Minor projects	195	100	57	26	67
Major projects	647	505	212	178	266
Total	1 200	905	344	322	388
150 per cent of 1980-81 level					
Service and operation	227	127	60	78	45
Rehabilitation	131	173	15	40	10
Minor projects	237	130	94	32	100
Major projects	1 212	908	347	333	427
Total	1 807	1 358	516	483	582

Source: NAASRA (1984a).

so adjustment on this basis was needed. Full details of the basis for adjustments is contained in Johnston (1984) and the adjusted BCRs are given in Table 7.9. The 'low' values of BCR are based upon assumptions of a low growth in benefits beyond 1991 and a high discount rate, while the 'high' values correspond to a high growth in benefits beyond 1991, and a low discount rate.

The figures presented in Table 7.9 indicate that high economic returns can be obtained from investment levels above those current 1980-81. The fact that the BCRs for different funding increments do not show a consistent decline as funds are increased indicates that projects with the highest returns are not being accorded highest priority. This is consistent with the results for the NIMPAC analysis of rural arterial roads programs and indicates clearly that factors other than economic efficiency play a significant part in project selection.

TABLE 7.9—BENEFIT COST RATIOS FOR FUNDING INCREMENTS[a]; URBAN ARTERIAL ROADS, 1981-1991

	Low benefit growth		*High benefit growth*	
City	*F50 to F100*	*F100 to F150*	*F50 to F100*	*F100 to F150*
Sydney	2	2	4	5
Melbourne	6	2	12	5
Brisbane	2	3	4	5
Adelaide	2	1	4	3
Perth	4	2	9	5

a. Funding levels correspond to 50, 100 and 150 per cent of 1980-81 expenditure.

Source: NAASRA (1984c). BTE estimates.

CHAPTER 8—ANTICIPATED FUTURE DEVELOPMENTS

BACKGROUND

The purpose of this Chapter is to draw together the material presented in previous chapters in order to assess the probable course of development of the Australian road system over the next decade or so. The intention is to describe what is likely to happen to the roads rather than to prescribe what should happen, although the probably impacts to changes in level and distribution of road funds are discussed.

The time frame for this discussion is the period to 1990, but particular emphasis is placed on the budgetary period 1985-86 to 1989-90 because of its relevance to Commonwealth funding.

The forecast demand for road use is combined with the current condition of the road system and possible levels of funding to determine the probable condition in 1990. The returns on the investment involved and the effects of changes in levels and patterns of funding are then discussed.

DEMAND FOR ROADS

Estimates of expected growth in annual vehicle kilometres of travel by vehicle type and by state were presented in Chapter 6. Two sets of estimates were produced, one based on high rates of growth in selected economic indicators and the other based on low rates of growth. Based on these scenarios the projected annual vehicle kilometres of travel in 1990, together with average annual growth rates, are presented in Table 8.1.

The current low growth forecasts are slightly lower than those used in the NAASRA Roads Study (NAASRA (1984c), Figure 3.10) while the forecasts based on high growth parameter changes are much higher. The difference between current low growth BTE and NAASRA forecasts are not large although they were arrived at by totally different processes[1]. Given this general agreement between results arrived at by different processes and the trend over the last ten years, it seems prudent to use something near to the low growth figures as a basis for planning, at least over the remainder of the present decade.

The forecast growth rates differed considerably between states with Queensland and Western Australia expected to show more rapid growth than the others and with South Australia well below the average.

Statewide averages do not tell the complete story, however, since growth is expected to vary quite considerably within states. The data used by BTE to make the present forecasts is not sufficiently disaggregate to permit that approach to be used to estimate growth in individual regions, but other methods may be used to obtain an indication of the likely growth pattern within any particular state.

As indicated in Chapter 6, the number of vehicles on register and the average annual vehicle kilometres of travel are both strongly correlated with population. Table 8.2 shows the rate of growth in population by road study region over the two intercensal

1. NAASRA estimates were made by extrapolation of recent data for individual road lengths for rural roads and by normal transport planning techniques for urban roads. Results of wider surveys (eg ABS MVUS) were used as controls on the process of aggregating individual results.

TABLE 8.1—ESTIMATES OF ANNUAL VEHICLE KILOMETRES OF TRAVEL AND AVERAGE ANNUAL GROWTH RATES, HIGH AND LOW GROWTH SCENARIOS, 1990

State	Estimated vehicle kilometres[a] (millions)			Average annual growth (per cent) 1982-1990	
	1982	1990			
		High Growth	Low Growth	High Growth	Low Growth
New South Wales	45 167	69 973	54 469	6	3
Victoria	32 678	49 149	37 164	6	2
Queensland	21 377	36 495	27 014	8	3
South Australia	12 052	17 341	12 649	5	1
Western Australia	12 610	22 038	16 082	8	4
Tasmania	3 639	5 480	4 221	6	2
Australia	127 524	200 476	151 599	6	2

a. Figures for ACT and NT are included in NSW and SA estimates respectively.

Source: Chapter 6.

periods 1971-76 and 1976-81. Assuming that this growth pattern is sustained over the immediate future, this gives a good indication of where road traffic growth is likely to be greatest and where least.

It is clear that strong growth in population occurred in regions 203 and 204 in New South Wales. These are the north and south coastal areas and it is anticipated that a continuing rise in traffic volumes will place strong pressure on the road systems in those areas. Growth in population was strongest in the north coastal area in the second half of the decade and growth also increased significantly in the Hunter area (202) during that period.

In Victoria, population growth was more evenly spread across the state being strongest in the Geelong area (305) in the first half of the decade and in South Gippsland (302) in the second half of the decade.

In Queensland population growth was strongest in the areas around Brisbane and the Gold Coast (401), in the mid north coastal area (404), where strong mining development is taking place, and in the far north coast area (405). Although the latter growth rate is high it began from a relatively low base level and so represents less pressure on the road system than is the case for the other two areas. The rural areas west of the mountains experienced a significant and increasing loss of population during the 1970s.

The most rapid population growth in South Australia occurred in the area surrounding Adelaide (501) and in the south east of the State (503). Early growth on the Eyre Peninsula (504) was not sustained later in the decade and the mid north (502) experienced a fall in population over the period 1976 to 1981. The north of the State (505) experienced a continuous loss of population over the decade.

Western Australia experienced strong population growth in the Pilbara (603), in the Kimberly area (604) and in the area around Perth (601). Both regions 603 and 604 started from relatively low base populations, but the sustained growth is sufficient to place considerable strain on existing road systems.

In Tasmania, population growth was fairly evenly spread across the state and no regions exhibited any unusual rates.

The Northern Territory exhibited a strong population growth in the second half of the decade, although starting from a relatively low initial base. The Territory has the least developed road system in the country.

Some states (New South Wales, Victoria and Western Australia) publish traffic count data on a regular basis and it is possible to compare recent rates of growth in arterial road traffic with population growth in particular regions. A brief examination of the published data suggests that traffic growth on the north and south coasts of New South Wales (regions 203 and 204) has been higher than the state average, while the growth in the Hunter region (202) appears less clearly related to population growth. In Victoria traffic in East Gippsland (302) has experienced a higher than average growth, while traffic in Geelong (305), the other area of high population growth, appears close to the state average. The area around Perth (601) has experienced higher than average traffic growth as has the Kimberly area (604), though traffic in the Pilbara appears to have exhibited growth at only about the state average. Thus, while the link between the two characteristics is not absolutely direct, it does appear that regional population growth may be used as an indicator of future arterial road traffic volumes.

The lack of any strong correlation between the regional growth patterns and the mismatch between road and demographic characteristics of local government areas

TABLE 8.2—POPULATION GROWTH BY ROAD STUDY REGION

(per cent)

State	*Region*	*Location*	*1971-1976*	*1976-81*	*1971-1981*
New South Wales	201	Sydney Area	3.95	3.55	7.64
	202	Hunter	1.49	6.87	8.45
	203	North Coast	4.01	20.09	24.90
	204	Illawarra and South Coast	11.56	6.98	19.34
	205	West	-2.36	-0.08	-2.44
Victoria	301	Melbourne Area	5.09	2.16	7.36
	302	South Gippsland	3.42	8.48	12.19
	303	North	7.15	4.08	11.52
	304	Murray and the West	4.95	0.61	5.59
	305	Geelong	11.54	3.10	15.00
	306	East Gippsland	8.40	4.76	13.56
Queensland	401	Brisbane and Gold Coast	14.10	11.14	26.81
	402	Darling Downs and Wide Bay	8.11	2.46	10.78
	403	South West	-2.96	-5.41	-8.20
	404	Mid North Coast	14.18	7.78	23.06
	405	North	13.29	12.87	27.86
South Australia	501	Adelaide Area	8.20	2.07	10.44
	502	Mid North	5.12	-1.64	3.40
	503	Murray and South East	7.46	4.95	12.78
	504	Eyre	6.89	1.37	8.35
	505	North	-6.24	-3.45	-9.48
Western Australia	601	Perth Area	14.84	12.07	28.70
	602	South West	1.93	6.23	8.28
	603	Pilbara	28.95	22.22	57.60
	604	Kimberley	3.62	27.54	32.15
	605	Goldfields and Midlands	-8.19	8.43	-0.36
Tasmania	701	North	5.19	2.64	7.96
	702	South	3.83	3.35	7.31
	703	West	3.40	2.81	6.31
Northern Territory	801	Whole Territory	12.39	27.02	42.75

Source: ABS Census, (1971, 1975 and 1981).

shown in Table 4.10 reflects the slow rate of response of the road system to changes in demand.

PROJECTED ROAD FUNDING TO 1990

Chapter 5 contained a summary of expenditure on roads in Australia over the period 1972-73 to 1981-82 and Table 5.1 shows that expenditure by all levels of government in 1981-82 amounted to almost two thousand five hundred million dollars. With the introduction of the ABRD and JOLOR programs it is estimated that total expenditure in 1983–84 will rise to around two thousand eight hundred milion dollars (in 1981–82 values).

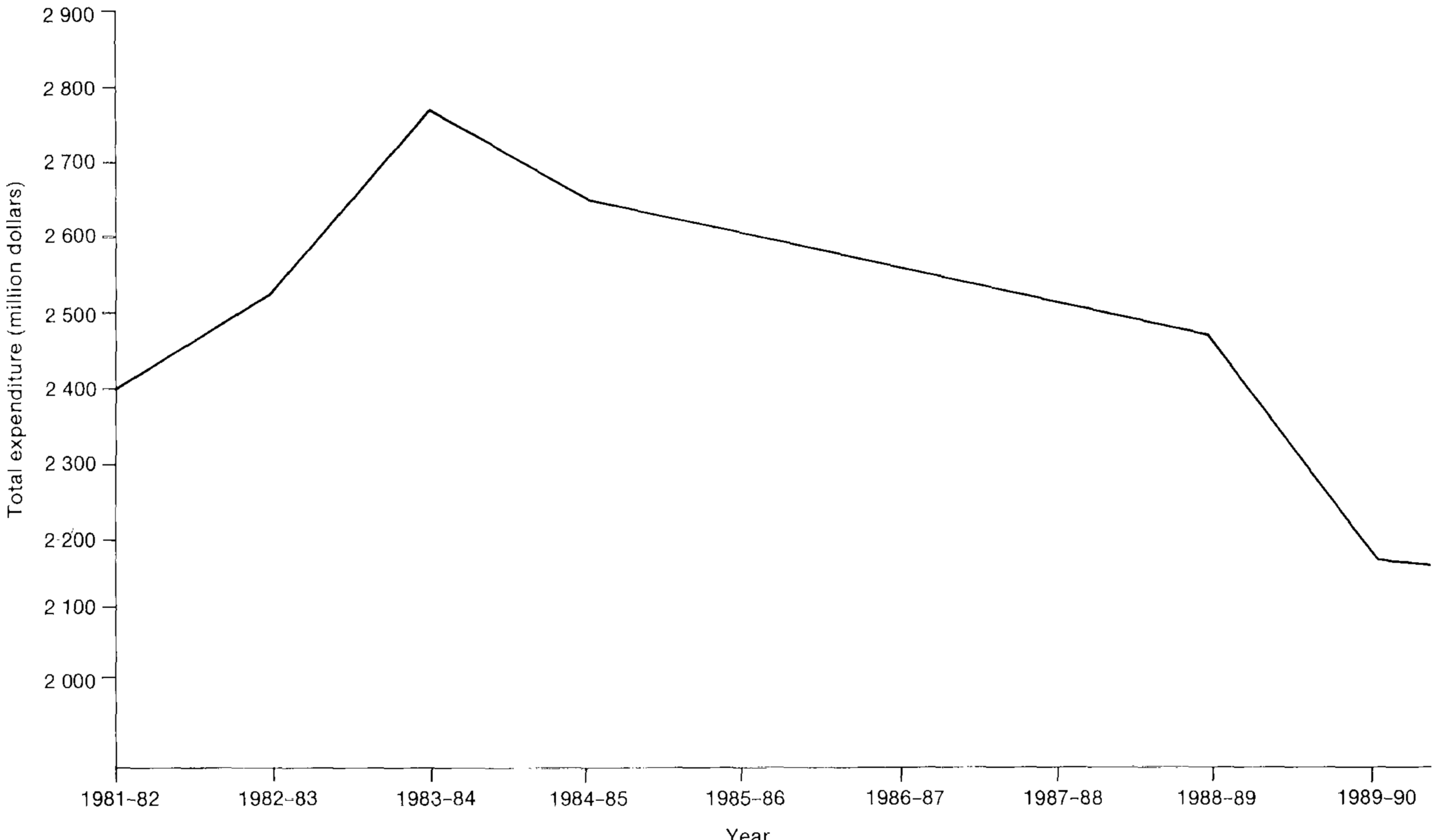
This expenditure, taken in isolation, may seem large, but it seems less so when viewed in the context of private spending on road transport. For example, some six thousand million dollars was spent in 1983-84 on the purchase of new vehicles and a further six thousand million dollars on fuel. Householders spend annually something in the vicinity of two thousand million dollars on motor vehicle expenses other than capital and fuel costs, and total motoring costs account for some fourteen percent of average household expenses (ABS 1977). Clearly, if the total cost of operating commercial vehicles is added then the amounts spent by governments on building and maintaining the infrastructure take on a rather different aspect. A relatively small gain to individual road users can easily provide a satisfactory economic return on investments at the level currently applied to roadworks.

However, the fact that a program provides a positive economic return is a necessary, but not sufficient, reason for maintaining or increasing funding levels. As indicated by the Commonwealth Treasury in its submission to the Inquiry into the National Road Freight Industry (Commonwealth Treasury 1984) many other factors associated with resource allocation between budgetary areas (health, social welfare, defence, etc) and macroeconomic policies must be taken into account. It is appropriate therefore to take as a basis for discussion a projected funding pattern based on existing levels and established trends. Figure 8.1 shows the projected total funding for roads over the period 1981-82 to 1989-90 based on the following assumptions (BTE 1984g):

- Commonwealth grants under the next *Roads Grants Act* will continue to decline in real terms.
- The excise hypothecated to ABRD program will continue at a fixed two cents per litre.
- The demand for motor fuels will grow only slowly in the latter part of this decade.
- The JOLOR program will cease in 1984-85.
- Overall State road expenditure will meet ABRD quota requirements (which will mean a real increase in some States).
- Local government expenditure will continue to decline slowly in real terms.
- Road construction and maintenance costs will increase at an annual rate of 10 per cent.

If these assumptions are realised total road expenditure will reach a peak in 1983–84 and then decline steadily until 1988–89 when the ABRD program is due to end, as shown in Figure 8.1. At that time, unless some action is taken to replace ABRD, road funding will fall rapidly to just over two thousand one hundred million dollars in 1989–90 (in 1981–82 values). If some replacement funding arrangement is made the expenditure level in 1989–90 will be of the order of two thousand four hundred million dollars.

Should the decline (in real terms) in Commonwealth grants be arrested at the 1984–85 level then total annual expenditure on roads in 1989–90 would be increased by about seventy five million dollars.



Source: BTE estimate

Figure 8.1—Anticipated total annual expenditure on road works in Australia, 1981-82 to 1989-90 (constant 1981-82 values)

ROAD SYSTEM TO 1991, PROJECTED WORK PROGRAMS

Given that the funding profile for the period 1981-82 to 1990-95 is as suggested above and if the distribution of funds between states and road categories remains broadly as it was at 1980-81, then the results of the NAASRA NIMPAC analysis for the F100 funding level give an indication of the work programs likely to be undertaken.

The projected distribution of funds for national highway projects over the period to 1991 is given in Table 8.3 for a funding level maintained at the 1980-81 level.

In New South Wales and Victoria main expenditure is expected to be on duplication and new routes[1] while the major expenditure in Queensland is on rehabilitation and widening of existing two lane sealed roads. Sealing of the remaining unsealed sections of national highway is expected to take the major part of remaining funds in that state. New two lane seal dominates expenditure in South Australia, while much of Western Australian expenditure is on new routes. Tasmanian expenditure is expected to be dominated by work on new routes while in the Northern Territory the work program is dominated by realignment and widening of existing two lane seal. Considerable bridgework is embodied in the other program items.

Table 8.4 gives a similar breakdown of project expenditure for rural arterial roads excluding national highways.

TABLE 8.3—PROJECTED FUTURE EXPENDITURE FOR NATIONAL HIGHWAYS PROGRAMS IF FUNDING MAINTAINED AT 1980-81 LEVEL
(per cent)

Work type	*Proportion of Annual Expenditure*	
	1981	*1981-1991*
Service and operating	15	18
Rehabilitation	4	14
Rehabilitation and improvement	51	48
New routes	25	24
Bridge works	5	6

Source: NAASRA (1984f).

TABLE 8.4—PROJECTED FUTURE EXPENDITURE FOR RURAL ARTERIAL ROADS IF FUNDING MAINTAINED AT 1980-81 LEVEL
(per cent)

Work type	*Proportion of Annual Expenditure*	
	1981	*1981-1991*
Service and operation	30	35
Rehabilitation	5	21
Rehabilitation and improvement	55	33
New routes	0	0
Bridges	9	11

Source: NAASRA (1984f).

1. Work is defined as producing a 'new route' if it involves construction of a road on a new alignment and the existing road remains in use. For example most of the present Hume Highway between Campbelltown and Mittagong would be classified as new route since the old road remains open and is use. Similarly, most town by-passes are on new routes. Where an existing road becomes one carriageway of the upgraded road the work is classified as 'duplication'.

The NIMPAC analysis suggests that almost half the expenditure in New South Wales will go on realignment and widening two lane roads while the main emphasis in Victoria is likely to be on rehabilitation and widening. New two lane seal and rehabilitation and widening of existing two lane seals are the main components in Queensland. Rehabilitation and widening is expected to dominate South Australian and Western Australian expenditure. In Tasmania and the Northern Territory most expenditure is projected to go on rehabilitation and widening of two lane roads.

Table 8.5 shows the variation expected in patterns of expenditure on urban arterial roads in the major cities of Australia if spending is maintained at about the 1980-81 level. The pattern changes little from that in 1981 and what change there is consists of a slight relative increase in recurrent expenditure (general maintenance, operations, refurbishment, etc) at the expense of major upgrading projects.

Minor projects cover such items as minor street widening, intersection improvements and traffic signals. It is of interest to note that expenditure in signalling over the period from 1981-1991 is expected to show a distinct change of emphasis, from installation of individual signal sets towards introduction of signal linking and area wide co-ordination.

Table 8.6 shows the expected pattern of expenditure on major projects, by city, for the period 1981-91, assuming funding levels remain at the 1980-81 level. The long forward planning horizon for major urban arterial road projects means that the program developed for each city is close to what can be expected in practice. The type of work undertaken in each city is expected to be quite different, reflecting the particular requirements of the individual network. The high proportion of funds on new routes reflects the very high cost of such projects in urban areas.

Table 8.7 shows a summary of expected expenditure on different project types on urban local roads assuming that total funding remains at the 1980-81 level. It can be seen from this table that future expenditure patterns are expected to closely follow existing patterns with a large portion of funds allocated to maintenance and rehabilitation. Modernisation of existing streets to an acceptable contemporary standard dominates the improvement work.

Similar data for the case of rural local roads are presented in Table 8.8. Rehabilitation expenditure is expected to be higher in the next decade than was the case in 1980-81. There exists a general feeling among road engineers that rehabilitation in the past has been less than sufficient and that continuation of existing trends would lead to a deterioration in general road condition. Generally the improvement component in the future expenditure is distributed by the work type in the same

TABLE 8.5—PROJECTED FUTURE EXPENDITURE FOR URBAN ARTERIAL ROADS IF FUNDING MAINTAINED AT 1980-81 LEVEL

(per cent)

	Proportion of Annual Expenditure					
	1981			*1981-1991*		
	Recurrent	*Minor projects*	*Major projects*	*Recurrent*	*Minor projects*	*Major projects*
Sydney	27	16	57	30	16	54
Melbourne	33	11	56	33	11	56
Brisbane	19	17	64	22	17	62
Adelaide	29	9	62	37	8	55
Perth	14	17	69	14	17	69
Australia	26	14	59	29	14	57

Source: NAASRA (1984f).

TABLE 8.6—PROJECTED FUTURE EXPENDITURE FOR MAJOR PROJECTS ON URBAN ARTERIAL ROAD IF FUNDING MAINTAINED AT 1980-81 LEVEL

(per cent)

Project type	Proportion of annual expenditure									
	Sydney		*Melbourne*		*Brisbane*		*Adelaide*		*Perth*	
	1981	*1981-91*	*1981*	*1981-91*	*1981*	*1981-91*	*1981*	*1981-91*	*1981*	*1981-91*
Duplication	3	0	13	21	40	20	35	42	3	12
Other widening	19	32	14	9	1	7	0	0	2	7
Grade separation	0	8	3	2	7	14	16	14	0	2
New/Duplicate bridge	5	4	0	1	7	5	0	13	a	a
New routes	53	36	54	51	34	37	27	8	83	68
Incomplete projects	14	15	9	9	10	10	12	13	12	12
Land acquisition	5	5	7	7	1	8	11	9	a	a

a. indicates amount included in other project values.

Source: NAASRA (1984f).

way as in the base year, that is with greatest emphasis on new two lane seal, road widening and traffic oriented works. Overall the management strategy reflects a move towards maintenance of the existing system.

Table 8.9 shows the expected pattern of expenditure on local roads in sparse rural areas if funding is maintained at the 1980-81 level.

A high proportion of the restoration work (maintenance and rehabilitation) in sparse rural areas is associated with repairing roads after the wet season in tropical areas. Most improvement work consists of sealing unsealed roads and paving previously unpaved roads. The proportion spent on rehabilitation is likely to increase in the future.

If the work programs and funding arrangements continue to follow the established patterns then the distribution of funds among the states and road categories over the period 1985-1990 will be as shown in Table 8.10. In that table expenditure under 'maintenance and rehabilitation' does not quite correspond to the conceptual

TABLE 8.7—PROJECTED FUTURE EXPENDITURE ON URBAN LOCAL ROADS IF FUNDING IS MAINTAINED AT 1980-81 LEVEL

(per cent)

Work type	*Proportion of Expenditure*	
	1981	*1981-91*
Maintenance	30	30
Rehabilitation	32	32
Improvements	36	36
New routes	1	1

Source: NAASRA (1984e).

TABLE 8.8—PROJECTED FUTURE EXPENDITURE ON RURAL LOCAL ROADS IF FUNDING MAINTAINED AT 1980-81 LEVEL

(per cent)

Work type	*Proportion of Expenditure*	
	1981	*1981-91*
Maintenance	33	34
Rehabilitation	16	18
Improvements	48	45
New routes	3	3

Source: NAASRA (1984e).

TABLE 8.9—PROJECTED FUTURE EXPENDITURE ON SPARSE RURAL LOCAL ROAD IF FUNDING IS MAINTAINED AT 1980-81 LEVEL

(per cent)

Work type	*Proportion of Expenditure*	
	1981	*1981-91*
Maintenance	45	46
Rehabilitation	11	15
Improvements	40	37
New routes	5	2

Source: NAASRA (1984e).

TABLE 8.10—PROJECTED TOTAL EXPENDITURE ON AUSTRALIA ROADS, 1985-90 (1981-82 VALUES)

($million)

State	Road category	1985-86			1986-87			1987-88			1988-89			1989-90		
		M&R[a]	I[b]	Total	M&R[a]	I[b]	Total	M&R[a]	I[b]	Total	M&R[a]	I[b]	Total	M&R[a]	I[b]	Total
New South Wales	National highways	29	91	120	29	89	118	29	88	117	29	86	115	29	72	101
	Rural arterial	151	68	219	148	67	215	146	66	212	145	65	210	138	46	184
	Rural local	76	81	157	76	83	159	76	81	157	76	79	155	76	60	136
	Urban arterial	71	104	175	70	103	173	69	12	171	67	101	168	66	82	148
	Urban local	149	137	286	149	133	282	149	129	278	149	125	274	149	92	241
	Total	476	481	957	472	475	947	469	466	935	466	456	922	458	352	810
Victoria	National highways	17	45	62	17	44	61	17	42	59	17	35	60	17	35	52
	Rural arterial	52	19	71	51	19	70	50	19	69	50	18	68	52	8	60
	Rural local	53	78	131	51	78	129	50	77	127	49	76	125	47	63	110
	Urban arterial	59	92	151	58	91	149	58	88	146	58	86	144	57	70	127
	Urban local	57	86	143	57	83	140	57	81	138	57	79	136	57	63	120
	Total	238	320	558	234	315	549	232	308	540	231	301	532	230	239	469
Queensland	National highways	18	58	76	18	57	75	18	56	74	18	55	73	17	47	64
	Rural arterial	55	48	103	54	48	102	53	47	100	52	47	99	55	32	87
	Rural local	45	79	124	45	77	122	45	75	120	45	73	118	45	59	104
	Urban arterial	20	30	50	19	30	49	18	30	48	17	31	48	16	26	42
	Urban local	45	61	106	44	60	104	45	58	103	45	56	101	46	43	89
	Total	183	276	459	180	272	452	179	266	445	177	262	439	179	207	386
South Australia	National highways	13	25	38	13	24	37	13	24	37	13	24	37	13	19	32
	Rural arterial	22	10	32	22	10	32	21	10	31	21	10	31	22	5	27
	Rural local	10	23	33	10	23	33	10	22	32	10	22	32	10	18	28
	Urban arterial	15	22	37	15	21	36	15	21	36	15	20	35	15	16	31
	Urban local	24	21	45	24	21	45	24	20	44	24	19	43	24	14	38
	Total	84	101	185	84	99	183	83	97	180	83	95	178	84	72	156

TABLE 8.10(Cont)—PROJECTED TOTAL EXPENDITURE ON AUSTRALIA ROADS, 1985-90 (1981-82 VALUES)

($million)

State	*Road category*	*1985-86*			*1986-87*			*1987-88*			*1988-89*			*1989-90*		
		M&R[a]	*I*[b]	*Total*	*M&R*[a]	*I*[b]	*Total*	*M&R*[a]	*I*[b]	*Total*	*M&R*[a]	*I*[b]	*Total*	*M&R*[a]	*I*[b]	*Total*
Western Australia	National highways	8	37	45	8	37	45	8	35	43	8	35	43	8	30	38
	Rural arterial	37	27	64	37	26	63	36	26	62	36	26	62	37	16	53
	Rural local	18	38	56	18	37	55	17	37	54	17	37	54	17	30	47
	Urban arterial	18	28	46	18	28	46	18	27	45	18	26	44	17	22	39
	Urban local	10	28	38	10	27	37	10	27	37	10	26	36	10	22	32
	Total	91	158	249	91	155	246	89	152	241	89	150	239	89	120	209
Tasmania	National highways	5	11	16	5	10	15	15	10	15	5	10	15	5	8	13
	Rural arterial	7	12	19	7	12	19	7	11	18	7	11	18	7	6	13
	Rural local	13	22	35	13	21	34	13	20	33	13	20	33	12	17	29
	Urban arterial	9	17	26	9	17	26	9	16	25	9	16	25	9	13	22
	Urban local	9	3	12	9	3	12	9	3	12	9	2	11	9	1	10
	Total	43	65	108	43	63	106	43	60	103	43	59	102	42	45	87
Northern Territory	National highways	12	6	18	12	6	18	12	6	18	12	6	18	12	6	18
	Rural arterial	3	2	5	3	2	5	3	2	5	3	2	5	3	2	5
	Rural local	10	15	25	10	15	25	9	15	24	8	16	24	8	9	17
	Urban arterial	4	9	13	4	9	13	4	9	13	4	9	13	2	7	9
	Urban local	3	–	3	3	–	3	3	–	3	3	–	3	3	–	3
	Total	32	32	64	32	32	64	31	32	63	30	33	63	28	24	52

TABLE 8.10—PROJECTED TOTAL EXPENDITURE ON AUSTRALIA ROADS, 1985-90 (1981-82 VALUES)

($million)

State	Road category	1985-86			1986-87			1987-88			1988-89			1989-90		
		M&R[a]	*I*[b]	*Total*	*M&R*[a]	*I*[b]	*Total*	*M&R*[a]	*I*[b]	*Total*	*M&R*[a]	*I*[b]	*Total*	*M&R*[a]	*I*[b]	*Total*
Australian Capital Territory	National highways	–	–	–	–	–	–	–	–	–	–					
	Rural arterial	1	–	1	1	–	1	1	–	1	1	–	1	1	–	1
	Rural local	–	–	–	–	–	–	–	–	–	–					
	Urban arterial	7	9	16	7	9	16	7	9	16	7	9	16	7	7	14
	Urban local	3	3	6	3	3	6	3	3	6	3	3	6	3	2	5
	Total	11	12	23	11	12	23	11	12	23	11	12	23	11	9	20
Australia	National highways	102	273	375	102	267	369	102	262	364	102	258	360	101	217	318
	Rural arterial	328	186	514	323	184	507	317	181	498	315	179	494	315	115	433
	Rural local	225	336	561	223	334	557	220	327	547	218	323	541	215	256	471
	Urban arterial	203	311	514	200	308	508	198	302	500	195	298	493	189	243	432
	Urban local	300	339	639	299	330	629	300	320	620	300	310	610	301	237	538
	Total	1158	1445	2603	1147	1423	2570	1137	1393	2529	1130	1368	2498	1121	1068	2192

a. M & R indicates maintenance and rehabilitation.
b. I indicates improvement.
– nil or rounded to zero.

Source: BTE estimates.

maintenance of the asset as identified in Chapter 3. This is because the expenditure under 'upgrading' will generally contain a restorative component. In many instances, were a road not upgraded it would require some expenditure of a restorative nature. Assuming that roads which are subject to upgrading would otherwise require expenditure per kilometre equivalent to that of the general rehabilitation projects the data in Table 8.10 has been adjusted to provide the data in Table 8.11.

In Table 8.11 the expenditure under 'restoration' approximates that required to maintain the asset, while that under 'upgrading' includes that required to keep pace with traffic growth and to improve the level of service provided. The figures indicate that under this overall funding scenario the real expenditure on upgrading would fall over the period 1985–90, but would still remain a significant proportion of total expenditure even when the ABRD program has ended in 1989–90.

ROADS SYSTEM TO 1991, PROJECTED LEVEL OF SERVICE

It was suggested earlier in this chapter that the level of funds for roads over the next ten years is likely to be slightly, but not greatly, above the level for 1980–81 in real terms. Given that traffic is expected to grow at around 3 to 4 per cent per year over the next ten years the question arises as to what is likely to be the state of the road system at the end of that period. A major thrust of the NAASRA Roads Study was to estimate the condition of the road system in 1991 if funding was maintained at 1980–82 levels in real terms and if funds were distributed among states and road categories in the same way.

Table 8.12 contains a summary of the changes in level of service expected from national highways between 1981 and 1991 given that funding levels in each state are maintained at about 1980–81 levels throughout the period. The terms 'fair' and 'poor' correspond to the criteria set out in Chapter 3. It may be seen that expenditure at this level is expected to provide some physical improvement in the road length and about maintain overall standards of service. By 1991 national highways in Queensland are still likely to provide a level of service below that in other states. The reason for the relatively high levels of service projected for Western Australia and the Northern Territory is the low traffic volume in those regions.

Table 8.13 shows a summary of expected changes in level of service for rural arterials (other than national highways) between 1981–1991 given maintenance of funding levels existing in 1980–81. Expenditure at this rate seems to be just about sufficient to maintain the existing overall level of service against rising traffic volumes. Once again Queensland rural arterial roads are expected to provide a lower relative level of service than the other states.

In the NAASRA Roads Study a series of measures for traffic service levels on urban arterial roads were developed, and used to access conditions in 1981 and in 1991 at different funding levels. Road utilisation (thousands of vehicles per day per lane) and the percentage of vehicle travel under mid-block volume/capacity condition are two such measures which have been used already in this report (see Chapter 4). A third useful measure is the percentage of travel at peak speed less than 40 kilometres per hour. These three measures are used here to assess the change in conditions likely to result if spending levels of 1980–81 are maintained over the next decade. Values of these measures for major Australian cities are given in Table 8.14.

It would appear from the information in Table 8.14 that some deterioration in the level of service provided by arterial roads in Australian major cities can be expected if funding levels are maintained at the 1980–81 level over the next decade. This is because strong traffic growth is expected which will outweigh the substantial physical improvements achieved at this funding level.

The information base relating to local roads is much less comprehensive and complete than for arterial roads. Traffic data in particular is deficient in many instances. Roads

TABLE 8.11—PROJECTED EXPENDITURE ON AUSTRALIAN ROADS BY WORK TYPE, 1985-90 (1981-82 VALUES)

($million)

State	*Road category*	*1985-86*			*1986-87*			*1987-88*			*1988-89*			*1989-90*		
		R[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*
New South Wales	National highways	38	82	120	38	80	118	38	79	117	38	77	115	38	63	101
	Rural arterial	160	59	219	157	58	215	155	57	212	153	57	210	151	33	184
	Rural local	97	60	157	97	62	159	97	60	157	97	58	155	97	39	136
	Urban arterial	85	90	175	83	90	173	82	89	171	79	89	168	77	71	148
	Urban local	176	110	286	176	106	282	176	102	278	176	98	274	176	65	241
	Total	556	401	957	551	396	947	548	387	935	543	379	922	539	271	810
Victoria	National highways	22	40	62	22	39	61	22	38	60	22	37	59	22	30	52
	Rural arterial	54	17	71	53	17	70	52	17	69	52	16	68	52	8	60
	Rural local	80	51	131	77	52	129	76	51	127	75	50	125	72	38	110
	Urban arterial	68	83	151	67	82	149	67	79	146	67	77	144	66	61	127
	Urban local	64	79	143	64	76	140	64	74	138	64	72	136	64	56	120
	Total	288	270	558	283	266	549	281	259	540	280	252	532	276	193	469
Queensland	National highways	22	54	76	22	53	75	22	52	74	22	51	73	21	43	64
	Rural arterial	66	37	103	65	37	102	64	36	100	63	36	99	62	25	87
	Rural local	50	74	124	50	72	122	50	70	120	50	68	118	50	54	104
	Urban arterial	25	25	50	24	25	49	22	26	48	21	27	48	19	23	42
	Urban local	54	52	106	53	51	104	54	48	102	54	47	101	55	34	89
	Total	217	242	459	214	238	452	212	232	444	210	229	439	207	179	386

TABLE 8.11(Cont)—PROJECTED EXPENDITURE ON AUSTRALIAN ROADS BY WORK TYPE, 1985-90 (1981-82 VALUES)

($million)

State	*Road category*	*1985-86*			*1986-87*			*1987-88*			*1988-89*			*1989-90*		
		R[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*
South Australia	National highways	20	18	38	20	17	37	20	17	37	20	17	37	20	12	32
	Rural arterial	22	10	32	22	10	32	22	9	31	22	9	31	22	5	27
	Rural local	14	19	33	14	19	33	14	18	32	14	18	32	14	14	28
	Urban arterial	17	20	37	17	19	36	17	19	36	17	18	35	17	14	31
	Urban local	27	18	45	27	18	45	27	17	44	27	16	43	27	11	38
	Total	100	85	185	100	83	183	100	80	180	100	78	178	100	56	156
Western Australia	National highways	15	30	45	15	30	45	15	28	43	15	28	43	15	23	38
	Rural arterial	40	24	64	40	23	63	39	23	62	39	23	62	39	14	53
	Rural local	19	37	56	19	36	55	18	36	54	18	36	54	18	29	47
	Urban arterial	22	24	46	22	24	46	22	23	45	22	22	44	22	17	39
	Urban local	13	25	38	13	24	37	13	24	37	13	23	36	13	19	32
	Total	109	140	249	109	137	246	107	134	241	107	132	239	107	102	209
Tasmania	National highways	10	6	16	10	5	15	10	5	15	10	5	15	10	3	13
	Rural arterial	9	10	19	9	10	19	9	9	18	9	9	18	9	7	16
	Rural local	14	21	35	14	20	34	14	19	33	14	19	33	13	16	29
	Urban arterial	11	15	26	11	15	26	11	14	25	11	14	25	11	11	22
	Urban local	10	2	12	10	2	12	10	2	12	10	1	11	10	0	10
	Total	54	54	108	54	52	106	54	49	103	54	48	102	53	37	90

TABLE 8.11(Cont)—PROJECTED EXPENDITURE ON AUSTRALIAN ROADS BY WORK TYPE, 1985-90 (1981-82 VALUES)

($million)

State	*Road category*	*1985-86*			*1986-87*			*1987-88*			*1988-89*			*1989-90*		
		R[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*	*R*[a]	*U*[b]	*Total*
Northern Territory	National highways	18	0	18	18	0	18	18	0	18	18	0	18	18	0	18
	Rural arterial	4	1	5	4	1	5	4	1	5	4	1	5	4	1	5
	Rural local	10	15	25	10	15	25	9	15	24	8	16	24	8	9	17
	Urban arterial	5	8	13	5	8	13	5	8	13	5	8	13	3	6	9
	Urban local	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3
	Total	40	24	64	40	24	64	39	24	63	38	25	63	36	16	52
Australian Capital Territory	National highways	–	–	–	–	–	–	–	–	–	–	–				
	Rural arterial	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1
	Rural local	–	–	–	–	–	–	–	–	–	–					
	Urban arterial	8	8	16	8	8	16	8	8	16	8	8	16	8	6	14
	Urban local	3	3	6	3	3	6	3	3	6	3	3	6	3	2	5
	Total	12	11	23	12	11	23	12	11	23	12	11	23	12	8	20
Australia	National highways	145	230	375	145	224	369	145	219	364	145	215	360	144	174	318
	Rural arterial	356	158	514	351	156	507	346	152	498	343	151	494	340	93	433
	Rural local	284	227	561	281	276	557	278	269	547	276	265	541	272	199	471
	Urban arterial	241	273	514	237	271	508	234	266	500	230	263	493	223	209	432
	Urban local	350	289	639	349	280	629	350	270	620	350	260	610	351	187	538
	Total	1376	1227	2603	1363	1207	2570	1353	1176	2529	1334	1154	2498	1330	862	2192

a. R indicates restorative work b. U indicates upgrading work—nil or rounded to zero.

Source: BTE estimates.

in 114 local government areas were sampled in the course of the NAASRA Road Study and the results of that survey and associated analysis give an indication of probable developments in relation to local roads. The work was undertaken and reported under three headings (urban, rural and sparse rural) and that classification is used here.

Table 8.15 presents a summary of the development in urban local roads over the period to 1991 if 1980–81 levels of funding are maintained, as indicated by the NAASRA study. On the basis of the sample results it does appear that maintenance of 1980–81 funding levels in real terms will permit some continued improvement in the urban local road system, including a significant reduction in the length of unsealed urban local road remaining and an increase in the length kerbed.

Table 8.16 presents the NAASRA Road Study results for roads in rural local government areas. Changes to unpaved and unformed roads were not examined in detail and no individual traffic volume figures are available. The overall length of such roads is reduced in 1991 for this funding level as roads are paved and sealed. All rural areas of the Northern Territory were classified sparse rural in the NAASRA study.

TABLE 8.12—EXPECTED CHANGE IN TRAFFIC SERVICE IF FUNDING MAINTAINED AT 1980–81 LEVELS, NATIONAL HIGHWAYS

(per cent)

State/level of service	*Length of road*						*Travel on road*					
	1981			*1991*			*1981*			*1991*		
	Poor	*Fair*	*Good*	*Poor*	*Fair*	*Good*	*Poor*	*Fair*	*Good*	*Poor*	*Fair*	*Good*
New South Wales	12	28	60	11	15	74	23	37	40	22	27	51
Victoria	3	29	78	9	9	82	5	35	60	8	21	71
Queensland	9	30	61	10	21	69	27	37	36	37	28	35
South Australia	35	6	59	0	13	87	10	27	63	3	46	51
Western Australia	13	11	76	1	1	98	5	17	78	6	4	90
Tasmania	18	20	62	0	14	86	32	21	47	0	20	80
Northern Territory	0	0	100	0	1	99	0	1	99	0	0	100
Australia	13	15	72	4	10	86	20	31	49	21	26	53

Source: NAASRA (1984b), Chapter 18.

TABLE 8.13—EXPECTED CHANGE IN TRAFFIC SERVICE IF FUNDING MAINTAINED AT 1980–81 LEVEL, RURAL ARTERIAL ROADS

(per cent)

State/level of service	*Length of road*						*Travel on road*					
	1981			*1991*			*1981*			*1991*		
	Poor	*Fair*	*Good*	*Poor*	*Fair*	*Good*	*Poor*	*Fair*	*Good*	*Poor*	*Fair*	*Good*
New South Wales	11	19	70	12	20	68	28	30	42	29	28	43
Victoria	4	14	82	3	12	85	17	25	58	16	24	60
Queensland	13	24	63	10	18	72	35	33	32	47	22	31
South Australia	7	12	81	6	16	78	14	23	63	17	28	55
Western Australia	1	9	90	1	12	87	9	14	77	18	25	57
Tasmania	6	27	67	2	27	71	17	39	44	15	39	46
Northern Territory	0	2	98	0	6	94	0	33	67	0	13	87
Australia	8	16	76	7	16	77	23	27	50	27	26	47

Source: NAASRA (1984b), Chapter 18.

TABLE 8.14—EXPECTED CHANGE IN TRAFFIC SERVICE IF FUNDING MAINTAINED AT 1980-81 LEVEL, URBAN ARTERIAL ROADS

City	*Road utilisation ('000 vehicles/ day/lane)*		*Travel distance with peak speed less than 40 kph (per cent)*		*Travel distance with Peak Volume/Capacity Ratio (per cent)*					
					1981			*1991*		
	1981	*1991*	*1981*	*1991*	>0.9	*0.7-0.9*	<0.7	>0.9	*0.7-0.9*	<0.7
Sydney	7.3	7.6	60	58	37	17	46	37	19	44
Melbourne	5.4	6.7	57	65	27	27	46	46	25	29
Brisbane	5.4	6.1	20	23	15	20	65	23	21	56
Adelaide	4.8	5.4	13	15	10	19	71	14	20	66
Perth	4.5	5.5	49	54	15	17	68	16	25	59
Darwin	na	na	na	na	0	6	94	11	10	79

a. No estimates of future conditions were available for Hobart.

na not applicable

Source: NAASRA (1984a).

It may be seen that some general improvement is evident at this funding level, but some reservations have been expressed about the work program likely to be undertaken in this case and this aspect is discussed in the next section of this Report.

The NAASRA analysis for roads in sparse rural areas was limited to likely physical changes to road lengths, that is the changes were not analysed by traffic volume.

TABLE 8.15—LENGTH OF URBAN LOCAL ROAD BY TRAFFIC VOLUME IF FUNDING MAINTAINED AT 1980-81 LEVEL

(km)

State and road	Traffic volume							
	1981				*1991*			
	<100	*100-500*	*500-1000*	*>1000*	*<100*	*100-500*	*500-1000*	*>1000*
New South Wales:								
Multilane	500	2900	2500	4300	500	3100	2400	5200
Kerbed	700	3700	1600	1100	500	3900	2000	1500
Sealed	600	1900	700	900	300	800	700	800
Unsealed	1500	200	200	200	1200	100	200	100
Victoria:								
Multilane	0	600	600	1500	0	900	900	1900
Kerbed	1200	3800	2400	2100	1800	4300	2400	2300
Sealed	700	1500	300	400	700	800	200	0
Unsealed	1200	200	100	0	100	100	0	0
Queensland:								
Multilane	400	600	400	1200	200	600	500	1400
Kerbed	2800	2200	1300	1500	2400	3200	1700	2300
Sealed	300	200	200	300	0	100	0	100
Unsealed	700	300	0	0	500	200	0	0
South Australia:								
Multilane	0	200	200	300	100	400	200	300
Kerbed	600	3400	700	300	800	4700	800	400
Sealed	400	200	100	100	300	0	0	0
Unsealed	700	300	0	0	300	100	0	0
Western Australia:								
Multilane	85	195	165	955	215	475	495	1210
Kerbed	1010	1480	480	490	1310	1675	475	495
Sealed	575	745	495	295	290	550	245	90
Unsealed	150	50	0	0	105	5	0	0
Tasmania:								
Multilane			313				338	
Kerbed	na	na	993	na	na	na	1090	na
Sealed			313				327	
Unsealed			128				5	
Northern Territory:								
Multilane	134	38	4	17	143	40	5	17
Kerbed	265	10	2	0	276	9	2	0
Sealed	22	2	1	1	10	1	0	1
Unsealed	4	2	0	0	2	0	0	0

na not available.

Source: NAASRA (1984e).

ISSUES

A number of issues were raised in the course of this study which require some comment before formal findings are presented.

A preliminary survey of social attitudes towards roads (BTE 1984h) indicated that people place a high value on their personal mobility and hence on their cars and roads. The survey cannot be regarded as definitive because of the very small samples used, but the results are consistent with previous surveys which indicate that roads have a hgh priority if additional funding is available, although road spending would be reduced before other major budget items if funds are reduced. In this respect the behaviour of local government seems to reflect the attitudes of the public (BTE 1984a, Chapter 8).

Of those interviewed the majority thought that the roads in general were 'good', the exception being the case of rural local roads which were thought to be less than satisfactory. This seems to reflect the fact that a certain basic standard is regarded as appropriate and that this standard has not yet been reached in the case of many rural local roads. In country areas concern focuses mainly on the physical condition of roads, with particular emphasis on all weather capability while in urban areas the main concern is with high traffic levels and, especially, child safety.

No issues of a national nature were identified. Almost all problems appear to be local in nature, although they may have some characteristics in common with problems elsewhere. For example, a relatively widespread problem is that of heavy trucks on particular roads, though the particular problem is different in each case. Coal trucks

TABLE 8.16—LENGTH OF RURAL LOCAL ROAD BY TRAFFIC VOLUME IF FUNDING MAINTAINED AT 1980-81 LEVEL

(km)

State and road type	*Traffic volume*			
	1981		*1991*	
	<100	*>100*	*<100*	*>100*
New South Wales:				
Sealed	14 100	12 000	17 100	14 400
Unsealed	52 100	3 100	57 600	2 100
Victoria:				
Sealed	10 000	19 100	9 300	22 700
Unsealed	41 300	4 400	42 000	800
Queensland:				
Sealed	7 700	5 800	8 000	7 700
Unsealed	19 700	1 800	18 100	1 700
South Australia:				
Sealed	1 000	3 300	1 000	4 500
Unsealed	33 200	1 900	34 800	1 200
Western Australia:				
Sealed	8 825	2 210	9 670	2 480
Unsealed	21 370	570	22 210	485
Tasmania:				
Sealed	na	2 815	na	3 449
Unsealed		7 723		7 212

na not available.

Source: NAASRA (1984e).

around Wollongong are seen as a problem because they are intermingled with moderately heavy ordinary traffic, while timber trucks in Western Australia and Tasmania are of concern primarily because they are seen to do significant damage to lightly constructed roads.

An ambivalent attitude is often found in areas of high seasonal variation, for example in tourist areas. Tourist traffic is often seen as imposing an 'unfair' load upon the road system and yet this same traffic often contributes significantly to the wealth of the area. This type of question may require special consideration in relation to distribution of funds for local roads, but the fact remains that it is primarily a localised problem.

The question of whether sufficient funds are being allocated to maintenance of the road system has been mentioned previously. The difficulty is that roads are a relatively long life asset and much of the system has been constructed in its present form only in the last twenty years, so that it is difficult to discern the real state of the system and the adequacy of maintenance (in the widest sense). A new approach to assessment of road condition and the adequacy of maintenance strategies (BTE 1984i) may cast light on this, but research is not sufficiently advanced to make a definitive statement. Initial analysis of Victorian and Tasmanian data suggests that the reconstruction rate in the latter state may need to be increased over the next few years if the system is to be maintained in good order, while the rate of reconstruction in Victoria appears to be adequate. The survey of Divisional Engineers in New South Wales revealed an opinion that the present rate of reconstruction (about 1 per cent per year) should be increased (to about 3 per cent per year) which would be consistent with an average road life of about thirty years. Rural local government engineers have often expressed the view that their roads are deteriorating and there would seem to be some truth in this, though the fact remains that local government continues to spend significant amounts on upgrading roads rather than diverting funds to long term maintenance work.

CHAPTER 9-FINDINGS

GENERAL

This Chapter presents the findings of the study in the context of the Terms of Reference. It covers the changes in condition and performance of the road system which have occurred over the the last decade and current trends in both levels and patterns of funding. The economics of road investment are examined and the returns to such investment are assessed. The implications of alternative levels and patterns of funding are explored.

Finally, the role, extent and effectiveness of Commonwealth road funding is examined.

ROAD CONDITION AND PERFORMANCE

The analysis presented in Chapter 4 makes it clear that the road system as a whole has improved considerably over the period since 1972.

By 1981 some 88 per cent of national highways had been sealed, compared with 73 per cent in 1972. Unsealed sections remained only in Queensland, South Australia and Western Australia and consisted of road lengths with very low traffic volumes. In the more heavily utilised sections of the national highway system considerable upgrading has occurred in the last decade. Travelling conditions on national highways improved significantly with improved seal width (and additional traffic lanes), shoulder width, alignment, etc, and was reflected in reduced travel times and fatal accident rates.

In the case of other rural arterial roads some 77 per cent of their length had been sealed by 1981 compared with 70 per cent in 1971. The most rapid rate of increase in percentage sealed occurred in the states with the less developed road systems (Queensland, Western Australia and the Northern Territory). The length of unsealed rural arterial road carrying relatively large volumes of traffic (greater than 300 vehicles per day) fell by almost 18 per cent over the period 1972 to 1981. Overall the distribution of traffic between rural arterial roads of different seal width showed that a significant improvement occurred during the decade. This improvement was reflected in decreased travel times and accident rates.

Taken together the sealed system of national highways and rural arterial roads now reaches the large majority of population centres. Only in the Northern Territory, Western Australia and Queensland are a significant proportion of communities of more than 200 people not served by a sealed road link.

The improvements made to urban arterial roads during the past decade appear to have been insufficient to keep pace with traffic growth. In the case of Sydney and Melbourne in particular there appears to be spreading of peak traffic conditions over a longer period each day, and the diversion of traffic from arterial to local roads appears to be increasing. Car use for journey-to-work in urban areas increased during the decade with a reduced emphasis on travel to and from the central business district in the major cities increasing the load on 'cross-town' links. There was a generally downward trend in fatal accident rates.

Local roads comprise some 85 per cent of the total road length in Australia, but carry only small traffic volumes compared with arterials. Through the 1970s, physical improvements to the rural local road system (for example, length of seal) more than kept pace with traffic growth. A significant problem in relation to urban local roads appears to be the spill-over from congested urban arterial roads in some specific locations. This is a reflection of inadequate capacity on the relevant arterial roads, not lack of development of the local roads.

TRENDS IN LEVELS AND PATTERNS OF FUNDING

Overall annual expenditure on roads declined in real terms over the period 1972 to 1982 by approximately 12 per cent. Preliminary estimates suggest that there has been a sharp recovery over the period 1982 to 1984 as a result of the ABRD and JOLOR programs.

Commonwealth expenditure on roads fell continuously in real terms over the period 1972 to 1982, a total fall of some 34 per cent, prior to the introduction of ABRD and JOLOR. Expenditure by state governments also fell between 1972 and 1976, rose to a peak in 1979 and then fell by 1982 to a level almost exactly the same as in 1972. Local government roads expenditure rose to a peak in 1976 and then fell steadily to a level in 1982 still about 6 per cent above the 1972 level. The introduction of Personal Income Tax Sharing (PITS) grants in 1976 appears to have had no long term impact on road expenditure by local government.

There was a decline in roads expenditure as a proportion of total expenditure over the decade for all three levels of government. In the case of the Commonwealth the fall was from 3.06 to 1.75 per cent, in the case of state governments from 6.72 to 4.68 per cent and in the case of local government from 34.13 to 25.41 per cent. This suggests that roads are assuming a lower relative priority, as against other budget items, for all levels of government.

The distribution of total expenditure among the states changed little over the period 1972 to 1982. The proportion of Commonwealth grants going to New South Wales and Queensland increased slightly. The introduction of ABRD funding is not expected to change this pattern significantly since 60 per cent of ABRD funds are to be distributed on the basis of existing Roads Grants Acts funds. Only the 40 per cent applied to national highway works are subject to change in pattern of distribution, and changes are not likely to be great in the initial years of ABRD.

Annual expenditure on national highways has remained relatively constant in real terms since their inception in 1974-75. This reflects the continuing priority given to this set of roads by the Commonwealth. Total annual expenditure on rural arterial roads declined by 16 per cent over the period from 1975 to 1982, while over the period 1972 to 1982 expenditure on rural local roads fell by about 11 per cent. Over the same period expenditure on urban arterial roads fell by some 46 per cent in real terms. Only in the case of urban local roads was there a rise in real expenditure, 7 per cent, between 1972 and 1982.

Road expenditure by state governments is funded almost entirely by charges applied to vehicle owners and users (registration and licence fees and a fuel franchise) and expenditure per vehicle on register has fallen in real terms in all states over the last ten years. There also exist wide differences between the states with Tasmanian expenditure per vehicle being twice that of South Australia, while Queensland, New South Wales, Western Australia and Victoria lie between the two extremes in descending order.

The use of loan money for roads expenditure has become more prevalent over the period from 1972 to 1982, reaching around 15 per cent overall at the end of the period and no less than 30 per cent in the case of New South Wales. This trend could have a significant impact on road funding over the next decade as loan repayments constitute an increasing component of total annual expenditure.

Local government expenditure on roads per head of population showed different trends in different states over the period 1972 to 1982. It remained relatively constant in New South Wales and South Australia, and fell steadily in Queensland and Tasmania. In Victoria and Western Australia it rose quickly between 1972–73 and 1973–74 and then remained relatively constant. In 1981–82 expenditure per head in New South Wales was some 30 per cent higher than in other states, which were fairly close to each other.

ECONOMIC ASSESSMENT

Overview

Together, the Commonwealth, state and local governments spent in the vicinity of two thousand five hundred million dollars on road works in 1981–82. With ABRD and JOLOR programs this is expected to grow to around two thousand eight hundred million dollars (in 1981–82 values) in 1983–84. Great as this expenditure may appear it is not large in the context of total spending on road transport. With around six thousand million dollars spent on new vehicles in 1983–84 and a similar amount spent on fuel, quite small unit cost savings can produce high overall benefits; hence good economic returns can be earned on roads investment. With motor vehicle costs, other than purchase of the vehicle and fuel, accounting for some 14 per cent of average household expenditure and with the addition of the total costs associated with operating commercial vehicles, government expenditure in building and maintaining roads is seen in better perspective.

The motor vehicle fleet and the vehicle kilometres of travel undertaken are both expected to continue to grow strongly, though at a rate slightly less than that experienced in the 1970s. Demand for motor cars and their use appears to be virtually invariant in relation to fuel price. The sharp real increases in the late 1970s had no significant effect on travel. Overall a growth in vehicle numbers total annual vehicle kilometres of travel in the vicinity of 3 per cent per year throughout the remainder of the century seems to be highly likely. Such a growth would still leave the number of vehicles per head of population in Australia by the year 2000 well below that which is current in California now. It would ensure that many projects aimed at maintaining existing levels of service would provide good economic returns (that is, benefit cost ratios (BCRs) greater than one with many of the order of two or more). History reveals, however, that expenditure on roads has consistently been at a level below that justified by projects showing such returns and, furthermore, that the expenditure actually undertaken has not been distributed in such a way as to produce the maximum economic return by concentrating on those projects with highest BCRs.

The determination of the overall budget allocation for roadworks by all three levels of government clearly involves the balancing of competing programs as well as the potential economic returns. Even when the overall amounts are set, objectives other than that of maximising economic returns (as indicated by high BCRs) may enter into the allocation of funds between road categories. The fact that a greater share of funds has been allocated to local roads over the years than would be the case if money was distributed on the basis of economic return simply reflects the fact that these other objectives exist and are given considerable weight in the decision process.

Even within categories, however, expenditure is not allocated in a way which will maximise economic returns. Institutional arrangements and rigidities may play a significant part in this, especially in regard to the continuity of work over time and the regular geographical distribution of available funds. Certainly the implicit acceptance that the maintenance (both physically and in level of service) of existing roads automatically takes a high priority reduces the scope for programming for economic efficiency.

The following sections deal specifically with individual road categories. In each case, unless otherwise stated, it is assumed that existing funding trends will be maintained. That is, it is assumed that total expenditure on roads will peak in 1983-84, and then decline steadily in real terms to 1988, when the ARBD program will cease, producing a sharp fall in expenditure in 1990 to an amount just below the 1981-82 level.

National Highways

If the proportion of total funds devoted to national highways is maintained at existing levels and distributed among the states in the same way as were national highway funds in 1981-82, a steady improvement in road standards and an associated improvement in level of service can be expected.

The BCRs for the projects undertaken can be expected to vary widely, however, ranging from less than one for upgrading in the sparsely populated areas of Queensland, Northern Territory and Western Australia and for duplication on some of the less trafficked sections in more populous areas, to greater than two for widening, realignment and reconstruction on sections with heavy traffic. Clearly, the investment in the low return projects can only be justified on grounds other than economic return.

Since the decision to develop the national highway system to a defined set of standards was taken some years ago, it is apparent that only the timing of the various projects involved is open to adjustment. To obtain maximum return from the investments it would be necessary to develop a long term plan for upgrading of the system and to undertake works in descending order of BCR.

Rural Arterial Roads

If existing trends in funding and arrangements for allocation remain unchanged, it is likely that road improvements will be undertaken at a rate just about sufficient to maintain existing overall levels of service to the end of the decade. Evaluations conducted in the course of this study indicate that the actual work programs undertaken produce a wide range of BCRs, but that, taken overall, slightly better average returns are likely to be realised from investments in New South Wales, Queensland and Victoria than in the other states. Average BCRs may be misleading, however, because of the different distributions of BCRs in different states (Figure 7.10). The strongly bi-modal distributions in Victoria and Queensland mean that a few large projects with high BCRs tend to raise the average. Some of these projects have characteritics more relevant to urban than rural roads and so should be discounted to some extent. Rigidities in the fund allocation process, both between and within SRA Divisions, have the effect of spreading expenditure over the range of BCRs rather than concentrating it on projects with the highest returns.

The figures in Table 9.1 indicate that over the last ten years there has been a redistribution (albeit slow) of total expenditure on rural arterial roads in the direction of increased economic efficiency as indicated by warranted programs. In spite of this movement, however, it remains a fact that a consistently lower proportion of the total than warranted in economic terms has been spent in New South Wales and an equivalently higher proportion in Western Australia.

Urban Arterial Roads

Examination of expenditure patterns for urban arterial road works over recent years shows that distribution among the states has been quite close to that based on warranted programs developed in previous road studies (CBR 1973 and 1975, and BTE 1979). The expenditure in Tasmania has been relatively high, but this is due largely to the building of the Bowen Bridge.

TABLE 9.1—DISTRIBUTION OF RURAL ARTERIAL ROAD EXPENDITURE AMONG STATES[a], ACTUAL AND WARRANTED, 1972-73 TO 1989-90

(per cent)

State	*Warranted 1973 report*	*Actual 1972-1975*	*Warranted 1975 report*	*Actual 1975-1980*	*Warranted 1979 report*	*Actual*		*Warranted (1985-1990) 1984 report*
						1980	*1981*	
New South Wales	44	32	41	34	44	41	38	45
Victoria	13	16	13	17	13	12	12	12
Queensland	24	22	25	26	24	23	28	27
South Australia	9	8	8	6	10	5	4	5
Western Australia	7	13	9	12	6	14	10	5
Tasmania	2	4	3	4	2	4	7	5
Northern Territory	1	5	1	1	1	1	1	1

a. Arterial roads category including national highways before 1975.

Source: CBR (1973 and 1975). BTE (1979, 1984e and estimates).

Local Roads

Analysis undertaken in the course of previous road studies has demonstrated that economic efficiency considerations would be best served by a smaller proportion of available funds being applied to local roads. This is primarily because the traffic volumes on local roads are much lower than those on arterial roads and this depresses benefit cost ratios.

In the case of rural roads, sealing at traffic volumes of less than 100 vehicles per day generally shows a very low benefit cost ratio, yet this standard is regarded as the basic target in many areas. To put this into perspective it is calculated that a toll of some 30 cents per vehicle per kilometre would have to be charged to recover the cost of sealing a road carrying 50 vehicles per day.

In the case of urban local roads, typical upgradings are in the form of kerbing, guttering, drainage, lighting and traffic controls. The benefits from such upgradings are difficult to quantify and are likely to be under estimated in cost benefit analysis.

In both cases, the decision to spend greater proportions than appear to be justified on strict economic grounds depends on other factors. In many cases it results from consideration of appropriate levels of service rather than economic return. Also of significance is the fact that for local roads, more than half the expenditure is applied to maintenance and rehabilitation of the existing system.

IMPACT OF ALTERNATIVE LEVELS AND PATTERNS OF FUNDING

If the existing trends in funding continue then it is estimated that something in the vicinity of two thousand five hundred million dollars per year (in 1981-82 values) will be spent on roadworks in the period 1985 to 1990. Of that amount roughly 53 per cent will be spent on maintaining the existing system (maintenance, rehabilitation, reconstruction, etc) and 47 per cent on upgrading to match traffic growth and improve levels of service. These proportions vary somewhat across road categories, however, as shown in Table 9.2.

Analysis indicates that this level and distribution of funding will allow significant improvements to the road system by the end of the decade.

It will not be sufficient to complete the full national highway system to the planned standards by 1988, but significant improvements will be visible.

Improvement to the rural arterial road system will be considerably less visible on the basis of existing funding trends due to the high and increasing share going to restoration of existing roads. Overall improvements should just about keep pace with traffic growth so that the general level of service is about maintained. If additional funding becomes available for this category of road, maximum economic return would be obtained by concentrating the additional resources in New South Wales, Queensland and Victoria, and within those states, in areas of greatest traffic volume and growth. Similarly, if funding is reduced then applying the reductions primarily

TABLE 9.2—PROJECTED EXPENDITURE PATTERN BY ROAD CATEGORY, 1985-90

Category	*Expenditure split (per cent)*	
	Restoration	*Improvement*
National highway	40	60
Rural arterial	67	33
Rural local	51	49
Urban arterial	46	54
Urban local	56	44
All categories	53	47

to the other states and areas of low demand would minimise the economic loss.

Maintenance of existing funding levels for rural local roads would permit continued improvements to standards generally. The major problems of rural local roads appear to be area-specific and associated with traffic of a particular type. The difficulty appears to lie not in a lack of funds overall, but in the failure of the allocative process to respond to these localised problems.

In the case of urban local roads a relatively high proportion of funds is expended on maintenance and rehabilitation of existing structures. Continuation of existing trends in funding would permit significant improvement in general levels of service though at a rate rather below that in the case of rural local roads. Many urban local road problems stem from overspill from congested urban arterial roads, and increased attention to arterial flows is a more appropriate way to solve those problems than is upgrading of the affected local roads. Not only would the application of any additional funds to arterial works provide a higher economic return, but it would also provide a more satisfactory solution from a social viewpoint by restoring the quality of the local road.

Urban arterial roads constitute the category of most concern, in that it seems likely that a continuance of existing trends in expenditure will result in a general fall in level of service. Although some 54 per cent of funds are expected to be applied to improvements, the overall amounts appear to be insufficient to keep pace with traffic growth. An increase in funding for arterial roads in Sydney, Melbourne and Brisbane would be expected to generate high BCRs.

Commonwealth Funding

Although the Commonwealth, through its contribution to road funding, plays a substantial part in the development and maintenance of the Australian road system, only in the case of national highway investment does it exercise direct control over the setting of standards, planning of projects, etc. In the case of the ABRD program some degree of control is provided by the requirement for individual projects to be approved by the Commonwealth. This has limited impact in practice, not only because of the practical difficulty of examining hundreds of individual projects, but also because projects can be switched between ABRD and other programs if they do not meet with Commonwealth approval. There is no effective Commonwealth control over funds provided for arterial roads generally, and any such control would require at least quota arrangements in order to limit the opportunity for substitution. To exercise any firm control would require individual project approval, with the attendant practical problems experienced in relation to ABRD, and with certain resistance from the states. Similarly, the various formulae used to allocate Commonwealth funds for local roads within states do not appear to have a consistent basis or to be directed at achieving specific Commonwealth objectives, except in the broadest sense of improving roads generally.

In the light of these factors consideration might be given to improving the degree of achievement of Commonwealth government objectives in respect of arterial roads by concentrating funding on particular road links or major projects. In the case of local roads a greater emphasis on specified needs, as against allocation by formulae, might be explored.

APPENDIX I—ROAD STUDY REGION

The growth in road traffic volume and type is not consistent across nor within states. Changes in population and economic activity can generate regional changes quite different from national or state averages. In the course of the present study a series of regions were identified to provide a structure of analysis and discussion.

Three criteria were used in the selection of regions:

- regions should be based on economic geography factors making the regions internally coherent but different from surrounding regions;
- regions should be a minimum in number consistent with the overview nature of the BTE assessment; and
- regions should be selected in such a way as to allow the use of integral combinations of available data.

Following a review of a number of possible bases the final regions selected were developed from the regions used in the National Travel Survey (BTE 1978).

Location and extent of each region is indicated in Figures I.1 to I.6. The Northern Territory is treated as a single region in this study.

The regions adopted for New South Wales and the Australian Capital Territory are shown in Figure I.1. Region 101 covers the Australian Capital Territory. Region 201 coincides with the Sydney Statistical Division. Region 202 covers the 'Hunter region' as defined in the NSW Government's Hunter Region Transport Improvement Program. Region 203 extends to the north of Region 202 to the Queensland border and includes intensive agriculture, a high population growth and a growing tourist industry. Region 204 extends from the Sydney region south to the Victorian border and includes the National Travel Survey Regions 210 and 213. Region 205 includes the remainder of New South Wales and is characterised by cattle, sheep and wheat growing areas.

The regions adopted for Victoria are shown in Figure I.2. Region 301 includes the Melbourne and East Central Statistical Divisions. Region 302 coincides with the National Travel Survey Region 310 and includes the mining and industrial areas of Gippsland. The northerly region of 303 includes areas of cattle, sheep and fruit production, to the north of Melbourne. Region 304 comprises most of western Victoria including the wheat producing areas. Region 305 around Geelong coincides with National Travel Survey Region 301. Region 306 covers the east Gippsland forestry area.

Figure I.3 show the regions adopted for Queensland. Region 401 consists of the Brisbane and Moreton Statistical Divisions and includes the Sunshine Coast and the Gold Coast. Region 402 is made up of National Travel Survey Regions 404 and 412 and covers the Darling Downs and Wide Bay area. Region 403 comprises all the western areas of Queensland and is characterised by extensive sheep and cattle production. Region 404 extends from the north of Region 402 to Townsville and contains the large black coal deposits. Region 405 covers the tropical north of the State to the Cape York Peninsula.

Figure I.4 indicates the Regions adopted for South Australia. Region 501 covers the Adelaide Statistical Division. Region 502 extends from Adelaide to Port Augusta and coincides with National Travel Survey Regions 503, 504 and 505. Region 503 is comprised of the Murray and south east areas, to the east of Adelaide. Region 504 covers the Eyre peninsula to Ceduna area. Region 505 covers the remaining unincorporated area of South Australia, which includes some sparse agricultural activity, mining and natural gas production.

The Regions adopted for Western Australia are shown in Figure I.5. Region 601 includes the Perth Statistical Division. Region 602 extends around the Perth Region 601 from Hopetown to Geraldtown. Region 603 covers the Pilbara area and extends east to the Northern Territory border. Region 604 covers all the Kimberley area, north of Region 603. Region 605 includes the remainder of the State and includes the gold mining areas around Kalgoorlie.

The regions adopted for Tasmania are shown in Figure I.6. Region 701 is centred on Hobart and includes Huon valley. Region 702 includes Launceston and Flinders Island and coincides with National Travel Survey Region 703. Region 703 covers the remainder of Tasmania.

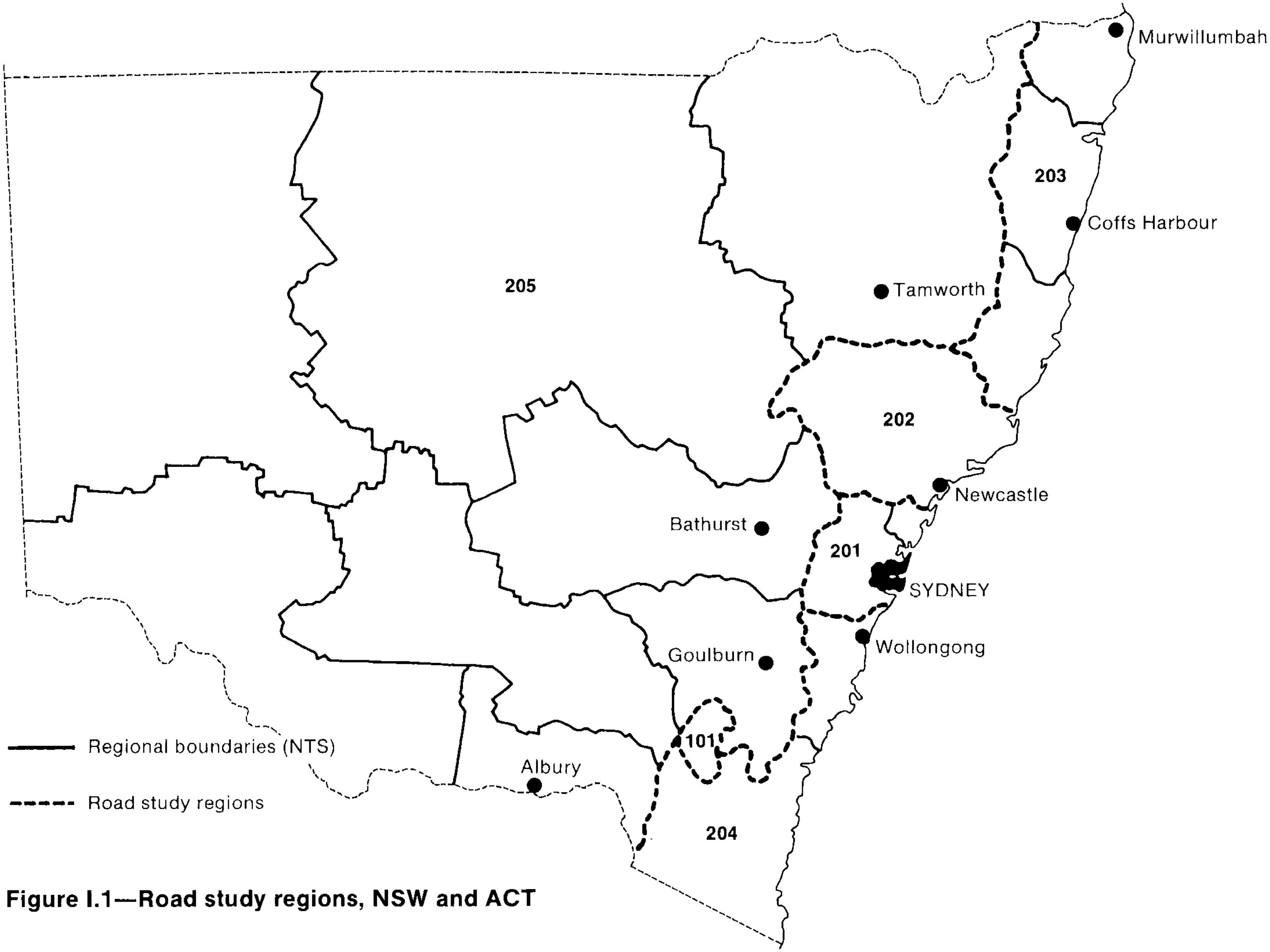


Figure I.1—Road study regions, NSW and ACT

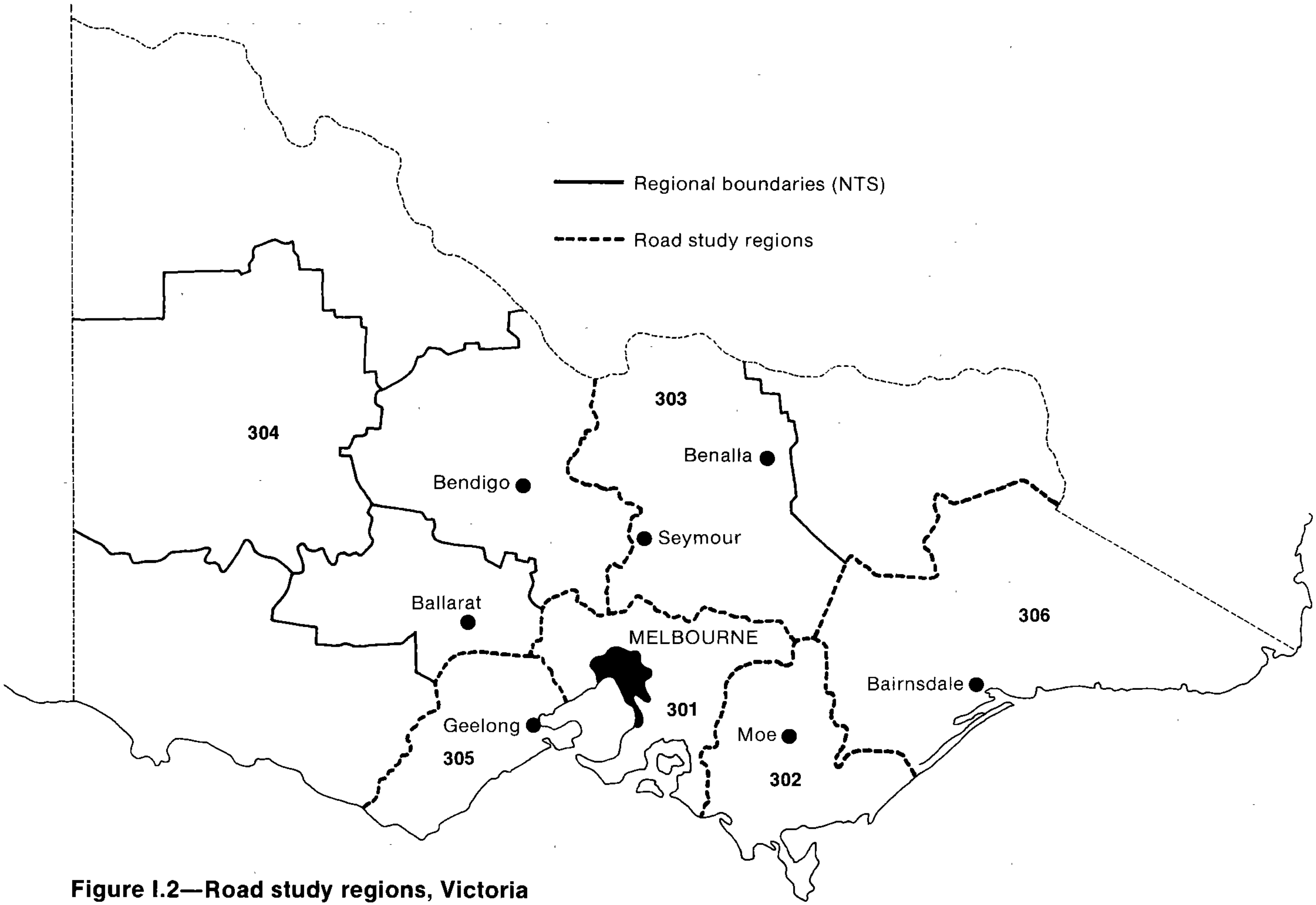


Figure I.2—Road study regions, Victoria

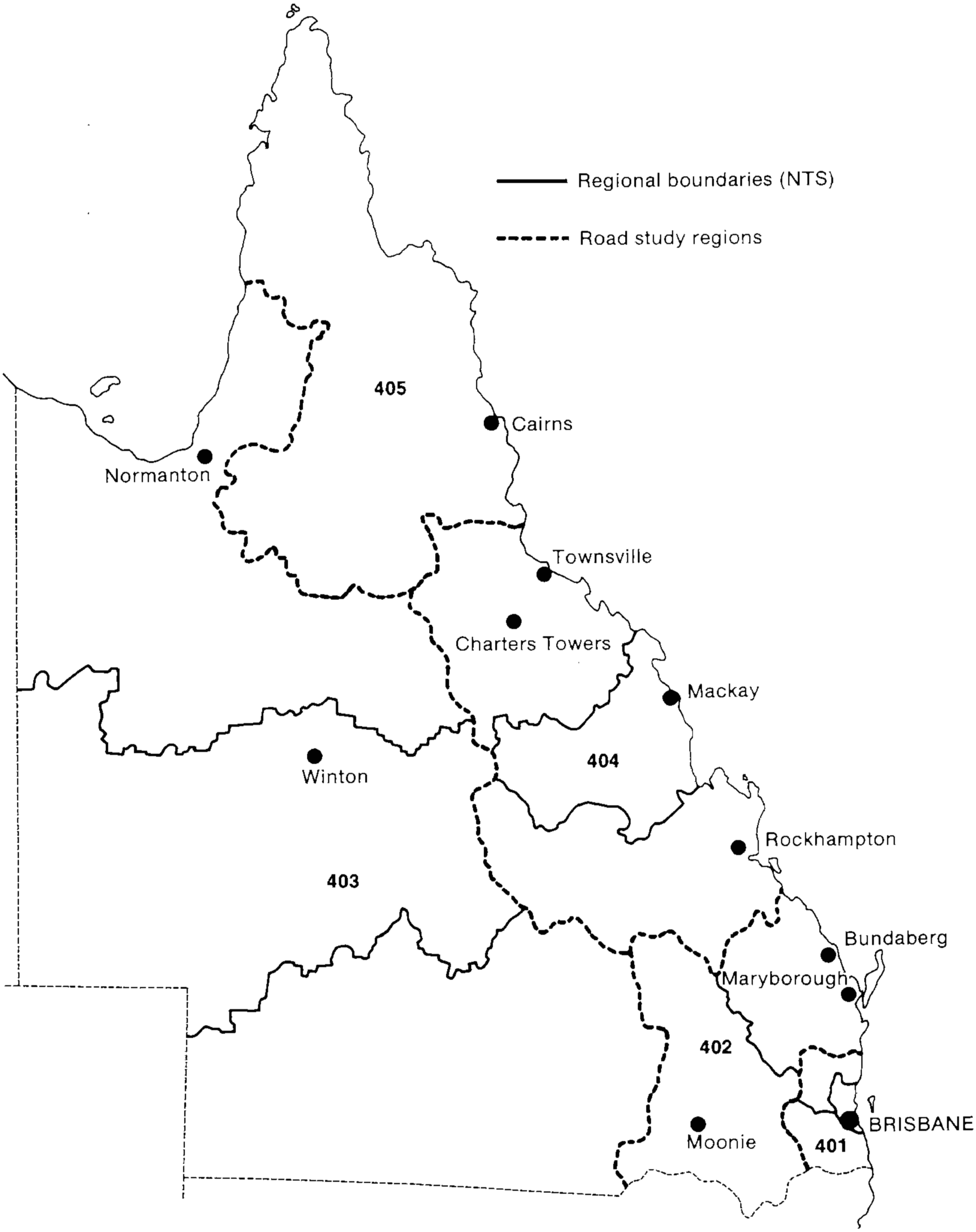


Figure I.3—Road study regions, Queensland

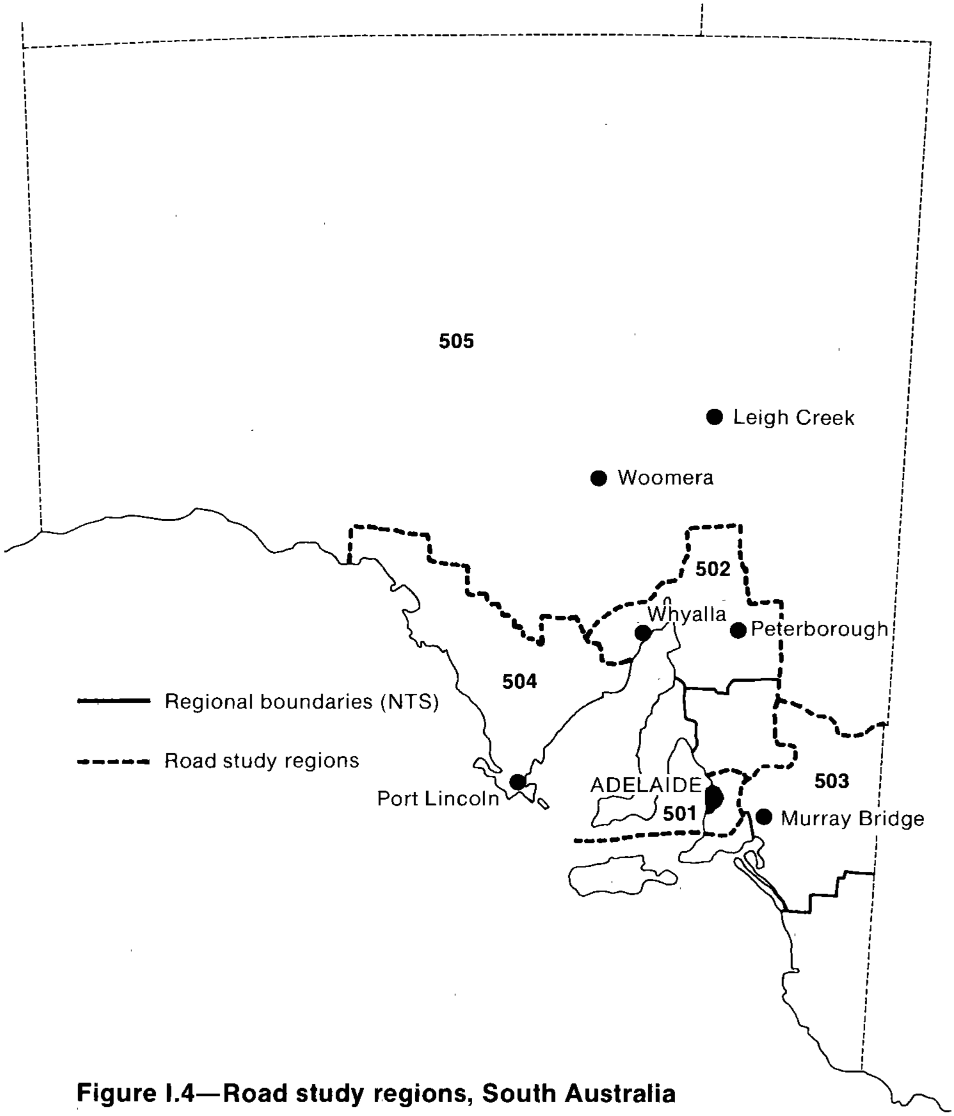


Figure I.4—Road study regions, South Australia

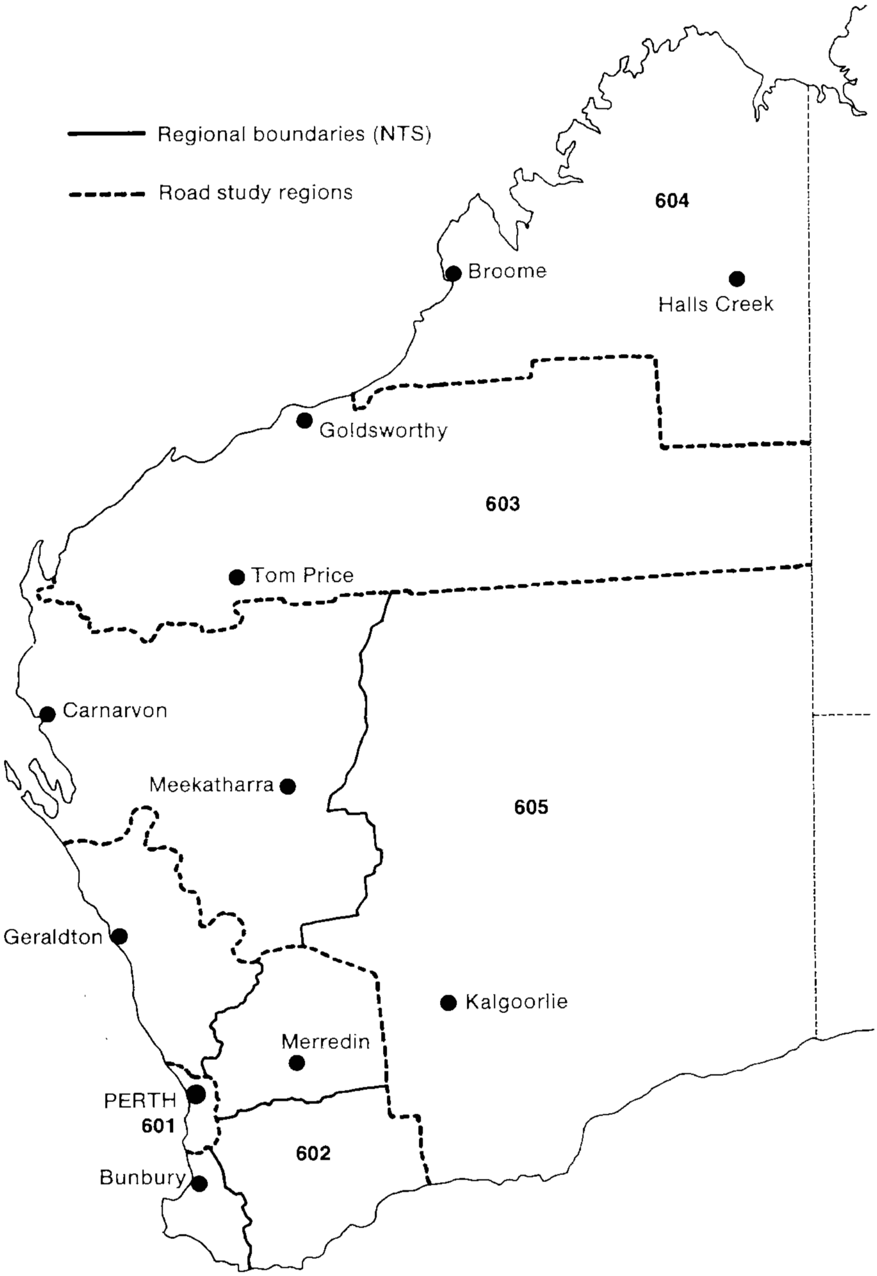


Figure I.5—Road study regions, Western Australia

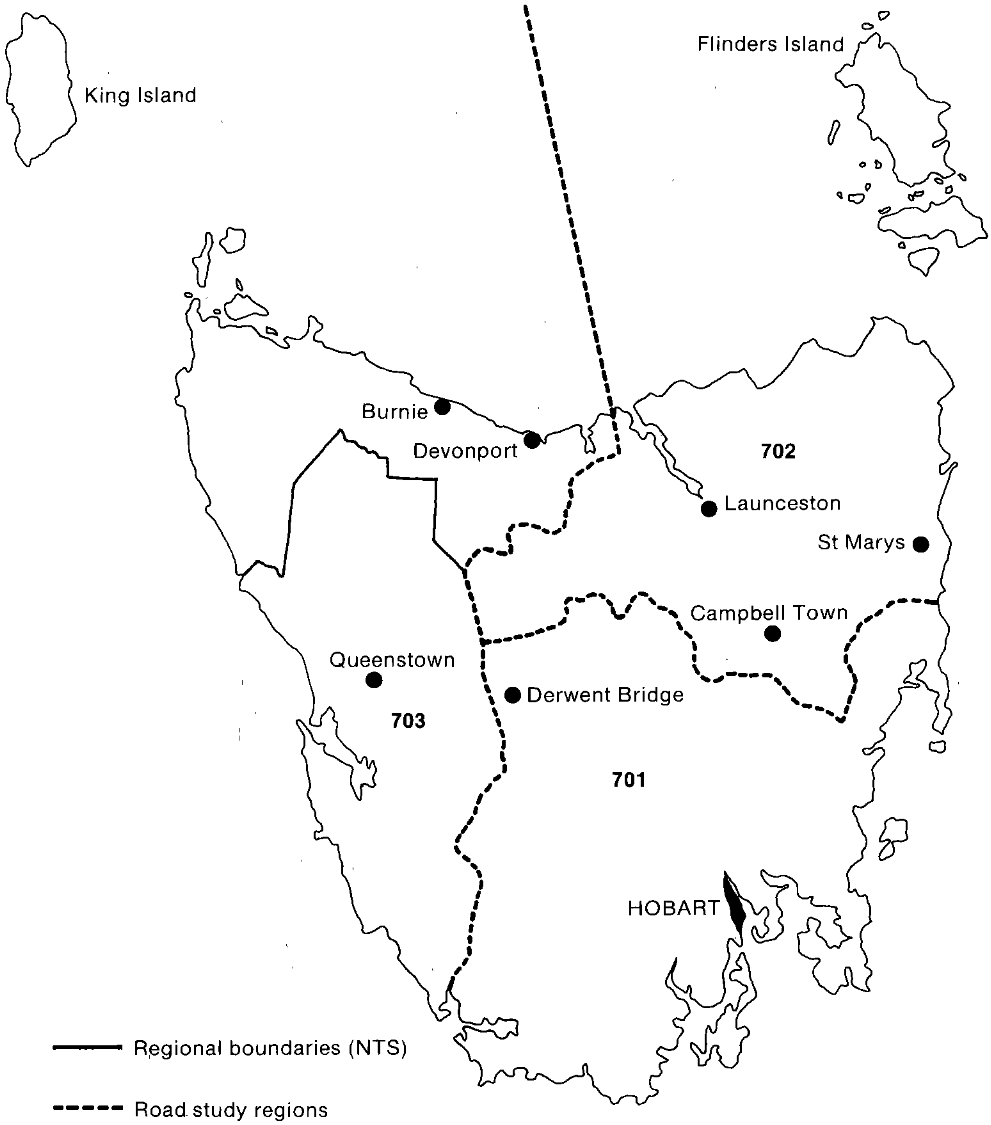


Figure I.6—Road study regions, Tasmania

APPENDIX II—CLASSIFICATION OF LOCAL GOVERNMENT AREAS BY ROAD CHARACTERISTICS

Local government areas in Australia were divided into fifteen groups by means of cluster analysis based mainly on percentage of road sealed, length of road per unit area and population density. The clustering process was multi-dimensional in nature, but broadly speaking the groups at one end of the spectrum have road characteristics typical of sparsely settled rural areas while those at the other end have road characteristics typical of urban areas. This Appendix simply gives a list of the LGAs assigned to each group.

The items (C), (S), (M), (B), (T) and (DC) identify cities, shires, municipalities, boroughs, towns and district councils respectively. The terms Part A and Part B refer to the town and country parts of those LGAs which have both a township and a country component.

Group 1

New South Wales

Balranald (S)
Bland (S)
Bogan (S)
Bourke (S)
Brewarrina (S)
Carrathool (S)
Central Darling (S)
Cobar (S)
Conargo (S)
Coonamble (S)
Lachlan (S)
Merriwa (S)
Wakool (S)
Walcha (S)
Walgett (S)
Wentworth (S)
Yallaroi (S)

Victoria

Donald (S)
Gordon (S)
Kaniva (S)
Kara Kara (S)
Kerkarooc (S)
Kerang (S)
Korong (S)
Lowan (S)
Mildura (S)
Omeo (S)
Stawell (S)
Walpeup (S)
Wimmera (S)
Wycheproof (S)

Queensland

Aramac (S)
Aurukun (S)
Balonne (S)
Banana (S)
Balcaldine (S)
Barcoo (S)
Bauhinia (S)
Belyando (S)
Bendemere (S)
Biggenden (S)
Blackall (S)
Borringa (S)
Boulia (S)
Bulloo (S)
Bungil (S)
Burke (S)
Carpentaria (S)
Chinchilla (S)
Cook (S)
Croydon (S)
Dalrymple (S)
Diamentina (S)
Eidvole (S)
Etheridge (S)
Fitzroy (S) part B
Flinders (S)
Ilfracombe (S)
Inglewood (S)
Isisford (S)
Jericho (S)
Longreach (S)
McKinlay (S)
Millmeran (S)
Miriam Vale (S)
Monto (S)
Mornington (S)
Murilla (S)
Murweh (S)
Nebo (S)
Paroo (S)
Peak Downs (S)
Perry (S)
Quilpie (S)
Richmond (S)
Tambo (S)
Tara (S)
Taroom (S)
Waggamba (S)
Warroo (S)
Winton (S)

South Australia

Balaklava (DC)
Beachport (DC)
Blyth (DC)
Browns Well (DC)
Burra Burra (DC)
Bute (DC)
Carrieton (DC)
Cleve (DC)
Clinton (DC)
Coonalpyn Downs (DC)
Dudley (DC)
Elliston (DC)
Eununda (DC)
Franklin Harbour (DC)
Georgetown (DC)
Hallett (DC)
Hawker (DC)
Jamestown (DC)
Kanyaka-Quorn (DC)
Karoonda-East Murray (DC)
Kimba (DC)
Kingscote (DC)
Lacepede (DC)
Lameroo (DC)
Le Hunte (DC)
Lincoln (DC) Part B
Lucindale (DC)
Mallala (DC)
Morgan (DC)
Mt Pleasant (DC)
Mt Remarkable (DC) Part B
Murat Bay (DC)
Naracoorte (DC)
Orroroo (DC)
Owen (DC)
Peake (DC)
Penola (DC)
Peterborough (DC)
Pinnaroo (DC)
Port Macdonnell (DC)
Port Wakefield (DC)
Redhill (DC)
Ridley (DC)
Riverton (DC)
Robe (DC)
Robertson (DC)
Saddleworth and Auburn (DC)
Snowtown (DC)
Spalding (DC)
Streaky Bay (DC)
Tatiara (DC)
Truro (DC)
Tumby Bay (DC)
Waikerie (DC)
Warooka (DC)

Western Australia

Boyup Brook (S)
Broomehill (S)
Chapman Valley (S)
Coorow (S)
Cranbrook (S)
Cuballing (S)
Cue (S)
Dalwallinu (S)
Dandaragan (S)
Denmark (S)
Dowerin (S)
Dumbleyung (S)
East Pilbara (S)
Esperence (S)
Goowanjerup (S)
Halls Creek (S)
Wellerberrin (S)
Kent (S)
Kojonup (S)
Kundinin (S)
Koorda (S)
Kulin (S)
Lake Grace (S)
Laverton (S)
Leonora (S)
Meekatharra (S)
Menzies (S)
Morawa (S)
Mt Magnet (S)
Mt Marshall (S)
Mukinbudin (S)
Mullewa (S)
Murchison (S)
Nannup (S)
Narembeen (S)
Narrogin (S)
Northhampton (S)
Nungarin (S)
Perenjori (S)
Ravensthorpe (S)
Sandstone (S)
Shark Bay (S)(S)
Tambellup (S)
Tammin (S)
Three Springs (S)
Trayning (S)
Upper Gascoyne (S)
Wandering (S)
West Arthur (S)
West Kimberley (S)
West Pilbara (S)
Westonia (S)
Wickepin (S)
Williams (S)
Wiluna (S)
Woodanilling (S)
Wyalkatchem (S)
Wyndham-East Kimberley (S)
Yalgoo (S)
Yilgarn (S)

Tasmania

Bothwell (S)
Bruny (S)
Esperence (S)
Fingal (S)
Flinders (S)
Portland (S)
Ringarooma (S)
Ross (S)
Strahan (S)

Group 2

New South Wales

Barraba (S)
Bingara (S)
Bombala (S)
Boorowa (S)
Cabonne (S) Part B
Coolah (S)
Coolamon (S)
Cooma-Monaro (S)
Coonabarabran (S)
Copmanhurst (S)
Corowa (S)
Crookwell (S)
Dumaresq (S)
Evans (S) part B
Fornes (S)
Gilgandra (S)
Gloucester (S)
Gundagai (S)
Gunnedah (S)
Gunning (S)
Guyra (S)
Hay (S)
Hume (S)
Inverell (S) part A
Jerilderia (S)
Kyogle (S)
Lockhart (S)
Manilla (S)
Moree Plains (S)
Mudgee (S)
Mulwaree (S)
Murray (S)
Murrumbidgee (S)
Murrurundi (S)
Narrabri (S)
Narrabri (S)
Narrandera (S)
Narromine (S)
Nundle (S)
Nymboida (S)
Oberon (S)
Parry (S)
Parkes (S)
Quirindi (S)
Richmond River (S)
Scone (S)
Severn (S)
Tallaganda (S)
Temora (S)
Tenterfield (S)
Tumbarumba (S)
Ulmarra (S)
Uralla (S)
Urana (S)
Warren (S)
Weddin (S)
Wellington (S)
Windouran (S)
Yarrowlumla (S)
Yass (S)

Victoria

Alberton (S)
Arapiles (S)
Ararat (S)
Avoca (S)
Avon (S)
Bairnsdale (S)
Bet Bet (S)
Birchip (S)
Charlton (S)
Dimboola (S)
Dunmunkle (S)
East Loddon (S)
Euroa (S)
Glenelg (S)
Goulburn (S)
Kowree (S)
Leigh (S)
McIvor (S)
Mansfield (S)
Narracan (S)
Nathalia (S)
Orbost (S)
Otway (S)
Oxley (S)
Rochester (S)
Swan Hill (S)
Tambo (S)
Tungamah (S)
Upper Murray (S)
Violet Town (S)
Wangaratta (S)
Waranga (S)
Warracknabeal (S)
Yea (S)

Queensland

Bowen (S)
Broadsound (S)
Calliope (S)
Cloncurry (S)
Crows Nest (S)
Duaringa (S)
Emerald (S)
Gayndah (S)
Glengallan (S)
Herberton (S)
Kilcoy (S)
Kilkivan (S)
Kingaroy (S)
Kilan (S)
Livingstone (S)
Mareeba (S)
Mundubbera (S)
Nanango (S)
Rosalie (S)
Rosenthan (S)
Tiaro (S)
Wambo (S)
Wondai (S)
Woocoo (S)

South Australia

Central Yorke Peninsula (DC)
Clare (DC)
Crystal Brook (DC)
Gladstone (DC)
Kapunda (DC)
Laura (DC)
Loxton (DC)
Mannum (DC)
Meningi (DC)
Minlaton (DC)
Paringa (DC)
Pirie (DC) part B
Port Broughton (DC)
Strathalbyn (DC)
Waikerie (DC)
Yankalilla (DC)
Yorketown (DC)

Western Australia

Albany (S)
Augusta-Margaret River (S)
Beverley (S)
Boddington (S)
Boulder (S)
Bridgetown-Greenbush (S)
Brookton (S)
Broome (S)
Bruce Rock (S)
Carnamah (S)
Carnarvon (S)
Chittering (S)
Coolgardie (S)
Corrogin (S)
Cunderdin (S)
Donnybrook-Balingup (S)
Dundas (S)
Gingin (S)
Goomalling (S)
Greenough (S)
Irwin (S)
Katanning (S)
Manjimup (S)
Merredin (S)
Mingenew (S)
Moora (S)
Pingelly (S)
Plantagenet (S)
Quairading (S)
Toodyay (S)
Victoria Plains (S)
Wagin (S)
Wongan Ballidu (S)
York (S)

Tasmania

Circular Head (M)
Deloraine (M)
Galmorgan (M)
Green Ponds (M)
Hamilton (M)
Huon (M)
King Island (M)
Oatlands (M)
Richmond (M)
Scottsdale (M)
Spring Bay (M)
Tasman (M)

Group 3

New South Wales

Berrigan (S)
Cowra (S)
Culcairn (S)
Great Lakes (S)
Leeton (S)
Nambucca (S)
Wade (S)
Wagga Wagga (S)

Victoria

Bass (S)
Buln Buln (S)
Bungaree (S) part B
Buninyong (S)
Chiltern (S)
Cobram (S)
Daylesford & Gleniyon (S)
Deakin (S)
Grenville (S) part B
Heytesbury (S)
Huntly (S) part B
Kilmore (S)
Korumburra (S)
Loxton (S)
Maldon (S)
Marong (S)
Mirboo (S)
Newham & Woodend (S)
Newstead (S)
Numurkah (S)
Pakenham (S) part B
Ripon (S)
Rodney (S)
Romsey (S)
Rutherglen (S)
Shepparton (S) part A
South Gippsland (S)
Talbot & Clunes (S)
Tullaroop (S)
Woorayl (S)
Warrawonga (S)

Queensland

Allora (S)
Boonah (S)
Camboova (S)
Clifton (S)
Laidley (S)
Murgon (S)
Noosa (S) part B

South Australia

Angaston (DC)
Barmera (DC)
Barossa (DC)
Gumeracha (DC) Part B
Kadina (DC)
Light (DC) Part B
Meadows (DC) Part B
Millicent (DC)
Mt Barker (DC)
Mt Gambier (DC) Part A
Murray Bridge (DC) Pt A
Port Elliot & Goolwa (DC)
Willunga (DC) Part B

Tasmania

Kentish (M)
Latrobe (M) Part B
Lilydale (M) Part A
Penguin (M) part A
Port Cygnet (M)
Sorrell (M) Part B
Wynyard (M) Part B

Group 4

New South Wales

Bega Valley (S)
Belligen (S)
Blayney (S) Part B
Cessnock Greater (C) Part B
Cootamundra (S)
Dubbo (C)
Dungg (C)
Eurobodalla (S)
Harden (S)
Hastings (M)
Hawkesbury (S)
Holbrook (S)
Junee (S)
Kempsey (S)
Lismore (C)
Lithgow Greater (C)
Maclean
Muswellbrook
Rylstone (S)
Shoalhaven (C)
Singleton
Snowy River
Taree, Greater
Tumut
Wingecarribee (S)
Wollondilly (S)
Young (S)

Victoria

Alexandra (S)
Bacchus Marsh (S)
Ballan (S)
Bannockburn (S) Part A
Berrabool (S) Part B
Beechworth (S)
Belfast (S)
Benalla (C)
Bright (S)
Broadbent (S)
Cohuna (S)
Colac (S)
Dundas (S)
Hampton (S)
Healesville (S) Part A
Kyneton (S)
Maffra (S)
Metcalfe (S)
Minhamite (S)
Mortlake (S)
Mt Rouse (S)
Myrtleford (S)
Portland (S)
Pyalong (S)
Rosedale (S)
Seymour (S)
Strathfieldaye (S)
Tallangatta (S)
Upper Yarra (S)
Wannon (S)
Warrambool (S)
Winchelsea (S)
Yackandandah (S)

Queensland

Atherton (S)
Ayr (S)
Beaudesert (S) Part A
Caboolture (S) Part B
Cardwell (S)
Douglas (S)
Eacham (S)
Esk (S)
Gatton (S)
Gooburrum (S) Part B
Hervey Bay (T)
Hinchinbrook (S)
Isis (S)
Johnstone (S)
Jonduryan (S)
Lanborough (S) Part B
Mirani (S)
Moreton (S) Part B
Mt Isa (C)
Mt Morgan (S)
Pioneer (S) Part B
Pittsworth (S)
Proserpine (S)
Sarina (S)
Stanthorpe (S)
Thurungowa (S) Part A
Widgee (S)
Woongarra (S) Part B

South Australia

Victor Harbor (DC)

Western Australia

Busselton (S)
Capel (S)
Collie (S)
Dardanup (S)
Exmouth (S)
Harvey (S)
Murray (S)
Northam (S)
Port Hedland (S)
Roebourne (S)
Serpentine-Jarrahdale (S)
Waroona (S)

Tasmania

Beaconfield (M) Part A
Brighton (M) Part A
Campbell Town (M)
Evandale (M) Part A
George Town (M)
Gormanston (M)
Longford (M) Part A
New Norfolk (M) Part B
Ulverstone (M) Part B
Waratah (M)
Westbury (M) Part A
Zeehan (M)

Group 5

New South Wales

Ballina (S)
Blue Mountains (C)
Byron (S)
Coffs Harbour (S)
Deniliquin (M)
Glen Innes (M)
Grafton (C)
Kiama (M)
Orange (C)
Tweed (S) Part B
Wyong (S)

Victoria

Ballarat (S) Part B
Bellarine
Castlemaine (C)
Cranbourne (S) Part A
Euchuca (C)
Eltham (S)
Flinders (S)
Gisborne (S)
Hastings (S)
Lillydale (S)
Maryborough (C)
Melton (S)
Mornington (S)
Morwell (S) Part B
Phillip Island (S)
St Arnaud (T)
Sherbrooke (S)
Stawell (T)
Warragul (S)
Wonthaggi (b)

Queensland

Dalby (T)
Maroochy (S) Part B
Maryborough (C)
Redland (S)
Roma (T)

South Australia

Berri (DC)
East Torrens (DC)
Moonta (DC)
Munno Para (DC)
Naracoorte (M)
Onkaparinga (DC) Part B
Renmark (M)
Stirling (DC)
Tanunda (DC)

Western Australia

Mundaring (S)

Tasmania

Burnie (M) Part A
Kingsborough (M) Part B
St Leonards (M) Part A

Group 6

New South Wales

Bathurst (C)
Camden (M)
Casino (M)
Gosford (C)
Hornsby (S)
Lake Macquarie
Maitland
Port Stevens

Victoria

Bulla (S)
Camperdown (T)
Corio (S) Part B
Kerang (B)
Koriot (B)
Port Fairy (B)
Portland (T)
South Barwon (C) Part B
Werribee (S)
Whittlesea (S)
Wodonga (C)

Queensland

Albert (S) Part B
Charters Towers (C)
Goondiwindi (T)
Mulgrave (S) Part B
Pine Rivers (S) Part B

South Australia

Whyalla (C) Part B

Western Australia

Armidale (T)
Kalamunda (S)
Kwinana (T)
Mandurah (S)
Rockingham (S)
Swan (S)

Tasmania

Queenstown (M)

Group 7

Queensland

Torres (S)

Group 8

New South Wales

Armidale (C)
Queanbeyan (C)

Victoria

Ararat (C)
Bairnsdale (T)
Ballarat (C)
Benalla (C)
Bendigo (C)
Colac (C)
Doncaster & Templestowe (C)
Eaglehawk (B)
Hamilton (C)
Horsham (C)
Port Melbourne (C)
Queenscliffe (B)
Sale (C)
Sebastopol (B)
Shepparton (C)
Swan Hill (C)
Wangaratta (C)
Warrnambool (C)

Queensland

Gympie (C)
Redcliffe (C)
Warwick (C)

South Australia

Gawler (C)
Jamestown (M)
Peterborough (M)
Port Augusta (C) Part A
Port Lincoln (C) Part A
Port Pirie (C)
Wallaroo (M)

Western Australia

Canning (C)
Geraldton (T)
Narrogin (T)
Northam (T)

Group 9

New South Wales

Albury (C)
Baulkham Hills (S)
Blacktown (C)
Broken Hill (C)
Campbelltown (C)
Goulburn (C)
Liverpool (C)
Newcastle (C)
Penrith (C)
Shellharbour (M)
Sutherland (S)
Tamworth (C)
Warringah (S)
Wollongong (C)

Victoria

Altona (C)
Berwick (C)
Diamond Valley (S)
Keilor (C)
Knox (C)
Kyabram (T)
Mildura (C)
Moe (C)
Springvale (C)
Sunshine (C)
Traralgon (C)

Queensland

Brisbane City
Bundaberg (C)
Cairns (C)
Gladstone (C)
Ipswich (C)
Logan (S)
Toowoomba (C)
Townsville (C)
Rockhampton

South Australia

Noarlunga (C)
Salisbury (C) Part A
Tea Tree Gully (C)

Western Australia

Albany (T)
Belmont (C)
Bunbury (C)
Cockburn (C)
Gosnells (C)
Kalgoorlie (T)
Wanneroo (C)

Tasmania

Clarence (M)
Devon Port (M)
Glenorchy (C)
Hobart (C)

Group 10

New South Wales

Ku-Ring-Gai (M)

Victoria

Croydon (R)
Geelong (C)

South Australia

Adelaide (C)
Campbelltown (C)
Elizabeth (C)
Mt Gambier (C)
Port Adelaide (C)

Western Australia

Bassendean (T)
Fremantle (C)
Melville (C)
Nedlands (C)

Tasmania

Launceston (C)

Group 11

New South Wales

Auburn (M)
Bankstown (C)
Botany (M)
Fairfield (C)
Hunters Hill (M)
Kogarah (M)
Manly (M)
Parramatta (C)
Ringwood (C)
Williamstown (C)
Preston (C)

Queensland

Gold Coast (C)
Mackay (C)

South Australia

Enfield (C) Part A
Henley & Grange (C)
Mitcham (C)

Western Australia

Stirling (C)

Group 12

Victoria

Brunswick (C)
Collingwood (C)
Fitzroy (C)
Richmond (C)

South Australia

Kensington & Norwood (C)

Group 13

New South Wales

Concord (M)

Victoria

Box Hill (C)
Brighton (C)
Camberwell (C)
Coburg (C)
Kew (C)
Malvern (C)
Melbourne (C)
Mordialloc (C)
Sandringham (C)
South Melbourne (C)
Waverley (C)

South Australia

Brighton (C)
Burnside (C)
Hindmarsh (C)
Marion (C)
Payneham (C)
Prospect (C)
St Peters (C)
Thebarton (M)
Unley (C)
Walkerville (M)
West Torrens (C)
Woodville (C)

Western Australia

Claremont (T)
Cottesloe (T)
East Fremantle (T)
Mosman Park (T)
Peppermint Grove (S)
Perth (C)
South Perth (C)
Subiaco (C)

Group 14

New South Wales

Ashfield (M)
Burwood (M)
Canterbury (M)
Drummoyne (M)
Holroyd (M)
Hurstville (M)
Lane Cove (M)
Leichhardt (M)
Mosman (M)
North Sydney (M)
South Sydney (M)
Sydney (C)
Woollahra (M)

Victoria

Caulfield (C)
Heidelberg
Moorabbin (C)
Hawthorn Northcote (C)
Nunawading (C)
Prahran (C)
Chelsea (C)
Essendon (C)

South Australia

Glenelg (C)

Western Australia

Bayswater (S)

Group 15

New South Wales

Marrickville (M)
Randwick (M)
Waverley (M)

Victoria

St Kilda (C)

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