Darwin and Northern Territory Freight Transport Study

Report

The difficulties associated with defining and funding an acceptable transport system to serve the needs of Australians living in the Centre and North of the continent have proved a continuing area of concern to successive Commonwealth and State Governments. In this study an attempt has been made to define a broad network of supply links to the major population centres of the Northern Territory and identify priorities for investment which would provide a satisfactory level of service at minimum total cost. The basic criterion of acceptability was taken as the provision of all weather links between the Northern Territory centres and their major sources of supply.

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DARWIN AND NORTHERN TERRITORY FREIGHT TRANSPORT STUDY

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FOREWORD

The difficulties associated with defining and funding an acceptable transport system to serve the needs of Australians living in the Centre and North of the continent have proved a continuing area of concern to successive Commonwealth and State Governments. In this study an attempt has been made to define a broad network of supply links to the major population centres of the Northern Territory and identify priorities for investment which would provide a satisfactory level of service at minimum total cost. The basic criterion of acceptability was taken as the provision of all weather links between the Northern Territory centres and their major sources of supply.

In undertaking the analysis, the study team developed a transport corridor concept involving the comparison of cost and performance of different modes within each corridor and the combination of corridors to provide a total system. This represents a new development in transport planning in Australia and one which promises much for future application.

The study team comprised Dr K. Tronson and Ms A. Currie under the overall direction of Mr R. Wyers. Mrs A. Walker was involved in the development of the study when she was an officer of the Bureau of Transport Economics.

The team is indebted to a large number of people, both in the Northern Territory and outside it, for the provision of information and for co-operation in the conduct of the study. In this regard special mention must be made of the assistance provided by Mr J. Cameron and Mr L. Penhall, of the Department of the Northern Territory, in arranging contacts with the people of the Northern Territory.

(G. K. R. REID)
Acting Director

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SUMMARY

The primary purpose of the study was to investigate and report on the investment necessary to maintain an efficient freight transport system for Darwin and the Northern Territory, taking all modes into consideration. In order to do this it was necessary to estimate future freight flows; examine the capabilities, economics and scope for development of existing transport services and infrastructure; and assess the impact of different levels of investment. Particular emphasis was placed on discussions with users and operators of transport services in the Northern Territory. The discussions were aimed at ascertaining the rationale behind the user's choice of mode and source of supply, and identifying problem areas in the transport system.

The transport task was defined as consisting of two elements:

- the freight volume;
- the level of service to be provided.

The freight transport volume for the next 20 years was forecast on the basis of expected population growth in the Northern Territory.

Discussions with Northern Territory residents indicated that the primary factors contributing to a satisfactory level of service were:

- reliability - the service should not be subject to long or frequent interruption;
- frequency - the interval between order and delivery should be minimised;
- source - the service should provide access to a source capable of supplying an adequate range of goods on a regular basis at competitive prices;
- price - the charge for the service should not place the Northern Territory community at an unreasonable disadvantage with respect to the rest of Australia.

The existing transport services to the N.T. operate through three corridors, the western, central and eastern. For each corridor a range of options was developed which would enable the corridor to meet the projected transport task. The options included suggestions made by residents of the N.T., developments currently under consideration by various transport authorities and options generated by the study team. For each corridor the preferred option was that which met the projected transport task at minimum resource cost.

The preferred transport systems for each corridor were combined to define a total transport system, and this was refined to account for the interactions between modes, redundancy of services and the ability of sources within each corridor to supply an adequate range of commodities. This process ensured that the final transport system was capable of meeting the freight transport task at minimum overall cost.

The study examined the relative economics of the three major transport modes: sea, rail and road. The capital and operating costs of road and rail were compared to determine the minimum volume at which rail becomes the least cost mode. At the freight traffic volumes predicted for the Northern Territory, the construction and operation of a road freight transport network was found to be superior to a rail based system.

A comparison of shipping and road transport costs shows that the east coast shipping service is at a cost disadvantage with respect to its road transport competitors. The disadvantage arises from the high cost of ship replacement and the difficulty of matching capacity to demand. Sea transport is also at a service disadvantage, since at low volumes it can only provide a low frequency service. A reliance on sea transport as a major carrier would entail extensive improvement of the general cargo facilities at the Port of Darwin.

The study examined the individual corridors in turn. The western corridor from Perth cannot be accepted as the major supply link because, irrespective of the economics of the West Australian State Shipping Service, a large percentage of relevant commodities originate in the eastern states.

The central corridor is the more important of the remaining two corridors for two main reasons:

(a) It is the shortest route to the N.T. population centres from the major sources Adelaide and Melbourne. For Sydney it is only marginally longer than the eastern corridor via Brisbane.

(b) Irrespective of the transport system chosen, part of the central corridor, the Darwin-Alice Springs sector of the Stuart Highway, must be upgraded to provide an efficient distribution system for the centre of the continent.

Within the central corridor the preferred option is to upgrade the entire Stuart Highway. The northern section from Alice Springs to Darwin can be made all-weather at a cost of between \$27m and \$58m depending on the standard adopted.

On the Port Augusta-Alice Springs link, the preferred option is to halt construction of the Tarcoola standard gauge railway, and upgrade the Stuart Highway to National Highway Standard. The capital cost of upgrading the highway from Port Augusta to Alice Springs is \$50m, whereas completion of the rail link would cost \$89m. Moreover the present rail service operates at a considerable deficit, and while the proposed standard gauge service may cover direct operating costs, this cannot be guaranteed.

The improvement of the entire Stuart Highway would provide an efficient all-weather transport system for the N.T. at a capital cost of \$77m to \$108m. The road could be all-weather from Darwin to Alice Springs by 1980 and the remainder all-weather by 1982 to 1983. Improvements to the Stuart Highway would provide benefits to other than freight service users. In particular the tourist industry and N.T. residents would benefit from the increased mobility provided by an all-weather road.

If, however, the decision is made to complete the rail link then the question of upgrading the southern part of the Stuart Highway must be reconsidered. The railway would have sufficient capacity to carry all the freight generated in the corridor, and so any decision to spend additional funds on the southern road would have to be justified on grounds other than the benefits for freight traffic, i.e. private travel, tourism, etc. On the basis of freight movements, once the railway is completed and the road from Alice Springs to Darwin improved, any additional capital available should be directed to road upgrading in the eastern corridor. It is instructive to note that the capital still needed to complete the Tarcoola-Alice Springs railway would be sufficient to undertake full upgrading of the roads in both the central and eastern corridors including significant upgrading works north of Alice Springs. This would be of much greater all round benefit to the Northern Territory than completion of the railway.

The road system for the eastern corridor can be upgraded at slightly less capital cost than the central corridor, but the capital advantage is lost in the higher transport costs arising from the longer distances between sources and destinations, in particular Alice Springs.

In summary, the study findings are:

- priority for investment should be given to the central corridor linking Adelaide, Alice Springs and Darwin;
- the least cost option would be to cease construction of the Tarcoola-Alice Springs Railway and put the available funds into upgrading and sealing the Stuart Highway;
- second priority should be given to making the Landsborough and Barkly Highways all-weather links;
- there is no economic justification for subsidising shipping services from either the east or west coasts to Darwin.

CHAPTER 1 - INTRODUCTION

In 1975, the Minister for Transport, the Honourable P.J. Nixon, directed the Bureau of Transport Economics to investigate and report on the freight transport requirements of the Northern Territory. The terms of reference were:

(a) Estimate the future freight requirements for Darwin and the Northern Territory.
(b) Examine the economics of the various transport modes in meeting this requirement for Darwin and the Northern Territory.
(c) Examine the existing transport services to Darwin and report on the scope for changes that would improve financially or operationally the services provided.
(d) Investigate the scope for changes in technology and or regulations in reducing the cost of transport services to the study area.
(e) Investigate and report on the investment necessary to maintain an efficient freight transport system for Darwin and the Northern Territory taking all modes into consideration.

The study arose from the need to co-ordinate decisions on various transport investment proposals for the Northern Territory. The most immediate problem concerned the coastal freighter, Darwin Trader, which operates from the east coast to Darwin. This service has run at a loss since its inception in 1970 and is under continual review by its operator, the Australian National Line (ANL). Any change in the status of the ANL service would have an impact on the Perth to Darwin shipping service which is operated by the Western Australian State Shipping Service (WASS) as an extension of its Perth to north-west W.A. service. This service also operates at a loss.

The Port of Darwin has been the subject of several studies all of which have recommended construction of new facilities to expedite the handling of general freight. However these recommendations are critically dependent on the quantity of freight moving through the port, which is in turn dependent on the state of coastal shipping services.

Although the road investment program within the N.T. for the next 3 years is defined by the Second Three-Year Program for the Improvement and Maintenance of the Stuart and Barkly Highways, two National Highway Corridor Studies have recently been undertaken.

These consider long range investment proposals for the section of the Stuart Highway between Port Augusta and Alice Springs,[(1)] and the Barkly Highway[(2)]. The latter report is not yet complete but the first report recommends extensive investment to improve the Stuart Highway to National Highway Standard (NHS). However, major investment in the Adelaide-Alice Springs corridor is already being undertaken in the form of a standard gauge railway between Tarcoola and Alice Springs.

The Australian National Railways (ANR) expects that revenues earned by services on the new line will be sufficient to cover operating costs, in contrast to the present narrow gauge service which operates at a considerable deficit.

The other N.T. railway, North Australia Railway (NAR) is a narrow gauge line between Darwin and Larrimah. NAR ceased operations in 1976 after the closure of the Frances Creek iron ore mine, which provided most of its traffic.

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(1) Steering Committee from Commonwealth Department of Transport, S.A. Highways Department, Commonwealth Bureau of Roads, Report on the National Highway linking Adelaide and Darwin, Port Augusta to Northern Territory Border, 1976.

(2) Northern Territory National Highway Corridor Study Team, Commonwealth Department of Northern Territory, Commonwealth Department of Construction, Commonwealth Bureau of Roads, Report on the National Highway linking Brisbane and Darwin in the Region of the Barkly Tableland, to be published.

Traffic freight flows for the N.T. are at present fairly evenly distributed between the three modes, sea, rail and road. However, the implementation of any one of the proposed capital improvements, or any alteration to the shipping services, could radically alter modal split and origin-destination patterns.

Any alterations to the transport infrastructure must therefore be considered in the context of the entire N.T. transport system, as the implementation of one project may completely change the economic status of other projects. The traffic volumes concerned are small, and there is a danger that unco-ordinated decisions may lead to unproductive duplication of services, while other projects are delayed through lack of funds.

This report considers the N.T. interstate transport network as an integrated whole, and the interdependence of the investment proposals is evaluated.

The report concentrates on general freight and does not discuss bulk freight requirements in detail. The majority of bulk freight is carried in specialised ships and so can be considered separately from general freight. The terms of reference do not encompass either passenger or livestock traffic, and so these issues are not discussed at length in this report. However it must be borne in mind that any investment in land based transport modes will benefit passenger and livestock traffic. Tourism is an increasingly important industry in the N.T. and, for that reason alone, the effects of any road or rail investment on the transport of passengers must be carefully considered.

The methodology of this report is discussed in Chapter 2, and an outline of the development of transport services to the N.T. is provided in Chapter 3. Estimates of freight movements into the Territory during the last 6 years are provided in Chapter 4, both as totals and on a per capita basis. Forecasts of the population and the freight requirements of the Territory are presented in Chapter 5. The resource costs of the various transport modes serving the Territory are given in Chapter 6.

The transport needs and possible future transport systems for the Territory are discussed in Chapter 7. The effects of regulation and technical innovation on transport services in the N.T. are considered in Chapter 8. Chapter 9 summarises the major conclusions reached in the study.

CHAPTER 2 - METHODOLOGY

INTRODUCTION

The aim of this report is to provide a background against which political and commercial decisions can be made to ensure the efficient operation of the transport system. The study has been undertaken as a cost minimisation analysis and can be broken into the following three basic steps:

- the definition of the freight transport needs of Darwin and the N.T.;
- an examination of the existing transport system in the light of these transport needs;
- the definition of proposed or possible changes to the existing transport system, and an examination of alternative future transport systems.

The reasons for adopting the above approach are outlined in the remainder of this chapter which provides details of the methodology employed.

FREIGHT TRANSPORT NEEDS

The freight transport needs can be separated into two elements:

- the quantity to be moved;
- the level of service to be provided.

The quantity of freight coming into the Territory is a function of the following variables:

- the elasticity of demand for transport of goods in aggregate;
- the quantity of goods consumed per person;
- the total population;
- the quantity of goods imported to support each unit of local production;

- productivity expressed on a per capita basis;
- the percentage of goods produced locally which are exported.

An estimate of -0.07 for the elasticity of demand for transport of goods in aggregate has been made by Fitzpatrick and Taplin[(1)]. This estimate suggests a decrease in demand of 0.7% for an increase of 10% in the average transport charge. Changes of this magnitude (less than 1%) are overshadowed by changes in the total population during the study period.

Changes in the other variables listed are similarly overshadowed by the population increase. Further, there is little or no information available on the allocation of commodities between personal consumption and inputs to local production, or local productivity. However, as noted in Chapter 4, estimates of per capita consumption for the N.T. show reasonable stability, and rather than undertake a complex analysis on inadequate data, it was decided to use prediction equations of the following form:

$$T_i = a_i . p$$

T_i = annual input to N.T. for commodity i (tonnes)
a_i = annual consumption per capita for commodity i (tonnes)
p = population of the N.T.

Estimates for a_i are provided in Chapter 4, while the details of the data preparation and the actual calculations are provided in Annexes A and B respectively.

The second component of the definition of freight transport needs, a statement of the level of service to be provided, is not usually regarded as an exogenous variable in transport studies, but in this case it must be considered as such, for a number of reasons.

(1) M.D. Fitzpatrick and J.H.E. Taplin, 'A Model to Estimate the Price Elasticity of Demand for Transport of Goods by Road', Proceedings 6th ARRB Conference, Vol 6, Part 2, pp. 252-265 (Melbourne, 1973).

Improvements in the level of service of a freight transport system will generate benefits in many areas. Some benefits, such as savings in inventory costs, are quantifiable, but others are not. These less quantifiable benefits include the perceived consumer benefit and the stimulus to industry generated by the improved service, and in the case of road or possibly rail improvements, benefits to residents accruing from increased mobility and increases in the tourist traffic. As level of service changes are small in most studies, these benefits are usually ignored, and level of service incorporated simply as a variable affecting modal split and generating inventory savings. This simplification allows a benefit-cost analysis to be undertaken, and a solution can be found which specifies an optimal level of service.

In the present study this approach was infeasible. The level of service to the N.T. can be changed greatly by relatively small investments in the transport infrastructure, and non-quantifiable benefits arising from these changes cannot be ignored. The level of service was therefore treated as an exogenous variable in this study, and no attempt was made to perform a benefit-cost analysis in the conventional manner. Instead, for a given level of service, a least cost solution was sought. The level of service expected by the N.T. community is discussed in Chapter 7.

EXISTING TRANSPORT SYSTEM

For the purposes of this study, the freight transport system supplying the N.T. has been classified into three corridors which can be described as:

- the Brisbane-Darwin, or eastern corridor,
- the Adelaide-Darwin, north-south or central corridor,
- the Perth-Darwin, or western corridor.

These terms are used in a general manner in that freight from Sydney moves into the N.T. through the Brisbane-Darwin corridor, while freight from Melbourne to the Territory generally goes via Adelaide. The term 'link' is used within this report to refer to a particular section of a corridor between two cities.

FUTURE TRANSPORT SYSTEMS AND EXAMINATION OF ALTERNATIVES

Rather than define a large number of alternative transport systems, each corridor was initially considered separately.

The transport infrastructure and services of the corridor were examined to determine the least cost configuration able to meet the anticipated transport task.

The preferred transport systems for each corridor were then combined to define a total transport system. This system was refined to account for the interaction of modes, the ability of each corridor to supply a range of commodities, and redundancy of services. This process ensured that the final transport system met the requirements of the N.T. community at minimum cost.

The alternatives considered for each corridor included the existing planning proposals which have been put to the Commonwealth Government, suggestions made by members of the N.T. community, and proposals generated by the study team. Many of the alternatives are not discussed in detail as they were eliminated early in the analysis. However, sufficient material is presented in the report to enable any interested party to consider most general proposals.

Given the manner in which the transport task is defined, the only variable by which alternatives can be ranked is cost. Costs can be considered in several ways which include:

- resource costs;
- financial costs;
- distribution of costs (charges).

For the most part costs discussed within this report are resource costs, as these represent the cost to the nation.[1] Accordingly the ranking of alternatives was based upon the resource cost (the mode of transport which is able to meet the transport task at minimum resource cost is the favoured mode). This ranking can be referred to as the 'least cost' method.

The other forms of costs cannot be ignored. Financial costs represent the costs as perceived by the transport operators and accordingly influence charges. The financial costs to the Commonwealth Government are quantified for all the alternatives considered.

Users of transport services are more concerned with the charges than the costs of the service. Charges are set by the balance between supply and demand and the degree of competition in the industry. The balance between supply and demand and the existence of competition are criteria used in the examination of alternatives. No consideration is given to government interference in the price structure by way of taxes or subsidies.

Each freight transport system is likely to make other impacts on the N.T. community; these include effects on the tourist and cattle industries. Reference is made to these impacts where they are likely to be a significant factor in differentiating alternatives.

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(1) The resource cost of a service or product is the community valuation of the resources consumed and excludes any indirect taxes such as excise duty or sales tax.

CHAPTER 3 - FREIGHT TRANSPORT SERVICES TO THE N.T.

PRESENT SITUATION - AN OVERVIEW

Until the last decade sea and rail have been the major freight modes serving the N.T., sea freight entering via the Port of Darwin, and rail freight entering via the narrow gauge line to Alice Springs. Road was used mainly for distribution within the Territory, but improvements in roads and road vehicle technology have resulted in a shift away from sea and rail to direct supply by road. Most bulk freight is still carried by ship, but the present N.T. non-bulk freight import task is split fairly evenly between the three major modes, sea, rail and road, and the proportions have remained almost constant for the last 5 years as Table 3.1 shows. The switch to road has not affected the small coastal settlements and missions, many of which have little or no road access. These centres still rely on shipping, using barges and small ships operating from Darwin, Cairns and Brisbane for all major supplies, and obtaining small light items and perishables by air. The sea, rail and road figures in Table 3.1 have been obtained from the Northern Territory Port Authority (NTPA), ANR, the Australian Bureau of Statistics (ABS) and the Department of Northern Territory respectively.

The freight transport pattern shown in Figure 3.1 and Figure 3.2 is complex, with the choice of origin strongly affecting choice of mode and vice versa. Each mode and source has its own particular problems and disadvantages, so that at present no particular source or mode plays a dominant role. The distances by land transport between various supply sources and Darwin and Alice Springs are shown in Table 3.2.

There is no all weather land link to the N.T. and during the wet season, inland towns such as Tennant Creek and Alice Springs can be isolated for considerable lengths of time. Darwin, which is served by two interstate coastal shipping services, is not as badly affected by the wet, but sea transport is unacceptably

TABLE 3.1 - NON-BULK FREIGHT FLOWS INTO THE NORTHERN TERRITORY, DISTRIBUTION BY MODE

(%)

	1971-72	1972-73	1973-74	1974-75	1975-76
Sea					
East coast	15	12	11	15	12
West coast	9	9	16	14	16
Overseas	10	7	5	8	9
TOTAL SEA	33	28	33	37	36
Road					
Barkly	22	20	19	21	25
Stuart	10	11	16	8	11
TOTAL ROAD	32	32	35	29	37
Rail					
CAR	35	40	32	34	27
ALL MODES	100	100	100	100	100

Source: See Annexes A and B for the derivation of Table 3.1.

TABLE 3.2 - DISTANCES BY LAND MODES: MAJOR CITIES TO DARWIN AND ALICE SPRINGS

(km)

	Brisbane	Sydney	Melbourne	Adelaide
Road				
Darwin via Adelaide	-	4668	3992	3238
via Brisbane	3497	4550	5443	-
via Burke	-	4069	-	-
Alice Springs via Adelaide	4183	3130	2449	1700
via Tennant Creek	3035	4088	-	-
Road-Rail				
Darwin via Maree	-	4359	3852	3054
via Tarcoola	-	4396	3859	3091
Rail				
Alice Springs via Maree	-	2821	2284	1516
via Tarcoola	-	2858	2321	1553

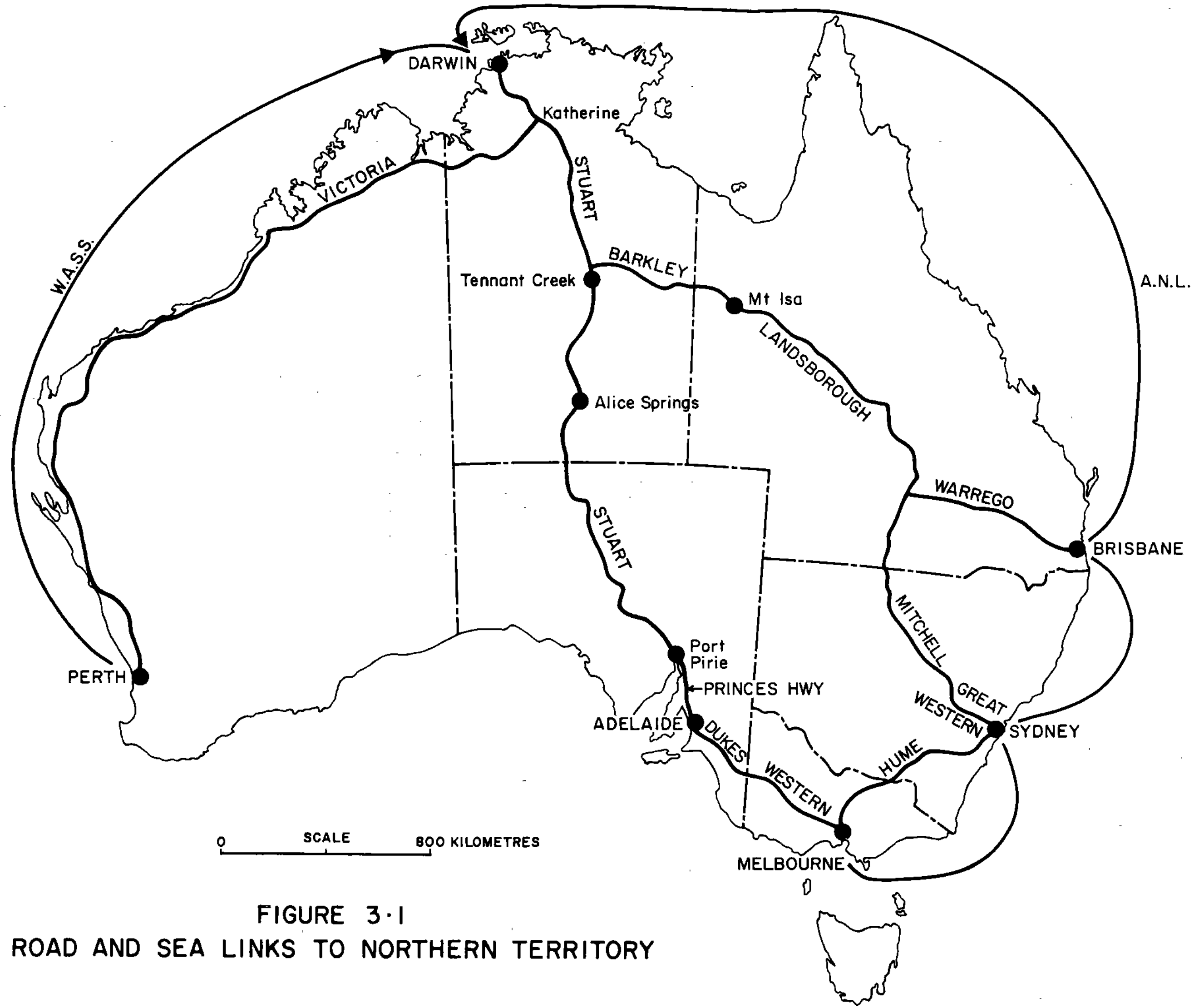

FIGURE 3·1
ROAD AND SEA LINKS TO NORTHERN TERRITORY

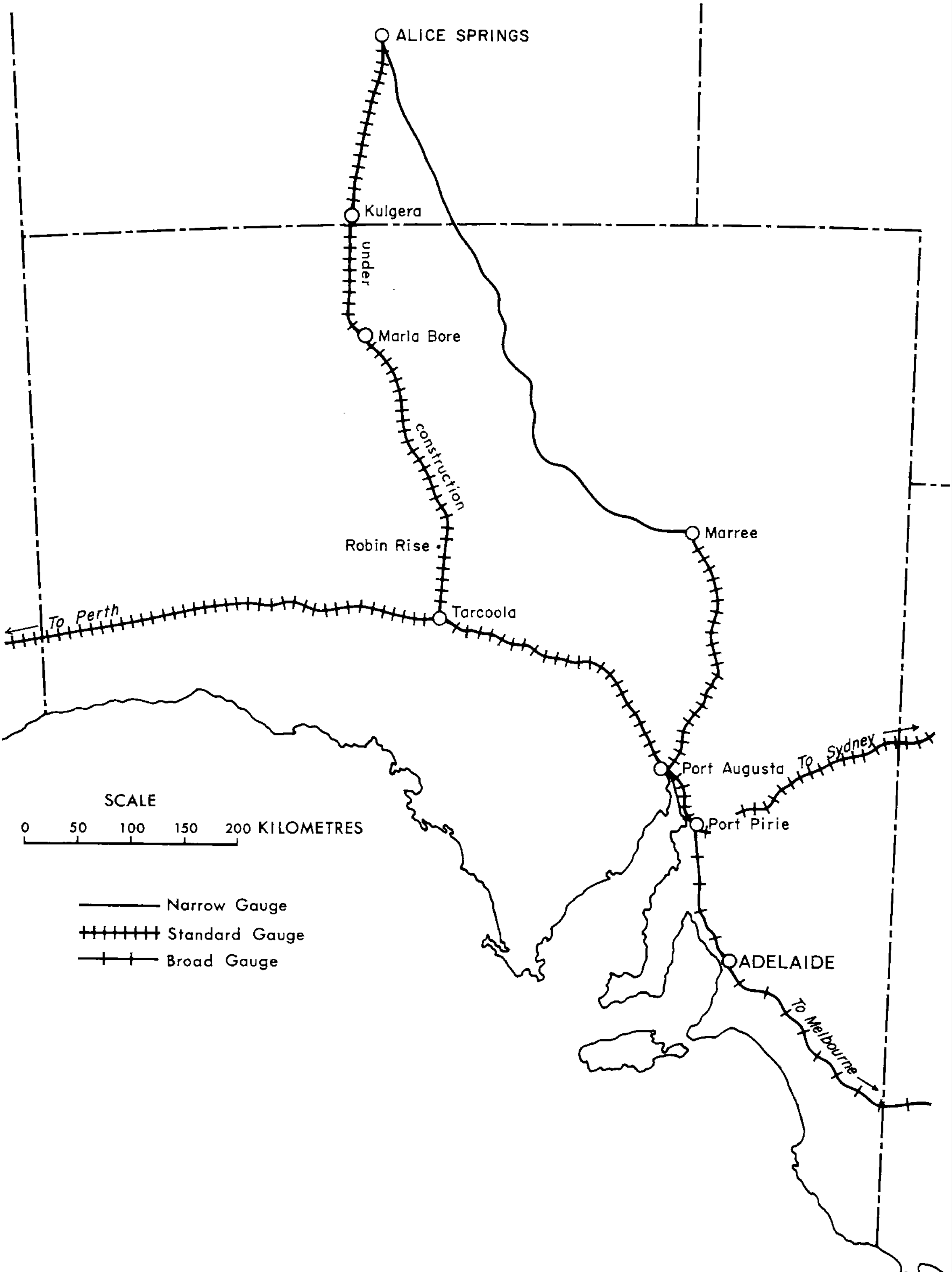

FIGURE 3·2
PRESENT AND PLANNED RAIL LINKS TO ALICE SPRINGS

slow for some shippers' requirements. Although the WASS service from Perth calls regularly every 10 days, the Darwin Trader from the east coast calls only about 10 times a year and, in the past, has had trouble meeting its advertised schedule.

Availability and reliability of supply, variety of choice and price of goods all play an important part in choice of source of supply. Alice Springs is connected by rail to Adelaide and has strong ties with that city, but Brisbane is gaining favour as a source of supply, the main reasons cited being greater variety of goods and lower prices. Katherine and Tennant Creek, in spite of their proximity to Darwin and Alice Springs respectively, rely heavily on Adelaide and increasingly on Brisbane as sources; preferring to order directly instead of risking the uncertainties and expense of indirect supply. It is difficult to estimate road flows to minor centres, but the little information to hand indicates that they are following the general trend, and that direct road supply from Adelaide and Brisbane is increasing.

Darwin is the major destination of N.T. freight and it is the N.T. centre with the greatest provision of interstate transport services. However the shipper's choice is subject to several constraints. Though the coastal service from Perth is excellent, some items are unavailable or expensive in Perth, or require a faster transit time than sea can provide. Adelaide suffers to a certain extent from similar inadequacies as a source, but is heavily utilised, being the nearest supply source to both Alice Springs and Darwin. However, most of the southern part of the Stuart Highway is unsealed and both road and rail in the Adelaide-Alice Springs corridor suffer from prolonged and frequent disruptions during and after rain, thus reducing the attractiveness of Adelaide as a source of supply. Brisbane, Sydney and Melbourne are all seen as excellent, reliable and inexpensive sources of goods, but the sea service from the eastern states is poor, and the road is long, partially unsealed and unreliable during the wet season.

The choice of source and mode is often determined by the commodity to be transported. Some items can only be obtained from one source (canned Carlton beer) or are constrained by modal restrictions. Any item that travels poorly by road will not be sourced in Adelaide for Darwin, or Brisbane for Alice Springs. Where possible goods such as steel decking, plumbing fittings, electrical equipment or any material in tins and drums, are transported by sea or rail to avoid vibration caused damage. However, much of the damage could be attributed to inadequate packaging or carelessness in trans-shipment, rather than to actual problems directly associated with the mode.

The past and present population distributions for the N.T. are shown in Tables 3.3 and 3.4. The population of the N.T. is becoming increasingly urbanised with over two-thirds of the population now concentrated in the five urban centres Darwin, Alice Springs, Tennant Creek, Katherine and Nhulunbuy, and over half resident in the two largest centres Darwin and Alice Springs. However, one-third of the population is scattered throughout the N.T. in small settlements which are not served directly by major transport links.

TABLE 3.3 - POPULATION OF THE N.T.

30 June	Population
1969	72962
1970	78811
1971	86390
1972	91666
1973	95629
1974	100000
1975	86677 (1)
1976	99800

(1) Decrease due to migration following Cyclone Tracy, December 1974.

Sources: For the years 1969 to 1974, Australian Bureau of Statistics, Northern Territory Statistical Summary. For the years 1975 to 1976, Department of Northern Territory estimates.

TABLE 3.4 - POPULATION OF THE N.T., DISTRIBUTION BY AREA

(%)

Year	Darwin	Alice Springs	Katherine	Tennant Creek	Nhulunbuy	Other	Total
1966	38	11	3	2	n.a.	46	100
1971	43	13	3	2	5	34	100
1973	45	13	3	2	4	33	100
1974	47	13	3	2	3	31	100
1975	39 (1)	14	4	3	4	36	100
1976	41	14	4	3	4	34	100

(1) Change in distribution due to migration following Cyclone Tracy, Melbourne December, 1974.

Sources: For the years 1966 to 1974, Australian Bureau of Statistics, Northern Territory Statistical Summary.
For the years 1975 and 1976, Department of Northern Territory estimates.

ROADS IN THE N.T.

The N.T. is served by three major interstate routes:

- the Stuart Highway from Adelaide connecting via the Princes, Dukes and Western Highways to Melbourne;
- the Barkly Highway from Mt Isa, connecting via the Landsborough and Warrego Highways to Brisbane, and via the Landsborough, Mitchell and Great Western Highways to Sydney;
- the Victoria Highway connecting via Route 1 to Perth.

The highways and their relationship to major population centres are shown in Figure 3.1, while present road conditions and distances are shown in Table 3.5.

TABLE 3.5 - MAJOR INTERSTATE ROADS SERVING THE N.T., PRESENT CONDITION

Road Sector	Distance (km)	Sealed %	NHS (1) %
Brisbane-Darwin			
1. direct	3497	92	24
2. via Boulia	3703	100	24
Sydney-Darwin			
1. via Bourke	4069	86	n.a.
2. via Brisbane	4550	92	23
Melbourne-Darwin (2)	3992	74	24
Adelaide-Darwin	3238	40	17
Melbourne-Alice Springs	2449	42	n.a.
Adelaide-Alice Springs	1700	61	n.a.
Alice Springs-Darwin	1533	100	n.a.

(1) National Highway Standard.
(2) via Adelaide.

Initial construction

Before World War II there were no sealed rural roads in the Northern Territory. During the War the Stuart Highway was sealed from Darwin to the railhead at Alice Springs, and the Barkly Highway was sealed from its junction with the Stuart Highway to the railhead at Mt Isa.

The geometric, drainage and structural standards adopted were considerably lower than present rural road standards, and the highways were built to carry axle loads of 6 tonnes, and with alignment suitable for speeds of 60 km/h except where flat terrain permitted a better alignment. The pavement thickness and quality were much less than for permanent roads, and the pavement width was 4.9 m except for 160 km of 6.1 m width immediately south of Darwin. Stream crossings were bed level causeways except at major rivers, where single lane low level bridges were provided.

Maintenance and improvements 1945-1971

Until 1957 the roads from the railheads were generally maintained to the original standard except that resealing was only to 3.7 m. Sections where the pavement failed were reconstructed and strengthened. From 1963 to 1970 reconstruction and improvements to alignment and drainage were undertaken when money was available.

In 1970 the Commonwealth Government approved the First Three-Year Program for the Improvement and Maintenance of the Stuart and Barkly Highways in the Northern Territory. Most of the work was undertaken on the Stuart Highway north of Tennant Creek, with only minor reconstruction south of Tennant Creek and on the Barkly Highway.

A total of 435 km of road was reconstructed, including 145 km of re-alignment; and twelve high level bridges were built. The Department of Northern Territory recently submitted a second

3 year works program to the Parliamentary Standing Committee on Public Works for consideration. The state of the highways at present, and on completion of projected improvements is shown in Table 3.6.

TABLE 3.6 - STUART AND BARKLY HIGHWAYS IN N.T., CURRENT AND PROJECTED CONDITION

	Stuart (1)	Barkly
Length in N.T. (km)	1524	448
First 3 year program		
km improved (2)	391	44
Bridges built	12	-
Second 3 year program		
km to be improved (2)	490	68
Bridges to be built	12	2

(1) Darwin to Alice Springs only.
(2) Strengthened and widened or re-aligned.
Source: Parliamentary Standing Committee on Public Works, Minutes of Evidence relating to the proposed Second Three-Year Program for the Improvement and Maintenance of the Stuart and Barkly Highways, Northern Territory (Canberra, 1976).

Stuart Highway

The highway is sealed from Kulgera near the S.A. border to Darwin, but the standard of construction is for the most part well below the recommended National Highway Standard. High level bridges cross nearly all major rivers between Darwin and Katherine and only minor delays due to flooding are expected on this sector. On the Katherine to Tennant Creek sector, the Newcastle Waters bridges are due for completion by the end of 1977. These bridges are expected to reduce delays at Newcastle Waters from weeks to a maximum of a day at a time (from Tennant Creek to the S.A. border there are no river crossings likely to cause substantial delays during the wet).

The section of the highway from the South Australian border to Port Augusta is unsealed, except for the 120 km into Port Augusta.

The road is in extremely poor condition with pot holes and dust creating driving hazards during dry weather, and flooding of the low level causeways and the road itself after even moderate rainfall.

The Stuart Highway south of the S.A. border has recently been the subject of a study to determine the best alignment for the highway in this area[1]. The study team recommended a more direct alignment, complete sealing, and bridging works to avoid disruption due to the occurence of a 1 in 50 year flood. The team estimated the cost of the highway plus its associated secondary road network at approximately $50.4m at 1974-75 prices, given a 5 year construction plan. The study team concluded that this work has a benefit-cost ratio of 1.1 given a 10% discount rate and a 30 year evaluation period[2].

Brisbane-Darwin highway link

The Barkly Highway is sealed for its entire length from Tennant Creek to Mt Isa. However the pavement is in poor condition in many places, and penetration of water into the pavement has forced the imposition of severe axle-load restrictions for prolonged periods during recent wet seasons. These axle-load restrictions effectively close the highway to heavy commercial vehicles for the period of enforcement. There are three major rivers crossed en route, the James and the Rankin in the N.T., and the Georgina in Queensland, and any of these rivers can cut the road for several days, but the major causes of disruption are the previously mentioned load restrictions. The Barkly Highway is

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(1) Steering committee from Commonwealth Department of Transport, S.A. Highways Department, Commonwealth Bureau of Roads Report on the National Highway linking Adelaide and Darwin, Port Augusta to Northern Territory Border, 1976.

(2) Most freight is assumed to travel by the new Tarcoola rail link, and benefits accrue mainly from passenger traffic. The benefit-cost ratio of 1.1 is therefore a minimum estimate if the highway is considered in isolation.

the subject of a corridor study[1] to define the short and long term strategies for the development of the existing Barkly Highway and associated National Highway Corridor.

The Landsborough Highway which forms part of the direct route between the N.T. and Brisbane, is unsealed for 118 km between Cloncurry and Winton. There are many bed level causeways, and flooded crossings and heavy mud on the unsealed sections often force closure of the highway after rain. The Landsborough is expected to be all weather by 1981 and completely sealed by 1983, and bridgeworks are proceeding at present.

An alternative route from Mt Isa to Winton via Boulia can be used in wet weather. It is 204 km longer than the Landsborough route, but it is completely sealed and is often still open when the Landsborough is closed. There is also an alternative, though much longer, route to Brisbane from Cloncurry via Townsville.

In summary the main problems on the Brisbane to Darwin route are the unsealed portions of the Landsborough Highway and weak pavement on parts of the Barkly. The N.T. National Highway Corridor Study Team is currently considering proposals for the development of the Barkly Highway in the N.T., and the Landsborough Highway is expected to be all-weather by 1981.

Darwin-Perth

There is little freight traffic on the Victoria Highway from Perth. The road is sealed from Katherine to Halls Creek but there are extensive unsealed sections in W.A. Route 1 is being improved progressively from the south and is sealed as far as Port Hedland. From Port Hedland to Derby is unsealed and impassable for long periods after rain. However, some bridges are

(1) Northern Territory National Highway Corridor Study Team, Commonwealth Department of Northern Territory, Commonwealth Department of Construction and Commonwealth Bureau of Roads.

being built. The Victoria river is spanned by a medium level bridge but in a bad wet season can be impassable for 10 days at a time. There is no prospect of the road from Perth being all-weather in the near future.

RAIL

The rail link from Mt Isa to Townsville is constructed to a high standard and is relatively free from disruption due to flooding. This line carries the Mt Isa traffic, and hence any freight for the N.T. is a marginal operation. Accurate statistics are unobtainable on the volume of road-rail freight from the eastern seaboard consigned via Mt Isa to the N.T., but traffic is certainly less than 25 000 tonnes per annum and is therefore not considered separately from other freight entering the N.T. via the Barkly Highway.

The present rail link from Adelaide to Alice Springs utilises three separate gauges, a broad gauge section from Adelaide to Port Pirie, operated by South Australian Railways (SAR)[1], a standard gauge sector from Port Pirie to Maree, and a narrow gauge sector from Maree to Alice Springs, both operated by Central Australia Railway (CAR). The first two sectors are good all weather tracks, but the narrow gauge is old, of poor quality and subject to frequent and prolonged washouts.

The Tarcoola-Alice Springs Railway is due to replace the old rail link in 1981. The Adelaide-Alice Springs traffic will then travel along the Trans Australian Railway (TAR) to Tarcoola and up the new line to Alice Springs. The high standard and superior alignment of the new line should ensure that disruptions due to flooding and flood damage are negligible.

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(1) Responsibility for non-metropolitan operations of SAR was assumed by ANR from July 1975. Central Australia Railway and Trans Australian Railway are both operated by ANR.

DEVELOPMENT OF SEA TRANSPORT TO THE N.T.

Darwin is served by two interstate coastal shipping services. The State Shipping Service under the auspices of the Western Australian Coastal Shipping Commission, generally referred to as Western Australian State Ships (WASS), operates a service ex-Perth calling every 10 days. The Australian National Line (ANL) operates a service from the eastern states ex-Melbourne Sydney and Brisbane calling about 10 times per annum. Information on the vessels operated by these two services is displayed in Tables 3.7 and 3.8. For many years the east coast traffic accounted for about two-thirds of the total coastal trade, but with the introduction of the Darwin Trader the east coast's share declined to less than half. This decrease is partially a reflection of the Darwin Trader's low frequency and initial poor performance, when contrasted with the reliable and regular service of WASS, though increased competition by road services from Brisbane is also a factor. Any marked change in service patterns will probably change the market shares of these two coastal lines.

TABLE 3.7 - INTERSTATE COASTAL SHIPPING SERVICES, CAPACITY FOR CONSIGNMENTS TO DARWIN

Line	No. of Vessels	Frequency	Annual Capacity (1) (2)	
			'000 m^3	'000 tonnes
WASS	3	10 days	317	170
ANL	1	30-40 days	100	40

(1) Assuming that 20% of WASS capacity is taken by W.A. coastal freight.
(2) Volumetric and weight measures of capacity are mutually exclusive, not additive.

The Port of Darwin no longer has a regular service from overseas lines, but about one vessel a month arrives from Japan carrying motor vehicles, and there are numerous calls from vessels carrying timber and plywood from New Guinea and S.E. Asia, cement from Taiwan and Thailand and bitumen feedstock from Singapore. The Port of Darwin has been the subject of many studies in the last

TABLE 3.8 - INTERSTATE COASTAL VESSELS CALLING AT DARWIN

Name	Line	DWT	Gross tonneage	Capacity[1]			Built	Reg.
				m^3	containers[2]	tonnes		
Wambiri	WASS	7 470	5 149	10 900	345	6 347	1963	Frem.
Boogalla	WASS	7 847	6 103	11 500	345	6 347	1966	Frem.
Nyanda	WASS	7 847	6 103	11 500	345	6 347	1966	Frem.
Darwin Trader	ANL	11 902	10 802	9 951[3]	321	5 890[4]	1970	Melb.

(1) Measures of capacity are mutually exclusive, not additive.
(2) Estimates of WASS capacity are for comparative purposes only.
(3) Equivalent to 321 6.1 metre containers.
(4) Maximum estimate assuming 18.35 tonnes per container.

few years, all of which have recommended capital works to improve the working of the port. The latest of these is a report by the Bureau of Transport Economics[1], which recommended the construction of a new land-backed wharf for general cargo at Fort Hill. No capital expenditure has yet been approved.

WASS

In 1912 the Western Australian State Shipping Service was founded with Darwin as a regular port of call on a run to the North-West, Darwin and Singapore. In 1938 the State Shipping Service withdrew from foreign trade and confined its operations to coastal shipping, and a reduced service to Darwin was maintained during the war. By 1948 the number of ships servicing the North-West had been increased from two to four to cope with increasing tonneages, and a monthly service was maintained until the mid-fifties when the frequency was doubled. By the sixties the frequency had doubled again and 3 to 4 ships were calling per month.

In 1971-72 WASS introduced two unit load ships of 7300 DWT to speed up the service. By 1973 it had introduced another two, had phased out the last of its old fleet and was maintaining a weekly sailing to all north-west ports and Darwin. In 1976 due to decreasing tonnage WASS dropped one of its ships from the north-west run, reducing to a 10 day interval between sailings.

ANL

In the early fifties Darwin was visited quarterly by an Australian Ship Board ship from the eastern states. In 1956 ANL introduced an east coast service to Darwin with two vessels of 3000 DWT. In 1958 James Patrick and Co. withdrew its vessels from the east

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(1) Bureau of Transport Economics, Provision of General Cargo Facilities at the Port of Darwin (AGPS, Canberra, October 1975).

coast trade and from that date ANL has been the only east coast operator. In 1961-62 one of the existing ships was replaced by a 6000 DWT ship capable of backloading ores. The remaining small ship was replaced by another 6000 DWT ship in 1964-65.

In 1970-71 the 6000 DWT ships were withdrawn, and the Darwin Trader was introduced. However, due to various problems it averaged only 7 trips a year for the first few years of operation, and only in the last two years has it begun to operate at the originally projected frequency of about 10 voyages per year. The Darwin Trader is currently sailing fully loaded, and customers occasionally complain of lack of space.

Nhulunbuy

Though many small coastal settlements are dependent on sea borne freight, Nhulunbuy, on the Gove Peninsula, is the only major population centre in the N.T. which is entirely dependent on sea and air for its freight transportation. Nabalco's bulk requirements for its industrial operations come into Nhulunbuy by sea, as does most general freight for the community, though some items such as newspapers and perishables are flown in. Nabalco has a 5 year charter on the 4500 DWT Seaway Queen which it operates ex-Sydney and Brisbane to Nhulunbuy on a 25 day turn round.

Nabalco does not cover costs on the freight rates it charges, but customers in Nhulunbuy still find freight costs a major component of total costs, especially on large heavy items of low intrinsic value. Nhulunbuy also obtains some supplies from Darwin by barge, but users find that this can be even more expensive than the Seaway Queen. The absence of land based services forces small retail operators to import small or urgently required items by airmail, adding greatly to their final retail price. The transport links between Nhulunbuy and the remainder of the N.T. are poor, and are not significant for Nhulunbuy or the Territory.

PUBLIC OPINION IN THE N.T.

During October 1976 a team of four Bureau officers spent a fortnight in the N.T. holding informal discussions with members of the community on the general topic of the transport needs of the Territory. The five major population centres of the Territory, Darwin, Alice Springs, Katherine, Nhulunbuy and Tennant Creek, were all visited. The people who took part in the discussions included members of the business community, union officials, local government representatives and members of the legislative assembly.

The aim of the visit was:

- to provide background information necessary for the conduct of the study;
- to create an opportunity for the N.T. community to provide an input into the study, either in the form of comments on the existing transport system, or proposals for alternative future systems;
- to obtain hard data on the performance of the transport system.

The N.T. community co-operated fully, providing information, often confidential, and comments about the present and future transport task.

In the course of the visit, a list was drawn up of organisations and people in southern Australia who are involved in making transport decisions which affect the N.T. community. Many of these organisations were later visited by members of the study team.

The contribution made by the community is best considered under two headings:

- perceived problems of the existing transport system;
- possible future transport systems.

Perceived problems

Almost all of the problems which people spoke about were a reflection of their recent experiences. The problem areas could be divided into two main categories:

- disruption of services caused by the wet, particularly as it affects supplies of perishables;
- degree of damage which occurs in transit.

This list is significant for its omissions. With the exception of Nhulunbuy there were no major complaints about charges or industrial relations. The general impression gained about charges was that although they were high by southern standards, they were not excessive given the long distances involved. Industrial relations were an area which had been difficult in the past and could be in the future, but were not causing problems at the moment.

The wet seasons since 1973-74 have been particularly severe, and accordingly the disruptions to the transport industry have been worse than normal. For most commodities moved, a disruption to the transport system results only in a delay in the arrival time, but if perishables are delayed the whole shipment can be lost.

Some damage is certain to occur given the rough conditions and distance involved in moving goods into the Territory on land based transport modes. Most users of the transport services seemed to have had recent experience of goods damaged in transit, no matter which mode they used. Some people accept the damage as a fact of life, while others are making efforts to reduce the problem. The possibility of damage to goods was often quoted as a major factor in modal choice, but there was no general concensus on the relative merits of the alternative modes in minimising damage.

Future transport systems

The study team attempted to discover what the Northern Territory community saw as the most suitable transport system for the Territory. The significant feature of most systems suggested was a standard gauge rail link. For people in Alice Springs this was the Tarcoola-Alice Springs link presently under construction, for the Darwin community it was a north-south trans-continental rail link. This suggestion was made by members of the community because they believed that a railway link would provide reliable transport services at minimum cost as well as being the catalyst for northern development. However the cessation of operations on the narrow gauge North Australia Railway caused little dissatisfaction, as it was seen as an uneconomic operation which slowed down delivery of freight moving by road-rail from Adelaide to Darwin. Some interviewees suggested the desirability of a rail link between Mt Isa and Tennant Creek.

Highways were often not mentioned, not because they were regarded as unimportant, but because they were considered to be a fundamental feature of any transport system and hence overlooked. In general, a highway system built to National Highway Standard was seen as a basic need to which the Government was already committed. The tourist traffic was expected to grow considerably with improvements in the highways.

The Darwin community was naturally the only group to seriously consider shipping as a transport mode to serve the Territory. Unless the interviewee used the existing shipping services, these services were seen as secondary to the land based alternatives. Those people using the shipping services saw them as essential, because they moved large quantities of goods with minimal damage and at apparent minimum cost. However, ship users recognised the need for a reliable and frequent land based transport operation to supplement the shipping services. They used these land based modes to meet deficiencies in stock caused by unexpected orders, or whenever the shipping service was disrupted.

As a general rule users of transport services in the Territory prefer to deal directly with major suppliers. Dealing through secondary warehouses increases costs and reduces reliability of supply; this explains the unpopularity of Perth as a supply source for nationally available goods. For the same reason, the inland centres of the Territory prefer to deal direct with Adelaide and Brisbane instead of Alice Springs or Darwin.

In general the N.T. community considered that it should have a similar transport service to those operating in southern Australia. This included a choice of mode, links to all capital cities, frequent and reliable services. On the question of the cost of such services, the opinion was often expressed that the infrastructure costs should be borne by the whole Australian community as a contribution to northern development and defence preparedness.

Determinants of mode-source choice

During the interviews members of the N.T. community were asked which of the following characteristics were the most significant in their mode-source choice for freight transport to the Territory:

- the charge for the transport service;
- the transit time;
- the frequency of the service;
- the reliability of the service;
- the degree of damage incurred during transit;
- the ability of the service to provide year-round service (i.e. minimal disruption during the wet season);
- the communication links with the supplier of the goods;
- the comparative ability of alternative suppliers to provide the goods;
- the reliability of the supplier or source;
- the price of the goods from alternative suppliers;
- the inventory levels required given the characteristics of each mode.

The first six characteristics are transport characteristics, while the next five were intended to cover the differences between alternative sources of supply.

With hindsight the last five characteristics in the list could be regarded as irrelevant to the choice of mode and source. The source of goods is either a function of:

- history (we have always obtained our goods from X and see no reason to change);
- company policy (as a component of a national company the Darwin office receives its supplies from X, as this is the least cost service given the alternative modes and company structure);
- a monopoly situation (the particular goods can only be obtained from one source of supply);
- recent marketing by a source in an attempt to increase or maintain sales in the Territory; or
- proximity to the source of supply.

The only situation where inventory levels are significant in determining mode choice is the supply of spare parts for heavy equipment. In this case almost no spare parts are held, and parts are usually flown in as required.

A ranking of the six transport characteristics was produced. The results for Darwin and Alice Springs were treated separately. However, the results from the two communities were similar and could not be separated given the limited number of interviewees. The ranking of the characteristics was as follows:

- reliability
- year-round service
- frequency
- damage
- charge
- transit time.

The first two characteristics were seen to be significantly more important than any of the others, while transit time was regarded as almost irrelevant. There was very little separating the other three components. These results are perhaps intuitively obvious, as the most significant problems with the N.T. transport system involve the disruptions to the system caused by the wet seasons, industrial disputes and mechanical failures. Most people recognise that long distances are involved in moving goods into the Territory and allow for the transit time involved. The remaining three factors are ranked according to the experience of the individuals.

Users of transport services in the N.T. regard year-round service from a good supply source, and reliability of both mode and source as the most essential characteristics of a transport service, charge and transit time being secondary considerations. A fortnightly frequency would generally be regarded as sufficient, given that the service was regular and capacity was adequate. None of the present alternatives open to N.T. users of transport services is seen as entirely satisfactory, all combinations of mode and origin having either a deficient transport service or an inadequate range of commodities available at the supply source.

CHAPTER 4 - EXISTING FREIGHT FLOWS INTO THE N.T.

INTRODUCTION

Information on internal N.T. freight flows is scarce, and there is not enough data on the ultimate destination of freight entering the Territory to allow estimates of freight requirements to be made on a regional basis. Consequently estimates of past and present freight requirements are made on a Territory wide basis. The following chapter provides per capita estimates for bulk and non-bulk freight entering the N.T. by all modes except air. The per capita estimates are based on freight flows for sea, road and rail for the years 1971 onwards, 1971 being the first year for which data are available for all three modes. Air freight is ignored as it is not a significant component of total freight flows, amounting to a maximum of only 250 tonnes per month during the wet season.

PREVIOUS STUDIES

The only previous study to provide detailed estimates for freight flows to the Northern Territory is the Maunsell Report.(1) This report provided a forecast for sea freight flows into Darwin and its 'area of influence', using Northern Territory Port Authority data for the 11 years 1957-58 to 1967-68. However, land based freight movement were not considered. Other studies of freight transport into Darwin have been made, but have provided no useful data for freight flow forecasting and are therefore not discussed in this report.

AGGREGATE FLOWS

Rail and sea statistics for freight flows into the N.T. are available over an extended period, but road data of any sort are only available since 1971. The non-bulk freight flows for the

(1) Maunsell and Partners, Development of Port and Harbour Facilities Darwin, Report for the Department of National Development (Melbourne, January 1969).

last 5 years are shown in Table 4.1 and bulk freight flows in Table 4.2. The methods used in deriving the road figures for freight are described in Annex A.

TABLE 4.1 - NON-BULK FREIGHT ENTERING THE N.T.[1]

('000 tonnes)

	1971-72	1972-73	1973-74	1974-75	1975-76
East coast sea	33.5	29.9	29.8	42.6	34.7
West coast sea	19.4	24.1	43.8	39.8	48.3
Overseas	21.2	18.3	14.6	23.4	25.8
Rail	79.0	101.7	86.7	95.8	82.0
Barkly Highway	48.0	51.9	52.3	59.8	76.4
Stuart Highway[2]	21.7	28.7	43.3	23.1	33.4
TOTAL NON-BULK	222.8	254.6	270.5	284.5	300.6

(1) Excludes non-bulk freight shipped directly into Nhulunbuy and Groote Eylandt. Petroleum products excluded from road.
(2) From Adelaide.

Sources: Sea; Northern Territory Port Authority statistics.
Rail; Central Australia Railway statistics.
Road; Australian Bureau of Statistics, Interstate Freight moved by major freight forwarders and road transport operators between specified Australian Centres. and Department of Northern Territory, Roadside Surveys.

COMMODITY CLASSIFICATION

There were many difficulties in obtaining a workable commodity classification which could be used for all three modes. The sea classification is detailed and complete, but rail does not record the contents of containers, and the only road classification available is extremely crude[1]. To add to the problem, sea freight is recorded in 'cargo tonnes'[2] not tonnes weight and is not directly comparable with road and rail freight.

(1) The Department of Northern Territory Roadside Surveys provide a 12 class commodity classification (See Annex A).
(2) A 'cargo tonne' for a commodity is one tonne weight or one cubic metre if the commodity is less dense than 1 tonne/m^3.

TABLE 4.2 - BULK FREIGHT ENTERING THE N.T.[1]

('000 tonnes)

	1971-72	1972-73	1973-74	1974-75	1975-76
Petroleum					
West coast	92.4	78.3	123.0	79.6	99.7
Overseas	199.6	229.9	180.3	247.9	231.3
Rail	21.1	20.0	26.2	21.8	14.6
Road	5.7	6.3	6.9	7.0	9.1
TOTAL[2]	318.9	335.5	338.5	357.3	355.7
Cement					
Overseas	44.4	42.4	41.9	39.9	67.0
Rail	12.8	14.5	12.4	13.8	3.6
TOTAL[3]	57.2	56.9	54.2	54.2	72.7
Bitumen					
Overseas	8.5	20.8	10.1	17.6	4.9
Bulk					
TOTAL	384.6	413.2	402.8	429.1	433.3

(1) Excludes bulk freight which is shipped directly into Nhulunbuy and Groote Eylandt.
(2) Includes minor flows from east coast not recorded above.
(3) Includes minor flows from west coast not recorded above.
Source: Refer to Annex B.

As a result of these problems, total freight flows and per capita estimates can be regarded with confidence, but individual commodity per capita estimates should be treated with extreme caution.

The commodity classification used is as follows:

BULK (sea and rail only)	NON-BULK
cement	food & drink (non-perishables)
petroleum products	food & drink (perishables)
fertiliser	hardware & building materials
bitumen	timber
	steel
	motor vehicles & machinery
	general

A discussion of the method used to covert the shipping cargo tonnes to their metric equivalents will be found in Annex A, while commodity classification and the calculation of the per capita estimates are discussed in Annex B.

PER CAPITA ESTIMATES

As discussed previously, incomplete knowledge of internal freight flows within the Territory forced estimates to be made on a Territory wide basis. The Maunsell Report calculated some items on a simple per capita basis, and some items such as steel and petroleum on a project(1) or trend basis. Unfortunately these more elaborate forecasting methods produced results that were often worse than a per capita estimate would have been, therefore in the present report simple average per capita figures are used for every commodity. The results are summarised in Table 4.3. The freight flows have been averaged over the period 1971-72 to 1975-76, the longest period over which road information is available. The disturbance caused by Darwin's reconstruction can be easily seen in the per capita figures for 1971-72 to

(1) Estimates were made of the amount of steel likely to be required given the development of Darwin, major construction projects, etc.

TABLE 4.3 - AVERAGE PER CAPITA FREIGHT REQUIREMENTS FOR THE N.T.: 1971-72 TO 1975-76, DISTRIBUTED BY COMMODITY

(tonnes per capita per annum)

Commodity	
Food and drink (non-perishables)	0.37
Food and drink (perishables)	0.22
Hardware	0.31
Timber	0.16
Steel	0.22
Motor vehicles and machinery	0.20
General	1.34
TOTAL NON-BULK	2.82
Petroleum	3.66
Cement	0.62
Bitumen	0.14
TOTAL BULK	4.41

Source: Refer to Annex B.

1975-76 shown in Table 4.4. However, freight flows are rapidly returning to normal and the reconstruction can be ignored for long term freight forecasts.

TABLE 4.4 - PER CAPITA NON-BULK FREIGHT REQUIREMENTS FOR THE N.T.
(tonnes)

Year	Per Capita
1971-72	2.431
1972-73	2.662
1973-74	2.705
1974-75	3.282
1975-76	3.012
AVERAGE	2.818

Source: Derived from Table 4.1 and Table 3.3.

Table 4.5 gives a comparison of per capita estimates for the Maunsell Report and the present study. The Maunsell Report's estimates are for sea-borne freight to Darwin and area of influence, while the Bureau estimates are for all modes for the entire Northern Territory. Given the difference in data the agreement between the total freight estimates is surprisingly good. The Maunsell total non-bulk freight estimate is lower than the Bureau estimate, but there is evidence to suggest that even in the period of the Maunsell Report's data (1963-64 to 1967-68), between 10% and 20% of Darwin's non-bulk freight was carried by land. This would go a long way to resolving the discrepancy between the two total estimates, while the difference in individual category figures is due in part to the difficulties encountered in the classification of land freight.

TABLE 4.5 - MAUNSELL AND BUREAU NON-BULK PER CAPITA ESTIMATES, COMPARISON BY COMMODITY

(tonnes)

Commodity	Bureau[(1)] Estimate	Maunsell[(2)] Estimate
Food and drink	0.59	0.660
Timber	0.16	0.275
Hardware	0.31	0.500
Steel	0.22	0.518[(3)]
Motor vehicles and machinery	0.20	0.08[(4)]
General	1.34	0.560
TOTAL	2.82	2.59

(1) Based on data for the years 1971-72 to 1975-76.
(2) Based on data for the years 1957-58 to 1967-68.
(3) Maunsell's trend forecast converted to a per capita figure for comparative purposes.
(4) Maunsell's cubic tonnes per capita converted to tonnes weight per capita for comparative purposes.

Source: Maunsell and Partners, Development of Port and Harbour Facilities Darwin, Report for the Department of National Development (Melbourne, January 1969).

CHAPTER 5 - FUTURE FREIGHT REQUIREMENTS OF THE N.T.

INTRODUCTION

Prediction is an art and not a science and never more so that when making predictions about the future of the Northern Territory. The local community regards official predictions with a good deal of scepticism as they point to the disparity between recorded growth rates of 10% and more per annum and much lower official forecasts. Unofficial predictions have been more a function of hope than of reasoned judgement, but have often proved to be correct.

The study team has estimated a 'most probable' population forecast, but given the impossibility of determining the future of the Territory, low and high estimates of population growth rates are also provided in order to determine the effects of other growth patterns on the results presented within the report. Although it would be possible for the growth rates to be outside the range examined it is unlikely and the structural changes which this would involve would render the conclusions drawn from this report meaningless.

POPULATION PROJECTIONS

As the study horizon is 1998 the three population projections high, median and low, have been made on a yearly basis till 1980 and for the years 1985, 1990 and 2000. The base year for the projection is 1976. The population figures for 1976 are from the Department of Northern Territory, dated June 1976, with the estimate of Darwin's population updated to the 1976 census figure. The growth rates used for the projections are given in Table 5.1. The population levels resulting from the application of these growth rates are given in Table 5.2.

The median growth rates for the total N.T. population are those which would be obtained given that the overall Australian net

TABLE 5.1 - POPULATION: ANNUAL GROWTH RATES, N.T. AND MAJOR CENTRES

(%)

	1976-80	1980-85	1985-90	1990-2000
Darwin				
High	10.0	8.0	6.0	4.0
Median	6.9	5.0	4.6	4.0
Low	4.0	2.9	2.8	2.3
Alice Springs				
High	7.0	8.0	5.0	4.0
Median	4.0	4.3	4.3	3.0
Low	2.0	2.0	2.0	2.0
Katherine				
High	6.0	5.0	5.0	3.0
Median	3.0	2.0	2.0	2.0
Low	1.0	0.5	0.5	0.0
Tennant Creek				
High	7.0	5.0	3.0	2.0
Median	2.0	1.0	1.0	1.0
Low	0.0	0.0	0.0	0.0
Nhulunbuy				
High	2.0	2.0	2.0	2.0
Median	1.0	1.0	1.0	1.0
Low	0.0	0.0	0.0	0.0
Non-urban				
High	2.3	5.0	5.3	4.4
Median	0.5	0.5	0.5	0.5
Low	0.5	0.2	0.2	0.2
Total N.T.				
High	6.8	6.9	5.5	4.0
Median	4.1	3.4	3.4	3.0
Low	2.6	1.8	1.8	1.6

TABLE 5.2 - FORECAST POPULATION OF MAJOR CENTRES WITHIN THE N.T.

('000)

	1976	1977	1978	1979	1980	1985	1990	2000
Darwin								
High		50.1	55.1	60.6	66.7	97.9	131.0	193.8
Median	45.5	48.1	54.7	55.2	59.5	75.8	95.0	140.3
Low		47.6	49.8	52.1	54.5	63.1	72.4	90.8
Alice Springs								
High		15.0	16.1	17.2	18.4	27.0	34.5	51.1
Median	14.0	14.6	15.2	15.8	16.4	20.2	24.9	33.5
Low		14.3	14.6	14.9	15.2	16.7	18.5	22.5
Katherine								
High		3.6	3.8	4.0	4.3	5.5	7.0	9.4
Median	3.4	3.5	3.5	3.6	3.7	4.2	4.6	5.6
Low		3.4	3.5	3.5	3.5	3.6	3.7	3.7
Tennant Creek								
High		3.0	3.2	3.4	3.7	4.7	5.5	6.7
Median	2.8	2.9	2.9	3.0	3.0	3.2	3.3	3.7
Low		2.8	2.8	2.8	2.8	2.8	2.8	2.8
Nhulunbuy								
High		3.5	3.5	3.6	3.7	4.1	4.5	5.5
Median	3.4	3.4	3.5	3.5	3.5	3.7	3.9	4.3
Low		3.4	3.4	3.4	3.4	3.4	3.4	3.4
Total N.T.								
High		108.5	115.9	123.8	132.2	184.6	241.2	357.0
Median	101.6	105.8	110.1	114.6	119.3	141.0	166.7	224.0
Low		104.2	107.0	109.7	112.6	123.1	134.6	157.7

reproduction rate (NRR) was unity, a net overseas migration of 50 000 per annum and interstate migration patterns equivalent to those of the period 1966 to 1971. It should be noted that the local value of NRR will be greater than unity, reflecting the age structure of the population in the N.T. This set of assumptions was considered by Borrie[(1)] to be the most probable. The breakdown of total N.T. figures into growth rates by region is difficult as there is no information on internal migration at this level. The growth rate of Darwin for the immediate future, from 1976 to 1980, was assumed to be that used as a working estimate by the Darwin Reconstruction Commission. All other regional growth rates were chosen as being a reasonable middle course between the upper and lower limits, and to satisfy the constraint of the total growth which has been determined above.

The growth rates for the low forecast also assume a NRR of unity for the Australian population as a whole, however Australia is assumed to have zero net overseas migration, and similarly there is no interstate migration. Borrie presented this set of assumptions as a lower limit of population growth. With minimal growth in the Territory, the growth that does occur will be in the major population centres. If the N.T. failed to attract migrants as assumed, it would be as a result of very limited economic growth, which implies no expansion of mining or tourism. Hence the low forecast growth rates are set to zero for the two mining towns of Tennant Creek and Nhulunbuy. The low growth rates for Darwin and Alice Springs were fixed by the estimate of the average N.T. population growth rate.

The high growth rates have been set approximately equal to the growth rates achieved over the last 10 years. These high growth rates have been assumed to decline over the latter part of the study period, in line with demographic changes occuring in

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(1) National Population Inquiry (Chairman, W.D. Borrie), Population and Australia, A Demographic Analysis and Projection, Vol. I, (AGPS, Canberra, 1975).

Australia. The high growth rate for Darwin for the period 1976 to 1980 is set at 10%. This was the maximum sustained growth rate of Canberra given considerable financial support and the backing of the Federal Parliament, and with this growth rate the system was under severe pressure; a higher growth rate for Darwin is highly unlikely. The total N.T. population is assumed to grow at approximately 6% compared with an overall Australian population growth rate of 1.3% over the corresponding period. These upper limits are approximately equal to the growth rates used by Department of Northern Territory in making population projections in June 1976.

FREIGHT PROJECTIONS

Using the per capita estimates developed in Chapter 4, freight flow projections for both non-bulk and bulk commodities can be obtained. High, median and low freight forecasts are given, corresponding to high, median and low population forecasts respectively. Non-bulk forecasts are displayed in Figure 5.1 and bulk in Figure 5.2.

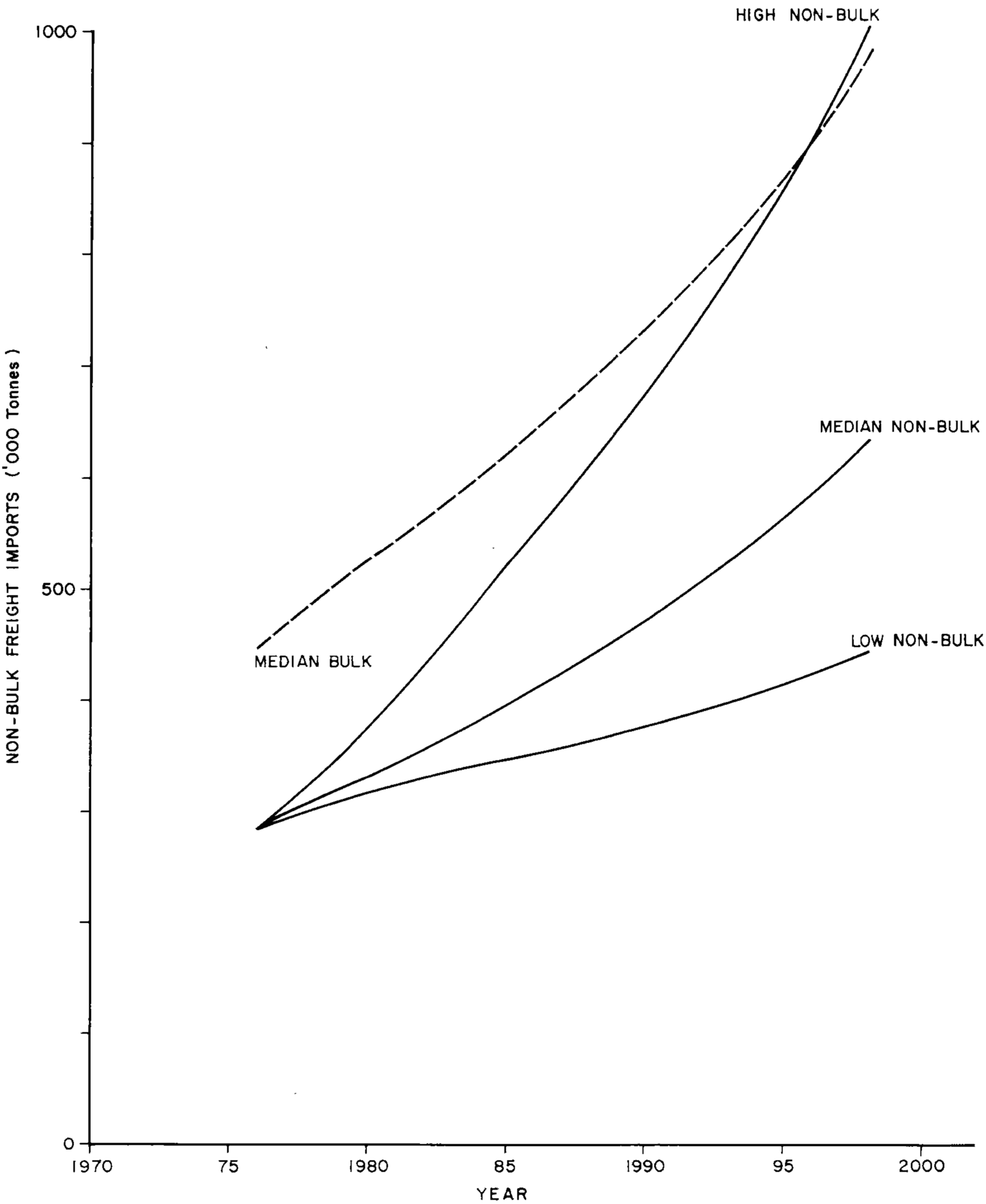

FIGURE 5·1
FORECAST: NON-BULK FREIGHT IMPORTS FOR N.T.

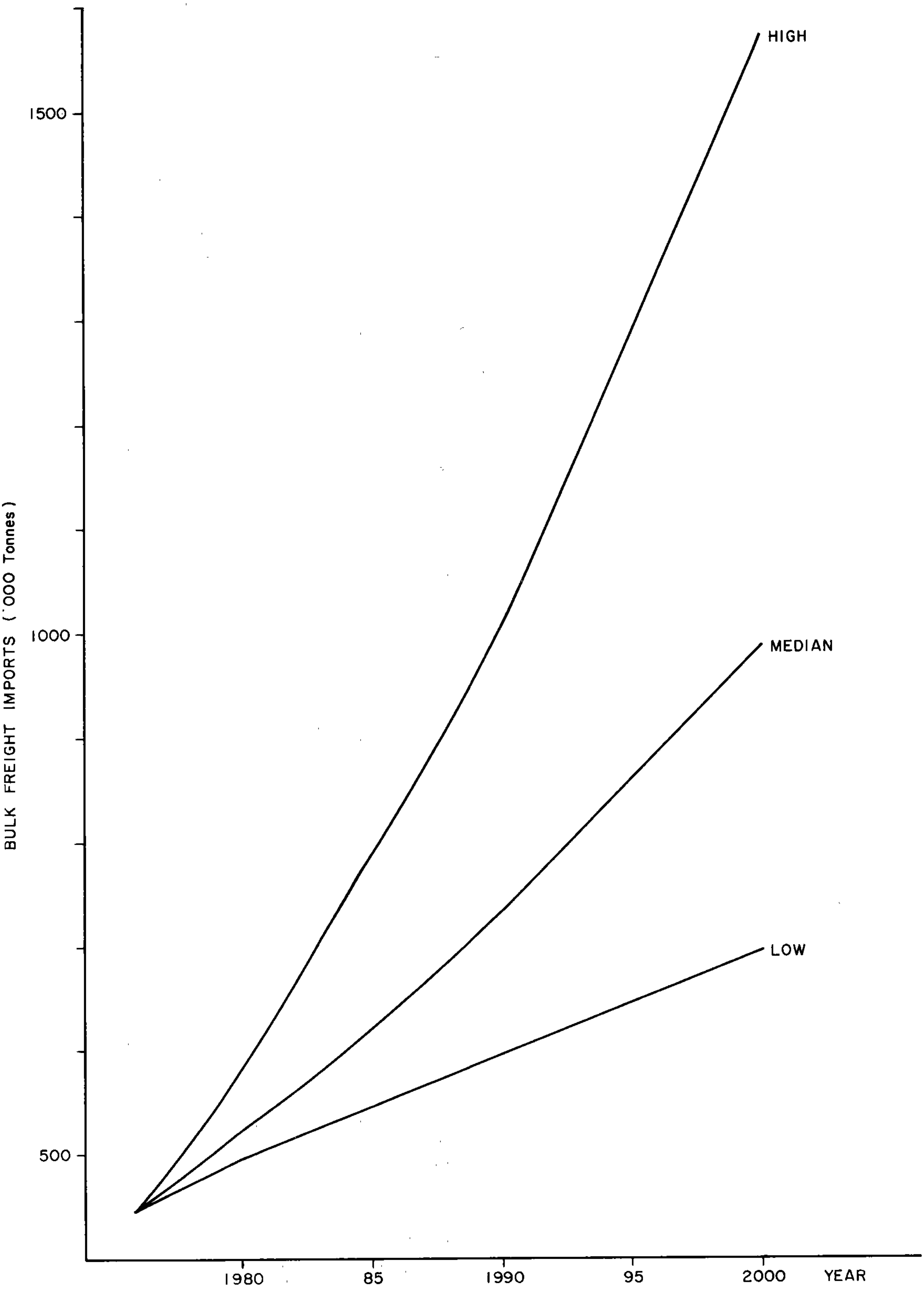

FIGURE 5·2
FORECAST: BULK FREIGHT IMPORTS FOR N.T.

CHAPTER 6 - RESOURCE COST OF TRANSPORT INTO THE N.T.

INTRODUCTION

Any consideration of a total transport system requires information on the costs of the components which form the system. This chapter discusses the capital and operating costs associated with the three modes, road, rail and sea, which presently service the N.T., and provides cost estimates for possible developments for these modes.

The quality and format of cost data varies from mode to mode, and any attempt to provide an overview of transport costs must be unsatisfactory in some way or another. For example administrative costs have been included for all modes, but there are strong arguments for excluding administration from at least rail resource costs, as rail staffing patterns are fairly inflexible to changes in the transport task. Distribution costs are not considered on the grounds that they are fairly similar for all modes. It can be argued that this will disadvantage road, but as distribution costs are especially difficult to estimate it would be pointless to add further uncertainty to the cost estimates.

The costs detailed in Annex C and discussed below are resource costs as for June 1976 unless stated otherwise. The discount rate used in the following analysis is 10%.

The costs considered fall into two categories:

- infrastructure costs, which include road and rail construction, terminal construction costs and ship purchase[1]; and

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(1) Ship purchase, being in a strict sense volume dependent could be entered in either category, but for the purposes of this study it was considered to be more appropriately classified as an infrastructure cost.

- operation costs, which includes all volume or time dependent costs such as rolling stock, labour, etc.

ROAD

The Bureau estimates the resource cost of operating a prime mover and two trailers in northern Australia to be 2.82 cents per tonne km moved. This estimate was made on the following premises:

- there is no backloading;
- the capital costs of road construction are excluded;
- an estimate of road maintenance cost is included;
- the road is assumed to be of National Highway Standard;
- no overloading occurs.

The detailed estimation procedure is presented in Annex C.

The operating costs change in response to changes in these assumptions:

(a) If there was no empty running (i.e. 100% backloading) the resource costs would be approximately halved.

(b) Operating costs on sealed roads built to wartime standards (unstrengthened) are 2.97 cents per tonne km with no backloading. The increase is due to increased road maintenance costs alone.

(c) For operations on gravel roads, extra costs arise from increases in both vehicle and road maintenance giving a total cost of 4.97 cents per tonne km, if no backloading is available.

As a comparison, road freight transport resource costs in southern Australia are estimated to be 1.84 cents per tonne km(1) assuming that 5 axle semi-trailers are used, and that vehicles are unladen for only 10% of the time. The operating costs of moving goods by

(1) Bureau of Transport Economics, Mainline Upgrading - evaluation of a range of options for the Adelaide-Serviceton link, (AGPS, Canberra, 1977).

road transport with the road network at the existing standard, and at National Highway Standard are presented in Table 6.1.

TABLE 6.1 - ROAD FREIGHT TRANSPORT TO THE N.T. TOTAL RESOURCE OPERATING COSTS[1]

(dollars/tonne)

Link		Existing	Improved
Brisbane	Camooweal	63.52	57.37
Camooweal	Three Ways[2]	13.64	13.00
Three Ways	Darwin	29.00	27.13
Three Ways	Alice Springs	15.67	14.89
Three Ways	Tennant Creek	0.77	0.73
Adelaide	Alice Springs	68.42	43.11[3]
Alice Springs	Tennant Creek	14.90	14.16
Alice Springs	Darwin	44.68	42.02

(1) Including road maintenance and reconstruction but not including $5.00 per tonne terminal costs.
(2) Junction of Stuart and Barkly Highways.
(3) The proposed new route is 171 km shorter than the existing route.
Source: Derived from Table 3.2 and Table C.1 in Annex C.

The capital cost of highway upgrading will be a significant cost component if road transport is to service the N.T., as only a small percentage of the highway system serving the Territory is up to National Highway Standard.

Estimates of highway construction costs were obtained from a number of sources which included the S.A. Highways Department[1], the Commonwealth Department of Construction[2], the Commonwealth Department of the Northern Territory[3] and in-house sources.

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(1) Commonwealth Department of Transport, S.A. Highways Department and the Commonwealth Bureau of Roads, Report on the National Highway Linking Adelaide and Darwin, Port Augusta to Northern Territory Border, 1976.
(2) Parliamentary Standing Committee on Public Works, Minutes of Evidence Relating to the Proposed Second Three-Year Program for the Improvement and Maintenance of the Stuart and Barkly Highways, Northern Territory, (Canberra, 1976).
(3) Northern Territory National Highway Corridor Study on the National Highway Linking Brisbane and Darwin in the region of the Barkly Tableland, Commonwealth Department of Northern Territory, Commonwealth Bureau of Roads, Commonwealth Department of Construction.

The cost per kilometre ranged from $65 700 for the construction of the Stuart Highway in South Australia, to $44 200 for the Barkly Highway upgrading. The cost differences result from savings accruing from the use of existing road structures in the upgrading process.

The capital costs quoted are totals and do not represent the costs which should be held against road freight transport. Research within the Bureau suggests that no more than 50% of road construction costs should be attributed to road freight transport.

RAIL

The only rail link to be considered in detail in this study is that between Adelaide and Alice Springs. The rationale for omission of other potential rail links is that the capital costs of establishing a new railway line can only be justified if more than 0.6m tonnes[1] of freight are to be moved per year (the details of this calculation are provided in Annex D). As evident from the information on the present and future freight flows presented in Chapters 4 and 5, no corridor is expected to reach the break-even figure of 0.6m tonnes for many years.

The Adelaide-Alice Springs rail link is already in existence and is presently being upgraded by the construction of the Tarcoola-Alice Springs standard gauge railway line. Estimation of operating costs for the new line is a difficult problem, because there is no line of similar standard with as low a volume of traffic. Operating costs for the old narrow gauge Alice Springs-Maree line are extremely high, being more than three times greater than costs on any other line operated by ANR, but ANR ascribes this to the old and outdated capital equipment, and the low operating speeds necessitated by this equipment.

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(1) This figure is an absolute minimum and is only applicable in the present context, as costs are likely to be considerably higher for rail in other areas.

The CAR Port Augusta-Maree standard gauge line carries about 2m tonnes of coal a year as well as the Alice Springs through freight traffic, and so its operating costs cannot be taken as indicative of costs on the new route. Similarly the TAR handles over ten times the traffic forecast for the Tarcoola-Alice Springs line, and as rail transport is a decreasing marginal cost industry, it is unlikely that the new line will be able to operate at the same cost per gross tonne km (GTK). The Australian National Railways provides itemised costs per GTK for all its operations, and these figures were examined in an attempt to estimate the operating costs for the new line. All costs, except track maintenance were taken from the TAR standard gauge. The track maintenance estimates of $1.49m per annum were taken from ANR estimates for the new line. The Bureau estimates the cost of operating the new line (excluding track maintenance) at 0.365 cents per GTK.

The construction and operation of the Tarcoola-Alice Springs rail link costs less than maintaining and operating the existing Maree-Alice Springs narrow gauge line. If the old line was to remain open for a further 5 years after 1981 an extra $1.7m per year would need to be spent on maintenance for 7 years from 1977. No increase in maintenance is assumed necessary if the line remains open for a further year, although heavy rain and subsequent flooding could alter this situation substantially.

The new line is only part of the rail link from Adelaide to Alice Springs. Any traffic from Adelaide must pass along the broad gauge line to Port Pirie, be trans-shipped to the standard gauge and railed to Port Augusta. Currently freight for Alice Springs then travels along the CAR standard gauge to Maree, is trans-shipped to the narrow gauge and proceeds to Alice Springs. When the new line is complete, Alice Springs bound traffic will proceed along the TAR from Port Augusta to Tarcoola and thence up the new line to Alice Springs. Northern Territory traffic represents less than 10% of total traffic on all lines except the present narrow gauge and the proposed Tarcoola line. Northern

Territory freight must therefore be regarded as a marginal operation, and is costed at line haul, plus terminal and trans-shipment costs, for all lines except the present narrow gauge, and the new Tarcoola-Alice Springs line. Estimated resource costs per tonne for general freight railed from Adelaide to Alice Springs are $65 per tonne for the present route and $30 per tonne for the proposed route. This estimate includes an allowance of $5.00 for terminal operations but excludes capital recovery on track and major buildings. The large difference in cost is due to the very high operating cost of the existing narrow gauge line. As suitable backloading is almost non-existent, all costs have been estimated to include empty return of the train.

The Alice Springs-Adelaide cost quoted above is based on the costs of operating fully loaded trains. At the traffic volume predicted for the Adelaide-Alice Springs link, the operation of fully loaded 3500 gross tonne trains may not be feasible if a reasonable level of service is to be maintained. If a minimum service of three return trains per week is assumed, then most of the variable costs such as crew become fixed and costs per tonne increase sharply as volume decreases. At 0.1m net tonnes per annum the cost is $51 per tonne; at 0.3m tonnes the service is fully utilised and the cost drops to $27 per tonne. Table 6.2 shows the estimated variation of costs with respect to the volume of freight carried.

TABLE 6.2 - RAIL RESOURCE OPERATING COST: ADELAIDE-ALICE SPRINGS VIA TARCOOLA, 3 TRAINS PER WEEK

Annual Volume ('000 tonnes)	Operating Cost (1) ($/tonne)
50	87
100	51
150	39
200	32.5
300	27

(1) Including load/unload costs at end of the line haul.

Besides general freight moving into the N.T. large quantities of livestock are also shipped out to Port Augusta. The narrow gauge line currently moves 40 000 to 50 000 head per year. This livestock is handled in special livestock trains which operate separately from the general freight traffic. No separate figures are kept for operating costs of stock trains, but the average cost per GTK and a suitable gross to net ratio can be used to calculate a rough estimate of cost per head. These estimates are shown in Table 6.3, together with estimates of revenue earned taken from ANR data. It can be seen that the shipment of cattle by rail is quite heavily subsidised.

TABLE 6.3 - RESOURCE OPERATING COST OF TRANSPORTING CATTLE BY RAIL, ALICE SPRINGS TO PORT AUGUSTA

($ per head carried)

	Resource Cost	Revenue	Loss
Maree line	35	14	21
Tarcoola line	14	14	-

Capital costs for rail present fewer problems of estimation. The Tarcoola-Alice Springs line at present under construction will cost approximately $140 000 to $150 000 per km. If this cost is taken as a reasonable indication of rail construction costs in the Territory, a rail link from Alice Springs to Darwin would cost well over $200m. As a comparison, upgrading of the Stuart Highway between Alice Springs and Darwin to a reliable all weather road would cost between $20m and $60m depending on the standard adopted.

SEA

The operating authorities, ANL and WASS, which service Darwin with interstate coastal shipping, are semi-government instrumentalities. The basic sources of data have been the financial accounts of ANL and WASS. Details of the analysis of their resource costs are given in Annex C.

The resource cost estimates of WASS operations during the study period are presented in Table 6.4. The increase in capital costs is due to replacement of the existing vessels during the study period. The traffic estimate is based on the assumption that WASS will retain its market share of the total N.T. freight traffic and that its other traffic remains constant.

TABLE 6.4 - WASS RESOURCE COSTS,WEST COAST SERVICE

Years	Total Traffic '000 tonnes	Annual Cost ($m)		Cost per tonne ($)		
		Capital	Operating	Capital	Operating	Total (1)
77-83	140-150	1.02	6.22	7	43	75
84-86	152-155	1.78	6.22	12	40	77
87-96	157-175	3.31	6.22	20	37	82

(1) Including stevedoring costs of $25 per tonne.

Similar resource cost estimates are given in Table 6.5 for the ANL coastal shipping service. The first estimate is for a one ship service, assumed to be the existing Darwin Trader, moving 40 000 tonnes per annum. The second estimate is for a two ship service. The operating costs per vessel for both services have been assumed equal to the existing Darwin Trader operating costs. As with WASS, the capital costs of these services change over the study period due to purchase of additional or replacement vessels. The replacement vessel is assumed to be similar to the Darwin Trader, but the additional ship for the two ship service is considered to be equivalent in type and size to the vessels used by WASS. Both maximum and minimum estimates for operating the Darwin Trader have been provided, corresponding to the cases of backloading at zero marginal cost for the maximum, and backloading costs equalling marginal costs for the minimum.

Although costs of the east and west coast shipping services cannot be directly compared, it has been possible to calculate some compatible cost estimates. The capital costs used in the comparison are those applicable to new ships rather than the

TABLE 6.5 - ANL RESOURCE COSTS, EAST COAST TO DARWIN SERVICE

Configuration	Years	Traffic ('000 tonnes)	Annual Cost ($m)			Cost per tonne ($)				
			Capital	Operating (1)		Capital	Operating (1)		Total (2)	
				min.	max.		min.	max.	min.	max.
1 Vessel	77-86	40.0	0.88	2.98	3.88	22	75	97	122	145
(10 Voy/Yr)	87-96	40.0	2.17	2.98	3.88	54	75	97	154	177
2 Vessels	77 (3)	38.8	0.88	2.98	3.88	23	77	100	125	148
(26 Voy/Yr)	78-86	40.5-53.6	1.98	6.48	8.28	37-49	121	204	183	279
	87-96	55.5-73.0	3.27	6.48	8.28	45-59	89	117	159	234

(1) Estimated minimum operating cost assuming backloading at marginal cost, maximum assumes backloading at no cost.
(2) Including stevedoring, cargo gear and commission of $25.60 per tonne.
(3) Only one vessel required in 1977.

existing vessels, thus avoiding confusion due to the different ages and values of the existing vessels. There are problems in using conventional measures of ship capacity for the Darwin Trader, and accordingly the concept of 'operational capacity' is used, defined as the quantity of cargo which the vessel can carry given the trade in which it operates.

Using cost per DWT km as the measure of cost, ANL appears to be marginally more efficient than WASS. However this is reversed if the cost per operational tonne km is used as the measure of efficiency. The details of this comparison are shown in Table 6.6.

TABLE 6.6 - COMPARISON OF TOTAL RESOURCE COSTS: ANL AND WASS, PRESENT COASTAL SHIPPING SERVICES TO DARWIN[1]

	ANL	WASS
Number of vessels	1	3
Total DWT of fleet (tonnes)	11902	23164
Operational capacity (tonnes)	4000	12000
Ratio: capacity/DWT	0.34	0.52
Annual fleet distance (1000 km)	120	250
Annual DWT km (m)	1428	1930
Annual operational tonne km (m)	480	3000
Annual total cost ($m)	5.15-6.05	9.53
Total Cost (cents)		
per DWT km	0.361-0.424	0.494
per operational tonne km	1.07-1.25	0.95

(1) Total cost here is operating cost plus annualised capital cost, but excluding $25 per tonne stevedoring. Capital cost estimated for new ships to allow comparison of services.

If sea is to become the major supply mode for the N.T., then some improvement of the general cargo handling facilities at the Port of Darwin is desirable. A recent report[1] has recommended the construction of a land backed general cargo wharf at a cost of $9m at 1976 prices.

(1) Bureau of Transport Economics, Provision of General Cargo Facilities at the Port of Darwin, (AGPS, Canberra, October 1975).

CHAPTER 7 - DEFINITION AND EVALUATION OF A TRANSPORT SYSTEM FOR THE N.T.

INTRODUCTION

For a complete description of the transport task it is necessary to define the level of service to be provided by the transport system. As the quantities to be moved have already been estimated, the transport task is fully defined once the level of service is set, and it is then possible to define the transport system which could best meet the transport task for the Northern Territory.

LEVEL OF SERVICE

The level of service is not a static parameter, but changes with the performance of each mode and with community expectations. Naturally the level of service demanded by the present Darwin community is different from that expected by the community of 20 years ago.

From discussions with the N.T. community it is clear that the level of service acceptable to the community is based upon the following requirements:

- the need to obtain a regular supply of goods from outside the Territory;
- disruptions to the supply should be infrequent and last for 2 to 3 days at most;
- that the charge for this service should be not at a level to place the members of the N.T. community at an economic disadvantage compared with the rest of Australia;
- that the time between ordering and delivery is 'not too long'.

The term 'all-weather transport service' will be used to describe a transport system which meets these requirements, although these requirements extend beyond the simple concept of a transport system which is unaffected by weather conditions. This concept of an all-weather system is used because the community requirements are met during the dry season and the term 'all-weather' reflects the extension of this service throughout the year. None of the transport services presently operating into the Territory meets all the requirements listed above. If one is primarily concerned with the all-weather requirement, then the shipping services come closest to fulfilling the conditions. However, the WASS service is unable to meet the fourth condition as any goods not readily available in Perth must be transported via Perth from the east coast. As well as increasing the transit time by approximately a fortnight, the costs are also substantially increased. The disadvantages involved are reflected in the small volume of freight originating in the eastern states which comes into the N.T. via Perth, although the advantages offered by the frequent and reliable WASS service must be considerable.

The major cause of dissatisfaction with the ANL service from the east coast is the time delay between ordering and delivery. The average time between ordering and delivery is 4 weeks, with a minimum of 2 weeks and a maximum of 6 weeks. Another problem with the ANL service has been the interruptions to the service which have resulted from industrial and mechanical difficulties. Although these have not been frequent or severe in the last 2 years, no positive marketing effort has been made to inform shippers of the improvements in the service. The use of only one vessel means that any disruption affects the total service.

Land based transport systems have been unable to meet the all-weather community requirements due to the disruptions to the service caused by the particularly severe wet seasons of the past 4 years. A total disruption of land based transport into Alice Springs occurred for a period of 2 months in 1974. This caused considerable problems due to a lack of preparation and the total dependence of an inland centre on land based transport services. Although similar disruptions occur to road transport services into Darwin, coastal shipping services continue to operate and the community accepts the disruptions as the norm rather than the exception.

AN ALL-WEATHER TRANSPORT SYSTEM FOR THE N.T.

The transport system serving the Territory can be divided into three corridors; the central corridor which supplies via Adelaide with links to Melbourne; the eastern corridor via Brisbane and Sydney; and the western corridor from Perth. Each corridor will be examined in turn to find the least resource cost method of providing an acceptable all-weather service through it. Where possible, timing and other issues are discussed, and the advantages and disadvantages of a choice made on purely resource cost grounds are clearly stated.

The resource costs of capital programs for the road, rail and sea modes and resource operating costs are given in Tables 7.1 to 7.4 respectively.

The central corridor, Darwin-Alice Springs

Any all-weather transport system for the N.T. must include a link between Darwin and Alice Springs to allow efficient distribution of freight within the Territory. Given the existing infrastructure (a partly reconstructed Stuart Highway) and the relatively small quantity of freight moving along the link, the least cost option is to upgrade the highway rather than build a railway line.

The capital resource costs of the road upgrading and alternative rail construction program are given in Tables 7.1 and 7.2 respectively. An order of magnitude estimate for the cost of road upgrading is $27m as compared with $220m for the construction of a railway line. Using the equation developed in Annex D, and the resource costs for road and rail developed in Annex C, a rail link would not be economically justifiable unless it carried 0.9m tonnes, or more[(1)]. The total traffic on the Darwin-Alice Springs link is not expected to reach this figure during the study period.

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(1) The threshold drops to 0.6m tonnes where the comparison is between an entirely new road and an entirely new rail.

TABLE 7.1 - CAPITAL RESOURCE COSTS OF ROAD UPGRADING PROJECTS

Link	Highway	Present Condition[1]	Upgrading Standard	Upgrading Period	Total Capital Cost $m	Discounted Cost (10%) $m
Brisbane-Camooweal	(Landsborough	288 km gravel remainder sealed	288 km NHS remainder sealed	4 yrs	14.4	9.6
	(Barkly	183 km sealed	all NHS	7 yrs	8.1	5.4
Camooweal-Three Ways	Barkly	405 km sealed 44 km NHS	73-74 condition	5 yrs	9.0	6.7[2]
			all NHS	7 yrs	19.8	13.1[2]
				10 yrs	19.8	12.2[2]
				20 yrs	23.6	12.1[2]
Alice Springs-Darwin	Stuart North	1147 km sealed 391 km NHS	881 km NHS remainder all-weather	3 yrs	26.9	22.3[3]
			all NHS	-	58.3	-
Adelaide-Alice Springs	Stuart South	951 km gravel remainder sealed	all NHS on new alignment	5 yrs	49.6	37.4[4]

(1) 'Sealed' implies sealed to below NHS specifications.
(2) N.T. National Highway Corridor Study on the National Highway Linking Brisbane and Darwin in the region of the Barkly Tableland.
(3) Department of Construction in Minutes of Evidence relating to the proposed second three year improvement and maintenance program - Stuart and Barkly Highways, Northern Territory, Parliamentary Standing Committee on Public Works, 1976.
(4) S.A. Highways Department in Report on the National Highway Linking Adelaide and Darwin, Port Augusta to Northern Territory Border, 1976, (costs updated to 1975-76).

TABLE 7.2 - CAPITAL RESOURCE COSTS: POSSIBLE RAILWAY TRACK CONSTRUCTION PROGRAMS, ADELAIDE-DARWIN CORRIDOR

Link	Distance (km)	Total Capital Cost ($m)	Discounted Cost (10%) ($m)	Upgrading Period or Date of Completion
Tarcoola	831	124	64.3	1981
Alice Springs		(35.2 committed)		
Alice Springs	1529	228 (1)	130 (2)	12 years
Darwin				

(1) Bureau estimate: includes terminals at Darwin and Alice Springs.
(2) Expenditure evenly spread over the construction period.

TABLE 7.3 - CAPITAL RESOURCE COSTS: ALL-WEATHER SHIPPING SERVICE

Corridor	Total Capital Cost ($m)	Discounted Cost(10%) ($m)
East Coast-Darwin	32.9	18.9
Perth-Darwin	32.5	5.4

TABLE 7.4 - OPERATING RESOURCE COSTS, CORRIDORS UPGRADED TO PROVIDE ALL-WEATHER TRANSPORT SERVICES

Link	Mode	Operating Cost (1) (2) ($/tonne)
Brisbane-Darwin	Road	103
East Coast-Darwin	Sea	115-230
Brisbane-Alice Springs	Road	90
Adelaide-Alice Springs	Road	48
	Rail	27-37
Adelaide-Darwin	Rail	55-83
	Rail-Road	71-81
	Road	90
Perth-Darwin	Sea	62-68

(1) Not including cost of infrastructure, but including terminal operations and stevedoring.
(2) For volume dependent costs the range shown covers the range of likely mode-source splits.

The Stuart Highway north of Alice Springs will be effectively all-weather by 1980 with the conclusion of the second three year improvement and maintenance program for the Stuart and Barkly Highways, and if required this program could be brought forward. The planning and construction of a railway line would require approximately 10 years.

The central corridor, Alice Springs-Adelaide

Although this is not an essential link in that an alternative link to Brisbane could be developed, Adelaide is the closest capital to both Alice Springs and Darwin and there are very strong historical connections between Adelaide and the Territory. These factors strengthen the case for upgrading the Alice Springs-Adelaide link, in preference to the N.T. to Brisbane corridor.

Given the operating and capital resource costs for road and rail shown in Tables 7.1 and 7.2 and the projected freight flow, the least cost means of providing an all-weather transport link between Adelaide and Alice Springs is to abandon both the existing rail link and the new partly completed line and re-align and seal the highway. This cost comparison has been made with the knowledge that $35m has already been spent or committed on the railway construction program. The freight traffic on this link is not expected to reach 0.3m tonnes per annum during the study period. At freight volumes below this level, road resource costs are less than rail, assuming the rail construction costs are the $89m required for completion of the rail link.

This ranking depends critically upon the volume of freight moving through the corridor and the capital expenditure required but not yet committed for the construction and completion of the rail and road projects. The maximum uncommitted capital(1) at which

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(1) Uncommitted capital is expenditure projected in budget forecasts but not yet committed in contracts.

the rail project is the least cost option is given in Table 7.5 for a range of annual freight volumes and service levels. This table has been calculated using a 25 year time horizon, a 10% discount rate, a constant annual freight volume, and allocating 50% of the road capital against freight.

TABLE 7.5 - MAXIMUM UNCOMMITTED CAPITAL FOR THE TARCOOLA-ALICE SPRINGS RAIL LINK AT WHICH RAIL IS PREFERRED TO ROAD ($m)

Freight Volume (annual tonnes)	Service Level	
	at least 3 trains weekly	minimum service level (1)
0.1m	22	34.5
0.2m	52	57.5
0.3m	81	81

(1) Trains only operate when fully loaded, that is approximately 1 train per week for each 0.1m tonnes per annum.

The road construction program has been designed as a 5 year program with sections of the highway being brought into use as they are completed. Even if the highway construction program was accelerated, it is unlikely to be completed before the anticipated opening of the Tarcoola-Alice Springs Railway in 1981. If rail construction is halted but the present level of service to the N.T. community is to be maintained the narrow gauge link must be kept open for a year or so after 1981 until the construction of the Stuart Highway is complete. The cost of this must be taken into account in deciding between a road and the new railway, but even allowing a total of $5m for extra narrow gauge maintenance and allocating 50% of the capital cost of the road to freight transport, the road is still the preferred option at freight volumes of up to 0.3m tonnes per annum.

ANR has circulated a proposal aimed at bringing the new standard gauge link into operation as soon as possible. The proposal involves the operation of a railhead at either Robin Rise (the end of stage 1) or Kulgera on the N.T.-S.A. border. If Robin

Rise is chosen it would be necessary to transport freight over 400 km on the unsealed section of the Stuart Highway. If Kulgera is selected, the operational date is advanced by only a year, and the necessity of continuing the line to Alice Springs is brought into question.

A third alternative involves construction of the railway as planned together with construction of the new Stuart Highway south from the N.T.-S.A. border. The aim would be to complete the railway from the south to Marla Bore (the end of stage 2), and to complete the highway from the north to the same point at the same time. A railhead could be opened at Marla Bore and an all-weather link between Adelaide and Alice Springs would be operational at the earliest possible date, probably 1979. A proposal of this type carries an inherent commitment to construct both the railway line and the highway.

If the rail link is preferred to road the provision of an all-weather link will be advanced by a maximum of 3 years, but the disadvantages are considerable. The provision of a rail service is not the least resource cost solution for such a low traffic volume, and the immediate construction costs which must be met by the Government are $40m greater for rail than for road. Further, provision of a rail link will not give the private individual the advantages of increased mobility that would arise from an upgraded highway. Similarly it is unlikely that a new railway link would provide as great a stimulus to the tourist industry as a sealed road.

If the political commitment to build the rail link is such that the line cannot be abandoned but must be brought into service, then the southern Stuart Highway upgrading is not necessary for the movement of freight into the Territory.

The existence of infrastructure for both road and rail on this link cannot be justified from benefits accruing to freight(1) on

(1) Non-freight traffic may generate sufficient benefits to justify road upgrading.

economic grounds, as each mode would separately have sufficient capacity to move all the freight generated by the region without any extra capital works. The resource operating costs for rail of $27 per tonne (Chapter 6) are quoted on the basis of a rail freight flow of 0.3m tonnes per annum. If both rail and road are upgraded, it is unlikely that rail would attract significantly more than half the traffic (this is similar to the modal split which occurs between road and rail in other areas). For most of the study period less than 0.15m tonnes per annum would move by rail along this link. The rail resource costs measured on a per tonne basis with this limited utilisation are $40 per tonne (excluding the capital cost of the rail line), a cost comparable with the $48 per tonne estimated for road.

The eastern corridor

The N.T. community, particularly the Darwin community, considers the link with Brisbane a significant component of the transport system and one which should be all-weather. If this link is to be an all-weather link, it could be accomplished by upgrading the Barkly Highway or by improving the shipping service between the east coast and Darwin.

The Barkly Highway is seen as the critical section of a Brisbane-N.T. land based transport link, as it is assumed that the Stuart Highway between Darwin and Alice Springs will be all-weather before the Barkly Highway, and an all-weather rail link already exists between Brisbane and Mt Isa at the eastern end of the Barkly Highway. A study is presently in progress with the aim of recommending a program for the upgrading and/or re-alignment of the Barkly Highway between Tennant Creek and the Queensland border to bring it up to National Highway Standard.

It is anticipated that the Landsborough Highway will be upgraded during the same period as the Barkly, and since this highway is part of the direct Brisbane-Darwin road link at least some of the costs of its upgrading should be held against the N.T. road freight traffic.

The road costruction costs for the Brisbane-Darwin link are shown in Table 7.1.

The alternative Brisbane-Darwin upgrading involves improvements in the coastal shipping service. This could be achieved by the introduction of a second vessel into the Darwin, east coast trade. Frequency would thus be increased from monthly to fortnightly and the reliability of the service would be improved. The precise details of the operation of this vessel are not important so long as it has approximately the same capacity as the *Darwin Trader*, and the sailing times of the two vessels could be co-ordinated to provide a fortnightly service between Brisbane and Darwin.

The total capital resource costs of this two ship service are shown in Table 7.3 and the annual resource costs are shown in Table 6.5. These costs have been calculated assuming that the extra vessel had similar costs to the *Darwin Trader*, except for the capital costs which were assumed to be similar to a new vessel of the type used by WASS. It should be noted that the resource costs are not constant over the next 20 years but increase with the replacement of the *Darwin Trader* and the subsequent increase in capital charges.

Given the capital resource costs, road transport must be preferred to coastal shipping on the Brisbane-Darwin link. The net present cost of upgrading of the Barkly Highway to National Highway Standard over 7 years is $18.5m compared with a net present capital cost of $18.9m for the provision of a fortnightly shipping service from the east coast. It should be noted that the total cost for the shipping service should be held against the freight service, whereas no more than 50% of the highway upgrading costs should be held against the freight service.

As well as being more expensive in terms of capital cost, the operational cost per tonne is also greater for east coast shipping than road. The line haul shipping costs for a fortnightly service into Darwin vary between $89 and $204 per tonne depending on volume, while the equivalent resource cost on road is $106 per tonne for the present road and $98 per tonne for the improved road. The handling costs associated with the line haul are $25 and $5 per tonne for sea and road respectively. If costs are compared for N.T. towns other than Darwin, the cost advantage of road over sea increases.

If the criterion used to determine the preferred mode is based on resource costs, then the preferred mode for the Brisbane-Darwin link must be road transport.

The upgrading of the Barkly Highway to National Highway Standard could be completed in 7 years, or spread over a 20 year period. The extension of the upgrading period increases policy flexibility, marginally reduces net present costs and benefits, but as flood prone sections of the highway are attended to early in the program, provision of an all-weather road system is not delayed. Accordingly the extended upgrading program should be preferred to the 7 year program. The shipping service upgrading could be accomplished with the purchase and commissioning of a second vessel, a process which would require at least one year.

Given that neither the road or shipping services can be upgraded immediately and that the community has adapted to the present circumstances, the timing of these alternatives is not critical in choosing between them.

Northern Territory-Perth

This link is seen by the Darwin community to be important because an all-weather coastal shipping service run by WASS operates within this corridor. The annual resource costs of this service are given in Table 6.4 and the total capital costs in Table 7.3.

A road link does exist between Perth and the Northern Territory. This is used to some extent, but its use will continue to be limited as several hundred kilometres have yet to be sealed.

Comments on this corridor are limited as it is not regarded as significant within the context of this report. Perth is an unsatisfactory supply source as it imports many of its requirements from eastern Australia. As the corridor from either Brisbane or Adelaide is upgraded, the importance of the Perth-Darwin link will diminish.

A total system

Given the ease of entry into the transport industry, it is impossible to define in detail a total transport system for the Territory. Rather than attempt a complete definition, the system will be defined in terms of the components which are essential to meet the transport task.

The primary component of the total transport system must be a land based north-south link between Adelaide and Darwin. This link is part of the shortest route between Darwin and the cities of Adelaide and Melbourne, and for Sydney is only marginally longer than the route via Brisbane (see Table 3.2). Accordingly it represents the least cost route for supplying the Territory. Given the detailed analysis above, the least cost option for the north-south corridor is to seal the road, and discontinue construction on the Tarcoola-Alice Springs Railway. If this is unacceptable then the rail link should be completed, and the Stuart Highway south should not be sealed or re-aligned unless it can be justified on grounds other than benefits accruing to freight transport movements. Approximately half the freight requirements of the Territory move through the north-south corridor in its present state and it is estimated that this would increase to more than 60% if it was upgraded.

The Brisbane-Darwin corridor was considered as a second transport link into the Territory. However it could not be justified as a second upgraded corridor, given that the north-south corridor would provide sufficient capacity to move the projected quantity of freight at an acceptable level of service. The only means of justifying upgrading this link would be to argue that a direct link with Brisbane is essential. As Adelaide, Melbourne and Sydney can best supply the Territory using the north-south link the exclusion of Brisbane as a reliable supplier is not critical.

If a second corridor is to be upgraded, the Brisbane-Darwin corridor is preferred to the Perth-Darwin corridor. This reflects the pattern of freight movements into the Territory, with 30% of general freight coming via the Brisbane-Darwin corridor compared with only 13% from Perth.

No further major transport infrastructure or services are necessary to meet the transport task of supplying the Territory during the study period. However, it is likely that other services, particularly coastal shipping services, will continue to operate.

OTHER CONSIDERATIONS

The total system defined above has been developed as the least resource cost system. Any evaluation of the system must include analysis of other impacts. These are considered below.

Financial cost to Government

The cost to the Government for the least cost system is simply the cost of infrastructure (the Stuart Highway upgraded to National Highway Standard) plus road maintenance. The capital costs amount to $108m but these would be spread over a number of years. This represents the total construction costs, and if the previous arguments are accepted, no more than 50% of these costs can be attributed to freight transport.

If the railway link between Alice Springs and Tarcoola is completed instead of the road link, then the capital costs increase by $39m to $147m, if the capital already committed to the rail link is ignored. Further the operation of this rail link creates a financial liability for the Government in the funding of any future operating deficits which may be incurred by the rail operating authority.

The probability of the rail operating authority incurring a deficit on the service to Alice Springs increases substantially if the south Stuart Highway is upgraded as well as the rail link. The charges for the rail service will be limited by road competition, but the cost per tonne for rail will increase sharply with decreasing volume (see Table 6.2).

Alternative transport systems based on coastal shipping require minimal infrastructure if the highway system is not an integral part of the plan, but do impose a continuing committment on the Governments concerned to fund future deficits incurred by the shipping operations.

Charges for transport services

The charge is explicitly defined within the level of service criteria as not being so great as to place the Northern Territory at an economic disadvantage compared with the rest of the Australian community. A necessary condition for this is that costs are minimised, and that this is then reflected in the charges through competition.

Costs are likely to be minimised by obtaining freight for the Territory from the closest sources. The transport system proposed provides for the sourcing of goods in Adelaide and Queensland, plus sufficient flexibility to source goods readily from Sydney or Melbourne.

With the proposed transport system, the second part of this price minimisation process, competition, will occur within the road transport industry. At the freight volumes expected for the N.T. competition between rail and road and between sea and road may lead to increased charges, since unit costs for rail and sea can increase significantly as traffic decreases. From information presented in Chapter 6 the charges for rail would need to be increased by approximately 50%-70% if road was to capture half the share of traffic and the rail charges were to reflect the average operating costs.

Bulk freight flows

As the least cost transport system has been developed without explicit reference to bulk freight flows into the Territory, it is necessary to consider the impact of bulk freight flows on the system.

More than 90% of the bulk freight coming into the Territory is moved by specialised ships and is distributed through Darwin. Most of the remainder is moved north from South Australia for consumption in Alice Springs.

This situation is unlikely to change radically with the introduction of improved land transport. Even if Alice Springs' bulk requirements were supplied entirely from Adelaide, the total bulk traffic would not be more than 0.1m tonnes per annum, and this does not affect the conclusions reached by this report. The economics of bulk freight movement are such that supply through the Port of Darwin will be the preferred means of providing the bulk freight requirements of the Territory.

Other impacts

Any upgrading of the existing transport infrastructure serving the Territory will introduce changes in other areas besides the flow of freight into the Territory.

The provision of a sealed road from southern Australia to Alice Springs will mean a substantial increase in tourist traffic; the more optimistic predicting a doubling of the number of tourists. It would also provide a cheaper means than presently exists for Northern Territory residents to move their families south for holidays, etc. The study team which examined this corridor with a view to highway upgrading, claimed that $50m could be spent on alignment and construction with a benefit-cost ratio of 1.1, even allowing for the rail link carrying most of the freight on the corridor(1).

If the southern half of the Stuart Highway were to be upgraded in preference to construction of the rail link, some adjustments would be needed in the cattle industry centred around Alice Springs. Presently the area produces store cattle, most of which are railed to Port Augusta for sale in southern markets. As shown in Table 6.3 the rail charges have been set considerably below cost for the existing rail link, but would approximately cover the operating cost on the Tarcoola-Alice Springs rail link. The equivalent resource cost of moving cattle to Port Augusta by road is approximately $20. If both costs were increased to incorporate the capital costs, the resource costs on road would be less than rail. Without a rail link the current indirect producer subsidy would cease to operate. Accordingly, either the Government would need to provide some form of alternative assistance to the cattle industry, or the industry would need to adjust to new circumstances. The provision of an indirect subsidy to the cattle industry via the availability of less than cost rail services may lead to inefficient allocation of resources.

If the coastal shipping services are supported at the expense of the land based transport links, the sense of isolation from the rest of Australia which exists in the N.T. community is likely to

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(1) S.A. Highways Department in Report on the National Highway Linking Adelaide and Darwin, Port Augusta to Northern Territory Border, 1976.

be intensified. This is a result of the less frequent services which would be expected with coastal shipping compared with land based transport, and because only Darwin and Nhulunbuy are served by interstate coastal shipping services.

Disruptions to transport services caused by industrial disputes have been significant on some of the modes serving the Territory. The road transport industry has suffered less from industrial disputes than the other modes.

Timing of investment

The timing of investment has a considerable impact on the net present cost of upgradings as shown in Tables 7.1 to 7.3.

If a serious attempt is to be made to meet the level of service criteria, the central corridor should be upgraded as a matter of urgency. The critical part of this corridor is the Alice Springs-Adelaide link. The rail line construction program is due for completion in 1981 and the alternative highway upgrading could not be completed before this date. The Stuart Highway north will be effectively all-weather with the completion of the current 3 year construction program.

Benefits of an all-weather transport system

The benefits which would be obtained by the provision of all-weather transport fall into two categories; the first is a direct benefit in the form of a decrease in costs, and the second is a latent consumer benefit.

The reduction in costs would arise as a result of reduction of inventory levels which are presently held to carry the community through periods when the transport system is disrupted. Accompanying these would be a reduction in the use of air freight. This benefit has been calculated to be $30 per person per year. The details of the estimate are provided in Annex C.

The latent consumer benefit arises from the provision of goods at a lower price with a subsequent increase in demand. An order of magnitude estimate is $50 per person per year. This estimate has been made by considering the perceived consumer loss of not having an all-weather transport system. Details of the estimate are provided in Annex C.

An order of magnitude estimate of the total benefits of an all-weather transport system is thus $80 per person per year.

CHAPTER 8 - TECHNOLOGY AND REGULATIONS

INTRODUCTION

Changes in technology and regulations may have a significant effect on the performance and cost of a transport system over a long time interval such as the 20 year horizon of this study. Technological change usually leads to reduced costs for a particular mode and often to a change in modal split.

No major technological change is expected in the immediate future which would have a marked effect on the transport system supplying the Northern Territory. However, a continuing string of minor innovations can be expected which will probably favour the land based modes. In addition, a steady increase in fuel costs can be expected which will tend to favour sea transport provided that it makes full use of the available technology to match its services to the demand.

Changes to regulation and operating procedures are at least as important as technological change in terms of their impact on the Northern Territory transport system. Changes in regulation will be primarily the responsibility of the new Northern Territory Administration, while operating procedures depend upon agreement between regulatory authorities, owners and unions.

ROAD TRANSPORT

Perhaps the most important regulation governing transport in the Northern Territory is that covering axle-load limits for road vehicles. The legal limits for axle-loads are a compromise between road construction and maintenance costs and the operating efficiency of large trucks. It is unlikely that axle-load limits will be changed significantly over the next 20 years, following the levels proposed by the recent National Association of Australian

State Road Authorities study[1], but strict enforcement may have a significant impact. For the purpose of discussion any vehicle whose axle-loading exceeds the legal limit is described as overloaded, although the truck itself may be designed to carry even heavier loads. This report is concerned with overloading of the road rather than the vehicle.

Although damage caused to the road by overloaded and heavy vehicles generally accumulates slowly, there are circumstances under which extremely rapid deterioration can occur. Roads in Northern Australia are particularly susceptible to such damage during the wet season. The cost of bringing the Barkly Highway back to pre 1973-74 condition (following deterioration caused by the movement of heavy vehicles on poorly drained sections during the wet season of 1973-74) has been estimated at $9 million. This restoration cost is equivalent to more than $100 per tonne assuming that only half the repair cost may be set against goods moved over the highway during the 1973-74 wet season. Given costs of this magnitude enforcement of axle-load limits will be of vital importance to the new Northern Territory Administration and plans are in hand to achieve a high level of compliance. Such enforcement will have two main effects.

The immediate impact of strict enforcement of axle-load limits will be to increase costs of road operators, with subsequent increases in freight rates. However, on balance, the cost to the community will be less because of the saving in road maintenance expenditure. It is unlikely that the change in rates will be sufficient to cause a major change in modal choice by customers, but there may be some move towards greater use of the sea services.

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(1) National Association of Australian State Road Authorities, A Study of the Economics of Road Vehicle Limits, Evaluation and Conclusions, Study Team Report - R2, (Sydney, February, 1976).

The second effect of enforcement of load limits will be to encourage technological innovation in the form of reduced vehicle tare weight. Such a reduction would allow operators to obtain the benefits of increased load capacity without exceeding axle-load limits and damaging the roads. This would simply reinforce the general technological trend towards lighter vehicles.

Continual improvements in vehicle suspension and tyre design are to be expected which will result in less road damage and lower operating costs. However the latter are likely to be offset by increased fuel costs.

There is little likelihood of change in vehicle length regulations. The usual configuration for interstate road freight vehicles moving into the Northern Territory is a prime mover and two trailers. Under economic pressures, a prime mover and three trailers is sometimes used, but this configuration is not favoured by operators. Changes in vehicle length regulations would have only a marginal impact on costs and, until more information is available on the effects of long vehicles on road traffic flow and safety, no change in regulation is likely to be considered.

RAIL TRANSPORT

Although not innovative in a true technological sense, the Tarcoola to Alice Springs railway is being constructed to a much higher standard than the Central Australia Railway which it replaces. The higher standard is important in the reduction of operating costs, particularly track maintenance, and this fact has been taken into account in the analysis. Similarly, the higher standard will lead to greater reliability of service which will assist in obtaining and holding a significant share of traffic in the north-south corridor.

At least an equal impact on costs can be expected from the improved operating procedures made possible by the new line. Operating conditions will be very different from those pertaining on the present Maree to Alice Springs link and, no doubt, ANR will be seeking to increase productivity to further reduce costs. Only if full advantage is taken of the higher standard can the railway be expected to cover its operating costs.

SEA TRANSPORT

No major technological change is seen as likely in the interstate coastal trade. The heavy investment required for a new ship is likely to prohibit major changes, but evolutionary change leading to better utilisation of resources and better matching of supply to demand is likely to occur. Emphasis for development will probably be on materials handling aspects and ship turnaround procedures rather than improvements in ship capacity or line haul performance. Such changes are not likely to be sufficient to change the modal split significantly.

It is in the area of shipping services to small coastal communities that pressure for change will be greatest. This applies in both technical and regulatory areas.

The small communities dotted along the north coast and on the islands depend almost entirely on barge operations from Darwin for the supply of staple items. These operations, using existing barges, are very expensive. These costs will impose economic penalties on the communities concerned unless changes can be made in both technology and operating procedures, or the services are heavily subsidised.

One possible innovation, mentioned by residents in the Northern Territory, is the introduction of dumb barges[(1)] to allow greater flexibility of operation than is possible with powered barges. This leads directly to conflict with the maritime unions who are

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(1) A barge which has no means of self-propulsion and is towed by another vessel.

firmly opposed to such operations on the Australian coast. Similarly, regulations related to crewing and loading of vessels of a size suitable for these services may be altered to facilitate cost reductions, but again this may be infeasible due to difficult industrial relations.

Although these operations are peripheral to the main transport services to and within the Northern Territory as a whole, they may well develop into a significant drain on the resources of the Administration or, alternatively, on the Department of Aboriginal Affairs which carries a responsibility for many of the settlements concerned. The alternative of constructing all-weather roads to these settlements would be prohibitively expensive because of the nature of the country and climate. It is suggested that the Northern Territory Administration should consider undertaking a detailed study into the supply problems of these settlements before escalating costs produce a crisis situation.

CHAPTER 9 - CONCLUSION

The freight transport requirements of the N.T. and the options available for meeting these requirements, have been discussed in previous chapters. A least cost approach has been adopted for evaluation of alternatives. No benefit-cost ratios have been presented, owing to the unquantifiable nature of many benefits, and the uncertainty in the time scale for many of the projects examined. The study team has neither the information nor the first-hand experience to determine detailed schedules and construction plans, however the general results that have emerged from the study are stable under a wide variety of forecasts and cost changes.

Table 9.1 provides a summary of the options and costs of the most likely alternative transport systems considered for the Territory.

The study has shown that road investment offers the least cost solution of meeting the Northern Territory's transport requirements. Road has several advantages, for the low traffic volumes occuring in the N.T. it is substantially cheaper in total resource cost terms than sea and rail; it also has a faster transit time than either of the competing modes. Road transport operates in small units and is much more responsive to changes than either rail or sea. Given the uncertainties involved in predicting the Northern Territory's future, such flexibility is a great advantage. Further the internal competition between road operators is the best guarantee, not only that costs will be kept to a minimum, but that prices will reflect costs. The construction of all weather roads to the Territory is likely to be of much greater direct benefit to the community than the construction of a rail link, or the implementation of a more frequent shipping service. Private citizens would benefit from increased mobility, tourist traffic would grow as roads improved, and those already travelling on the road would do so in vastly improved conditions.

TABLE 9.1 - OPERATING AND CAPITAL RESOURCE COSTS OF THE MAJOR TRANSPORT OPTIONS CONSIDERED

Source	Mode	Operating Cost (1) $ tonne		Capital Cost ($m)	Action
		Darwin	Alice Springs (2)		
Brisbane	Road	103	90	69-100	Upgrading of Barkly, Landsborough and Stuart Highway (North)
	Sea	115-230	159-274	60-91	Upgrading of Stuart Highway (North) purchase of second ship
Adelaide	Road	90	48	77-108	Construction of Stuart Highway (South) upgrading of Stuart Highway (North)
	Road/Rail	71-81	27-37	151-182	Rail constructed Alice Springs-Tarcoola upgrading of Stuart Highway (North)
	Rail	55-83	27-37	352+	Rail construction Tarcoola-Darwin
	Road/Rail	75+	33+ (3)	201-232	Rail constructed Alice Springs-Tarcoola construction of Stuart Highway (South) upgrading of Stuart Highway (North)
Perth	Sea	62-68	106-112	60-91	Replace WASS vessels as required upgrading of Stuart Highway (North)

(1) Includes load/unload costs at ends of line haul.
(2) Sea mode to Alice Springs includes road transport from Darwin to Alice Springs.
(3) Assuming up to 0.2m tonnes annually carried by rail.

The central corridor from Adelaide to Darwin is the most important N.T. transport corridor by any criteria. Adelaide is the nearest capital to both Alice Springs and Darwin, and the road from Alice Springs to Darwin is a vital link in the Northern Territory's internal transport system.

Given that a least resource cost solution is required, the best development for the Adelaide to Alice Springs sector of the corridor is to build a re-aligned Stuart Highway and abandon construction of the new Alice Springs-Tarcoola Railway. If this proposal is not feasible then the rail link should be constructed, but the road should not be built unless it can be justified in terms of the benefits accruing to non-freight road traffic.[1] The volume of freight traffic in the corridor cannot justify the upgrading of more than one transport mode between Alice Springs and Adelaide.

If immediate provision of an all-weather link rather than cost is the criterion, then the rail link can be completed by 1981, while the road even if started immediately could not be complete before 1983. However, an all-weather road-rail link between Alice Springs and Adelaide could be provided by 1980 if the road was constructed from the north and a railhead established at a suitable point on the rail construction line. It must be borne in mind that any proposal involving the permanent retention of the rail link involves a substantial increase in total resource cost to the community. However, until an upgraded road or rail link is available, the old narrow gauge line must continue to operate. In its present unsealed state the south Stuart Highway could not carry extra freight traffic without massive deterioration.

The second half of the central corridor, the Alice Springs to Darwin sector, is also best served by road. Here the case is even more clear cut, as there is no sunk expenditure involved in

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(1) Any analysis of the highway upgrading should consider the increase in the unit cost of rail freight which would occur due to diversion of freight to road.

a rail project, and the northern Stuart Highway requires far less expenditure to improve it to an acceptable standard than the south Stuart Highway. The second three-year maintenance and construction program presently being undertaken will provide an all weather road at the cost of $27m by 1980. A total expenditure of approximately $58m would bring the entire road north of Alice Springs to National Highway Standard.

Most N.T. residents interviewed expressed a wish for road links to both Adelaide and Brisbane. However, the upgrading of a second corridor to all-weather standard cannot be justified on the supply of freight alone. Shipping from the east coast may continue as a commercial operation, but from the resource cost point of view it is expensive and should not be supported by a Government subsidy.

One supply source which was only considered in passing is S.E. Asia. Darwin already imports substantial quantities of building materials from this area, but expansion of trade is inhibited by Australia's high tariff barriers. While many constitutional difficulties are involved, Darwin and the Northern Territory would benefit greatly from easier access to S.E. Asia as a source of supply.

In summary, this report concludes that the construction of the entire Stuart Highway from Port Augusta to Darwin to all-weather standard is the least cost method of meeting the freight transport requirements of the N.T. If the Alice Springs-Tarcoola rail link construction continues, the Stuart Highway south of Alice Springs should not be improved unless the improvement can be justified without considering benefits arising from freight traffic.

ANNEX A
PREPARATION OF DATA

ROAD DATA

The road freight flow data for the Northern Territory are of poor quality and incomplete. There are two sources of information, both collected since 1971, the Australian Bureau of Statistics (ABS)[(1)] and the Department of Northern Territory (DoNT) quarterly roadside surveys.

The ABS figures (Table A.1) record flows into Darwin from major centres (e.g. Brisbane, Sydney, Adelaide, Melbourne) via forwarders moving at least 500 tonnes quarterly. They therefore record only partial flows into Darwin, and they do not record movements to other centres in the Territory or from origins other than those stated. There is no commodity classification available for the ABS statistics.

The DoNT roadside surveys are taken for a week each quarter. There are three entry points monitored, Avon Downs (Barkly Highway from Qld.), Mt Cavenough (Stuart Highway from S.A.) and Dingo Gap (Victoria Highway from W.A.). The Dingo Gap flows are so small that they were ignored in the data analysis which follows.

These surveys record all traffic in and out of the N.T. for the week the survey operates. The questionnaire asks for information including weight, commodity classification of freight, origin and destination, and whether the load is part of a co-ordinated road-rail service. The data is of course biased in many ways; the driver is under no obligation to reveal his actual tonneage,

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(1) Australian Bureau of Statistics, Interstate freight moved by major freight forwarders and road transport operators between specified Australian Centres.

TABLE A.1 - ABS ROAD FREIGHT FLOWS TO DARWIN

(tonnes)

Year	Quarter	Brisbane	Sydney	Melbourne	Adelaide
1971	3	2942	1324	273	505
	4	3452	817	532	902
1972	1	2563	956	430	765
	2	3711	986	545	1455
	3	3349	1002	588	1070
	4	3799	1308	790	1157
1973	1	2208	1446	756	873
	2	3674	1457	906	1114
	3	3095	1959	2063	1457
	4	4004	1601	1956	1789
1974	1	412	745	980	694
	2	3948	1572	636	1298
	3	4252	1590	698	1155
	4	4952	1429	728	1173
1975	1	2863	652	602	414
	2	3635	1185	1013	n.a.
	3	5849	1380	1170	1224
	4	5373	2290	809	966

Source: Australian Bureau of Statistics, Interstate Freight Moved by Major Freight Forwarders and Road Transport Operators between Specified Australian Centres.

and he is asked where he picked up his load, not where it originated. For this reason DoNT figures cannot give a reliable picture of the freight origin, although they can give a reasonable idea of freight destination. However, even here, results of the DoNT surveys must be treated with caution. For example, very few consolidated loads go entirely to Katherine, a Darwin-bound driver will normally just drop part of his load at Katherine as he passes through. As a result the DoNT surveys show only minimal flows to Katherine from Adelaide and Brisbane, whereas interviews with Katherine tradespeople reveal that much of their freight comes direct from these cities.

In brief, the DoNT surveys can give only the crudest of information about the origin, destination, weight and commodity classifications. However they are useful as estimates for calculating the total flow through the border crossing points.

A comparison of the DoNT road surveys and the ABS statistics shows that:

- the ABS figures underestimate the major cities to Darwin flows;
- flows into the N.T. relating to other origin destination pairs are also significant.

The DoNT survey results were used as samples, first to correct the ABS (major cities to Darwin) flows, and then to provide estimates for other flows into the Territory.

As a first step the ABS (major cities to Darwin) estimates were adjusted using the DoNT surveys as a sample. The ABS quarterly figures for Brisbane and Sydney were aggregated as the Barkly corridor, and the ABS figures for Adelaide and Melbourne were aggregated as the Stuart corridor. In quarters where DoNT observations were available, these were inflated to give estimates for freight flows from Brisbane and Sydney to Darwin on the Barkly, and Adelaide and Melbourne to Darwin on the

Stuart. For each corridor these estimates were then divided by the corresponding ABS figures giving Table A.2. An average ratio for each corridor was then taken, and the ABS quarterly series were inflated by these ratios, the Brisbane and Sydney series by the Barkly ratio of 1.53:1, and Adelaide and Melbourne series by the Stuart ratio of 2.31:1, giving Table A.3.

TABLE A.2- DoNT SURVEYS: ESTIMATES OF ROAD FREIGHT FLOWS MAJOR CITIES TO DARWIN

(tonnes)

Corridor	Quarter Year	ABS	DoNT Estimate (1)	Ratio
Barkly	3.71	4266	6721	1.58
	4.71	4269	3705	0.87
	1.73	3654	5616	1.54
	2.73	5131	8047	1.57
	4.73	5605	7969	1.42
	2.74	5520	9230	1.67
	3.75	5842	14937	2.56
	4.75	6381	6734	1.06
			Average	1.53
Stuart	3.71	778	3861	4.96
	4.71	1434	884	0.62
	1.73	1629	2184	1.34
	2.73	2020	3406	1.69
	4.73	3745	3159	0.84
	2.74	1934	4277	2.21
	3.75	2394	5759	2.41
	4.75	1775	7176	4.04
			Average	2.31

(1) Weekly sample inflated to a quarter.

TABLE A.3 - ROAD FREIGHT FLOWS: MAJOR CITIES TO DARWIN ABS FIGURES CALIBRATED WITH RESPECT TO DoNT SURVEYS

('000 tonnes)

Year	From Brisbane/ Sydney	From Adelaide/ Melbourne
1971-72	25.5	12.5
1972-73	27.6	16.5
1973-74	27.8	24.9
1974-75	31.8	13.3
1975-76	40.6	19.2

The Department of Northern Territory survey observations were then aggregated to give a ratio:

$$R = \frac{\text{total incoming freight}}{\text{freight major cities to Darwin}}$$

for the Barkly and Stuart Highways.

These ratios; R = 2.08:1 for the Barkly and R = 1.80:1 for the Stuart, were applied to the corrected major cities to Darwin flows in Table A.3 to give the total road flows in Table A.4.

TABLE A.4 - TOTAL ROAD FREIGHT FLOWS INTO THE N.T.

('000 tonnes)

Year	Via	
	Barkly	Stuart
1971-72	53.0	22.4
1972-73	57.3	29.6
1973-74	57.8	44.7
1974-75	66.1	23.8
1975-76	84.4	34.5

Source: Table A.3, Brisbane/Sydney inflated by 2.08, Adelaide/ Melbourne inflated by 1.80.

The commodity and destination breakdowns given in Tables A.5 and A.6 were also estimated as percentages of the aggregated samples, the data being insufficient to justify more complex methods of analysis.

SHIPPING FREIGHT FLOWS

Maritime freight is measured in 'cargo' tonnes, which is either a cubic or a weight measurement depending on the density of the commodity. Items which bulk as more than one cubic metre per tonne are recorded at one cargo tonne per cubic metre. A list of general items and their cargo tonne equivalents is shown below (Table A.7).

TABLE A.5 - DoNT ROADSIDE SURVEYS: ROAD FREIGHT INTO THE N.T., BY COMMODITY

(%)

Commodity	Corridor	
	Barkly	Stuart
Food and drink (non-perishable)	3.9	6.4
Food and drink (perishable)	9.5	22.9
Building materials	12.8	23.9
Domestic durables	1.9	0.5
Plant and machinery	4.7	7.3
Containers	1.7	-
Motor vehicles	1.7	2.6
Fuel	9.4	3.1
Minerals	3.4	1.0
General	51.1	32.3
TOTAL	100.0	100.0

TABLE A.6 - DoNT ROADSIDE SURVEYS: ROAD FREIGHT INTO THE N.T., BY STATED DESTINATION

(%)

Destination	via Stuart	via Barkly
Darwin (1)	56	65
Alice Springs	30	2
Katherine	1	3
Tennant Creek	6	16
Other	7	14
TOTAL	100	100

(1) Darwin freight via Stuart: 46% Adelaide, 7% Melbourne, 3% other. Darwin freight via Barkly: 39% Brisbane, 8% Sydney, 18% other.

TABLE A.7 - RELATIVE CONSIGNMENT DENSITIES

Item	Cargo Tonnes per tonne weight
Cornflakes large	11.6
Kleenex tissues	8.8
General merchandise	4.0
Washing powder	3.4
Bottled drinks	2.1
Canned fruit	1.4
Self raising flour	1.4
Sugar	1.0

Source: G.J. McDonell, Report on the Commission of Inquiry into Darwin Port Operations Northern Territory Transport and Consumer Prices, (January 1972).

TABLE A.8 - RATIO OF CUBIC TO METRIC TONNES, OVERSEAS VEHICLES ENTERING PORT OF DARWIN

Year	No. Vehicles	Tonnes weight (1)	Cubic tonnes	Ratio cubic/metric
1971-72	759	1381	8 284	6.0
1972-73	1048	1907	11 968	6.3
1973-74	1785	3249	18 511	5.7
1974-75	2120	3858	22 609	5.9
1975-76	2485	4523	25 709	5.7
			Average	5.9

(1) Converted by the ratio of 1.82 tonnes per vehicle.
Source: Northern Territory Port Authority.

Ships generally carry dense general freight due to their charging policies. One category for which cubic and weight tonnes are likely to be widely divergent is machinery and motor vehicles. To make sea and land figures comparable for this freight category the cargo tonnes were converted to weight tonnes according to the procedure outlined below.

From ANR data, an average of 1.1 tonnes per passenger vehicle was obtained, and from discussions with car dealers in Darwin, it was estimated that approximately 80% of sea imports were light commercial vehicles, the rest being sedans. The resultant average of 1.82 tonnes per unit was used to convert vehicle numbers to tonnes weight for ship carried motor vehicles (Table A.8). This figure was then used to obtain a cubic to weight tonnes conversion ratio, and drilling equipment and other machinery were then converted to tonnes weight using the same conversion ratio.

ANNEX B

PREPARATION OF PER CAPITA ESTIMATES

CLASSIFICATION

Classification of commodities was a follows:

NON-BULK	BULK
food and drink (non-perishable)	bitumen
food and drink (perishable)	cement
timber (sea and rail only)	petroleum products (including road flows)
hardware	
steel (sea and rail only)	fertilizer
motor vehicles and machinery	
general (including unclassified rail containers)	

Sea

The Northern Territory Port Authority statistics are already separated into a detailed commodity classification, and are therefore easily aggregated under the coarser Bureau commodity classification. The only modification required is to the classification 'Motor vehicles and machinery' where the shipping tonneages (recorded in cubic tonnes) are converted from cubic to tonnes weight by dividing by a conversion factor (see Annex A: preparation of sea data).

Rail

The classification of the CAR data is also very detailed, but a large percentage of the freight is entered as 'containers', 'block-rate' or 'pallets'. All these classifications are entered under 'General', except for rail 'refrigerated containers' which are entered under 'Perishables' and 'containers groceries' which are entered under 'Non-perishables'. Vehicles of rail passengers are excluded from the freight tally, as it is assumed that most of these are tourist vehicles, not vehicles belonging to permanent Northern Territory residents.

Road

The only classification available for road data is the one used in the Department of Northern Territory Roadside Surveys. This classification is extremely simple and aggregates many commodities distinguished by other modes. As a result some Bureau commodity categories do not include road freight, or include road freight that should actually be in another category. However, these categories were still retained in order to get a rough idea of the actual commodity distribution. The correspondence between the road categories and the Bureau categories is:

ROAD	BUREAU
food & drink (non-refrigerated)	food & drink (non-perishable)
food & drink (refrigerated)	food & drink (perishable)
building materials	hardware
fuel	petroleum
plant & machinery	motor vehicles & machinery
motor vehicles	motor vehicles & machinery
general	general
domestic durables	general
containers	general
minerals	general
other	general
livestock	n.a.

NON-BULK COMMODITIES

Bulk commodities, particularly petroleum, are a dominating factor in the freight flows, and any commodity analysis of freight flows must separate out bulk commodities from the non-bulk as a first step. Accordingly the non-bulk flows into the Territory for the mode-origin pairs east-coast sea, west-coast sea, overseas and rail were averaged over the years 1971-72 to 1975-76 to give the commodity breakdowns for non-bulk freight for individual mode-origin pairs (Table B.1).

TABLE B.1 - NON-BULK FREIGHT ENTERING THE N.T.: 1971-72 TO 1975-76, COMMODITY DISTRIBUTIONS FOR INDIVIDUAL MODES

(%)

	Sea[(a)]			Rail[(b)]	Road[(c)]	
	East Coast	West Coast	Overseas	CAR	Barkly	Stuart
Food & drink (non-perishable)	43.4	17.3	1.5	10.5	4.3	6.6
Food & drink (perishable)	1.1	5.7	0.2	5.4	10.5	23.6
Timber	0.8	8.0	55.5	0.8	-	-
Hardware	14.4	19.3	5.7	1.4	14.1	24.7
Steel	26.0	20.6	2.3	4.4	-	-
Vehicles & machinery	0.6	1.9	16.0	8.7	7.1	0.0
General	13.8	27.2	28.9	68.7	64.1	35.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Sources: (a) Northern Territory Port Authority.
(b) Central Australia Railway.
(c) DoNT Roadside Surveys.

The Department of Northern Territory Roadside Survey samples were too small to separate out petroleum on road directly, but two commodity breakdowns were calculated from the road samples, one in Table B.1 with petroleum factored out, and one in Table B.2 with petroleum included.

Mode-origin pairs: non-bulk commodities

Using Table 4.1 which records non-bulk total flows for the years 1971-72 to 1975-76 (road flows have petroleum excluded), Table B.3 a mode-origin distribution for non-bulk freight was obtained.

TABLE B.2 - ROAD FREIGHT ENTERING THE N.T.: 1971-72 TO 1975-76, COMMODITY DISTRIBUTION (INCLUDING PETROLEUM)

(%)

Road Corridor	Food & Drink		Timber Hardware Steel	Vehicles and Machinery	General	Petroleum Products	Total
	Non-Perishable	Perishable					
Barkly	3.9	9.5	12.8	6.4	58.1	9.4	100.0
Stuart	6.4	22.9	23.9	9.8	33.9	3.1	100.0

Source: DoNT Roadside Surveys.

TABLE B.3 - NON-BULK FREIGHT ENTERING THE N.T.: 1971-72 TO 1975-75, DISTRIBUTION BY MODE(1)

(%)

Sea			Rail	Road		Total
East Coast	West Coast	Overseas	CAR	Barkly	Stuart	
12.8	13.2	7.7	33.4	21.6	11.3	100.0

(1) Petroleum excluded from road.

Table B.1 and Table B.3 were then used to derive Table B.4, a matrix of non-bulk freight flows, distributed as mode-origin pair and commodity.

Per capita estimates: non-bulk commodities

Using Table 4.1, a per capita annual non-bulk freight requirement for the Northern Territory was obtained (Table B.5). This estimate of per capita non-bulk freight was then distributed according to the breakdown in the final column of Table B.4, giving individual non-bulk commodity per capita estimates as shown in Table B.6. When using these per capita estimates the qualifications discussed in the following sections should be borne in mind.

Timber and hardware: These two classifications should be amalgamated as the available road classification does not distinguish between them, aggregating timber, hardware, cement and steel under 'building material'. Though for the purposes of this study all building materials on road were entered under 'Hardware', it was still thought useful to retain 'Timber' as a separate category, thus enabling a lower estimate of timber per capita requirements to be made.

Steel: Due to its sensitivity to vibration damage, rolled sheet steel is carried where possible by sea and rail. Road has no separate classification for steel, but the only steel likely to be carried by road is structural steel, and this forms less than 10% of steel requirements by weight. It was therefore assumed that a meaningful estimate can still be made from sea and rail figures along.

Vehicles and machinery: This class presents great difficulties in estimation, for in this class shipping cubic tonneages are not directly comparable with land statistics measured in tonnes weight. A method of conversion to weight tonnes has been used on the shipping tonneages, (Table A.8) but it is extremely crude, and

TABLE B.4 - NON-BULK ENTERING THE N.T.: 1971-72 TO 1975-76 DISTRIBUTION BY MODE AND COMMODITY

(%)

	Sea			Rail	Road		Commodity (All modes)
	East Coast	West Coast	Overseas	CAR	Barkly Highway	Stuart Highway	
Food & drink (non-perishable)	5.56	2.28	0.12	3.51	0.93	0.75	13.1
Food & drink (perishable)	0.14	0.75	0.02	1.80	2.27	2.67	7.7
Timber	0.10	1.06	4.27	0.27	-	-	5.7
Hardware	1.84	2.55	0.44	0.47	3.05	2.79	11.1
Steel	3.33	2.72	0.18	1.47	-	-	7.7
Vehicles & machinery	0.08	0.25	1.23	2.91	1.53	1.14	7.1
General	1.77	3.59	1.46	22.95	13.85	3.96	47.6
Mode (all commodities)	12.8	13.2	7.7	33.4	21.6	11.3	100.0

TABLE B.5 - NON-BULK FREIGHT ENTERING THE N.T. PER CAPITA CONSUMPTION PER YEAR

(tonnes)

Year	1971-72	1972-73	1973-74	1974-75	1975-76
Tonnes	222 000	254 600	270 500	284 500	300 600
Population	91 666	95 629	100 000	86 677	99 800
Annual per capita (1)	2.431	2.662	2.705	3.282	3.012

(1) 2.818 average per capita.

TABLE B.6 - NON-BULK FREIGHT ENTERING THE N.T.: 1971-72 TO 1975-76, AVERAGE PER CAPITA CONSUMPTION BY COMMODITY

(tonnes)

Commodity	Per Capita
Food & drink (non-perishable)	0.37
Food & drink (perishable)	0.22
Timber	0.16
Hardware	0.31
Steel	0.22
Motor vehicles & machinery	0.20
General	1.34
TOTAL	2.82

TABLE B.7 - BULK FREIGHT ENTERING THE N.T.

('000 tonnes)

Year	Petroleum	Cement	Bitumen	Fertiliser
1968-69	265.6	48.7	14.7	8.5
1969-70	289.3	39.6	12.2	8.8
1970-71	334.8	57.3	9.3	7.4
1971-72	318.9	57.2	8.5	2.7
1972-73	335.5	56.9	20.8	9.7
1973-74	338.5	54.2	10.1	10.3
1974-75	357.3	54.2	17.6	0.1
1975-76	355.7	72.7	4.9	0.3

Source: Sea - Northern Territory Port Authority statistics.
Rail - ANR data.

estimates for this class should be treated with extreme caution. A comparison of the Maunsell[1] and Bureau per capita estimates (Table 4.5) for this category will show that the Bureau's estimate is considerably higher. It is likely that considerable land movement of new motor vehicles into the Territory was already occurring in the sixties when the Maunsell estimate was made. As the Maunsell estimates were based on sea movements only, any land movement would not be included. The method of conversion of cubic to tonnes weight is another possible source of discrepancy. If the cubic to tonnes weight divisor is too large then the Maunsell figure will be reduced to a far greater extent than the Bureau estimate (which includes a substantial land transport component). The method of conversion from cubic to tonnes weight has been discussed in Annex A.

General: This category includes all unclassified containers, and items such as furniture, domestic appliances, household commodities, other general goods, and non-bulk chemicals. This category is inflated at the expense of the other categories due to the inclusion of unidentified containers.

BULK COMMODITIES

Bulk flows are mainly via sea and rail, and the individual per annum flows displayed in Table B.7 are easily obtained. Apart from petroleum, the only known road flow of a commodity classified as bulk is cement for Tennant Creek, which comes from Townsville via the Mt Isa railway.

The road cement flow is not distinguishable on the Department of Northern Territory road commodity classification and therefore cannot be included in the bulk cement flows shown in Table B.8.

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(1) Maunsell and Partners; Development of Port and Harbour Facilities Darwin, Report for the Department of National Development, (Melbourne, January 1969).

The road petroleum flows have been estimated from the total road flows in Table A.4 and the road commodity distribution in Table B.2. Road petroleum flows amount to less than 10 000 tonnes per annum, the major flow being the supply of rural areas via the Barkly Highway. The distribution of petroleum flows by mode is shown in Table B.9.

No bitumen or fertiliser bulk flows are recorded for either road or rail, and therefore the tonneages in Table B.7 for these commodities are via sea only.

Per capita estimates: bulk commodities

Annual per capita figures for the bulk commodities are shown in Table B.10. These figures fluctuate considerably from year to year, but no trend is observable and an average of the annual per capita figures was used as the per capita estimate for bulk freight requirements. Maunsell used more sophisticated methods to forecast bulk commodity requirements, but in retrospect its methods of estimation provided less reliable predictors than simple per capita estimates.

TABLE B.8 - BULK CEMENT ENTERING THE N.T. BY MODE

('000 tonnes)

Year	Sea	Rail (CAR)	Total
1968-69	38.5	10.2	48.7
1969-70	31.4	8.2	39.6
1970-71	46.6	10.7	57.3
1971-72	44.4	12.8	57.2
1972-73	42.4	14.5	56.9
1973-74	41.8	12.4	54.2
1974-75	40.4	13.8	54.2
1975-76	69.1	3.6	72.7

Sources: Sea - Northern Territory Port Authority statistics.
Rail - ANR data.

TABLE B.9 - BULK PETROLEUM ENTERING THE N.T. BY MODE

('000 tonnes)

Year	Sea	Rail (CAR)	Road		Total
			Barkly	Stuart	
1968-69	245.7	19.8	n.a.	n.a.	265.5
1969-70	269.9	19.4	n.a.	n.a.	289.3
1970-71	316.3	18.5	n.a.	n.a.	334.8
1971-72	292.1	21.1	5.0	0.7	318.9
1972-73	309.2	20.0	5.4	0.9	335.5
1973-74	305.4	26.2	5.5	1.4	338.5
1974-75	328.5	21.8	6.3	0.7	357.3
1975-76	332.0	14.6	8.0	1.1	355.7

Sources: Sea - Northern Territory Port Authority statistics.
Rail - ANR data.
Road - DoNT Roadside Surveys and Australian Bureau of Statistics, Interstate Freight Moved by Major Freight Forwarders and Road Transport Operators between Specified Australian Centres

TABLE B.10 - BULK FREIGHT ENTERING THE N.T. TONNES PER CAPITA

Year	Petroleum	Cement	Bitumen	Fertiliser
1968-69	3.639	0.667	0.201	0.116
1969-70	3.671	0.502	0.155	0.112
1970-71	3.875	0.663	0.108	0.087
1971-72	3.479	0.624	0.093	0.029
1972-73	3.508	0.595	0.218	0.101
1973-74	3.385	0.542	0.101	0.103
1974-75	4.122	0.625	0.203	0.001
1975-76	3.564	0.728	0.049	0.003
AVERAGE	3.655	0.618	0.141	0.069

ANNEX C

TRANSPORT RESOURCE COSTS

RESOURCE COSTS OF ROAD TRANSPORT

The resource cost of road freight transport is here interpreted in the strict sense of a resource cost to the community, and accordingly should not be confused with the financial cost to the operator. However, many of the components of the two costs are equivalent or can be assumed to be equivalent for the purposes of this study. The three principal components of road freight transport are:

- line haul costs;
- administrative and terminal costs;
- road construction and maintenance costs.

A summary of truck resource costs is provided in Table C.1. All costs are for 1975-76 unless stated otherwise and a discount rate of 10% is used throughout the annex.

Line haul costs

An estimate of the resource cost of the line haul can best be made via the operating costs of owner drivers who are dedicated to a particular route. The figures presented are for the Brisbane-Darwin route but as the operating environment is similar throughout northern Australia the results are applicable throughout the region.

Naturally the cost of the line haul operation is critically dependent upon the choice of vehicle. As the operators are familiar with their vehicles and operating environment and as the industry is highly competitive the operator's choice of vehicle should minimise his cost. The operator's choice of equipment is:

TABLE C.1 - TRUCK RESOURCE COSTS[1]

(cents)

	Unsealed	Unstrengthened Sealed	Strengthened Sealed
Line Haul (truck/km)	57.03	47.03	47.03
Administration (truck/km)	2.35	2.35	2.35
Total operating cost (tonne/km)[2]	2.97	2.47	2.47
Routine road maintenance (tonne/km)	2.00	0.20	0.20
Reconstruction of sealed road (tonne/km)	-	0.30	0.15
TOTAL (tonne/km)	4.97	2.97	2.82

(1) Excluding terminal costs for road which are estimated at $5.00/tonne.
(2) Assuming no backloading and 40 tonnes/loaded truck.

- a 262 kW(350hp) prime mover equipped for heavy duty with a value of $51 000 plus 15% sales tax;

- two 12 m heavy duty triaxle trailers plus one heavy duty bogie dolley valued at $29 750 plus 15% sales tax;

- plus sundry items such as tarpaulins, chains, jacks and ropes worth $4 250 plus 15% sales tax.

Vehicles of this power and weight are not necessary to move loads within the legal axle-load limits, but given the opportunities to overload and the financial incentives to do so, vehicles of this size are the norm.

The only comparable costing exercise has been conducted by the Director General of Transport, W.A.[1] for road train operation to the Pilbara Region.

The resource cost of the line haul using vehicles of the type described above is given in Table C.2. The breakdown of this resource cost is as follows:

Cost of capital: This is similar to depreciation and the return to owner in a financial analysis of the line haul operation, but is not equivalent. The cost of capital is defined as an annuity which ensures sufficient funds for the replacement of the equipment at the end of its life, and also provides a return on the capital employed equal to the discount rate for this study. The gives a lower figure than that used for depreciation and the return to the owner calculated in earlier Bureau work[2]. Resource costs of capital exclude sales tax.

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(1) Director General of Transport, W.A., Road Train Operation; Cost Savings on Line Haul to the Pilbara Region, 1976.
(2) Bureau of Transport Economics, A Study of Intersystem Railway Freight Rating Practices, (AGPS, Canberra, 1976).

TABLE C.2 - RESOURCE COSTS OF LINE HAUL FOR ROAD TRANSPORT IN NORTHERN AUSTRALIA ON SEALED ROADS

	Annual Cost ($)	Cost/Truck km (cents) (1)
Cost of Capital		
Prime Mover ($51 000, 5 yrs)	13453	
Trailers, dolley ($29 750, 10 yrs)	4842	
Sundry ($4 250, 2 yrs)	2449	
	20744	13.83
Repairs and maintenance	8200	5.47
Tyres and tubes	12000	8.00
Fuel 80 l/100km @ 9.81c/litre	11800	7.85
Accident	3800	2.53
Sundry	5000	3.33
Labour	9000	6.00
TOTAL	70544	47.03

(1) The vehicle is estimated to travel 150 000 km per annum. This figure is representative of current long distance road freight operations in Northern Australia (see NAASRA, A Study of the Economics of Road Vehicle Limits, Commercial Vehicles Surveys, Study Team Report - R4, (January 1976)).

The life of a prime mover is assumed to be 5 years. That of the trailers is 10 years, while the sundry items have a life of 2 years. The equipment is heavy duty and unsuitable for operation elsewhere in Australia and is assumed to be used in this type of operation throughout its life. The figures presented in Table C.2 are calculated accordingly.

Repairs and maintenance: The only information available is operators' estimates of their average expenditure. Their estimates are simply yearly averages with no functional relationship between age of vehicle and expenditure. For the purposes of this analysis the operators' estimates are converted into a cost per kilometre and used as a proxy for the resource cost of repairs and maintenance.

Tyres and tubes: Information on cost of tyres and tubes is also lacking. The figure given in Table C.2 is an operator's estimate of his costs for an average year's running in northern Australia. Ideally, sufficient information should be available to determine the improvement in tyre life due to sealing of a road.

The most which can be said at present is that the average life of a tyre on a driving or steering axle is 20 000 km on the unsealed southern half of the Stuart Highway, compared to 150 000 km for a tyre (including recaps) on a truck travelling between Darwin and Brisbane on an almost completely sealed road.

Fuel: The cost of fuel shown in Table C.2 is based on a fuel consumption of 80 litres per 100 km. The price of fuel (9.81 cents per litre) is an average of the Brisbane and Mt Isa prices less government duty.

Accident costs: An upper bound for accident costs can be calculated from insurance rates. The compulsory third party insurance is charged at a flat rate, while comprehensive accident insurance is based on the value of the vehicle insured. For the purposes of this analysis this is taken to be the value of equipment half-way through its life, giving a value of $50 000.

The rates charged by the State Government Insurance Office of Queensland for comprehensive insurance are $1958 on the first $24 000 plus 6.63% on the balance of the insured value (these figures do not include stamp duty). The Third Party rates in the N.T. are $137 for a prime mover and $8 per trailer while the equivalent figures for Queensland are $49 and $43 respectively.

Sundry: This item is no more than a rough estimate designed to give some recognition of the minor cost items. The figure shown in Table C.2 is an operator's estimate.

Labour: As a large percentage of line haul operations are operated by owner drivers the most appropriate value for labour is the average weekly earnings.

To convert these figures into a cost per tonne km, it is necessary to estimate the distance travelled and the total freight carried by a single truck per annum. The distance travelled in a year in northern Australia depends critically on the length and severity of the wet season. In the dry season two trips per month between Darwin and Brisbane can be considered the long term average. However, in the wet season the average reduces to one trip per month. For a 'dry' of 7 months and 'wet' of 5 months this gives 150 000 km per year (19 trips). This could be increased to 175 000 km (22 trips) for an owner driver if the road were all weather or 200 000 km for a vehicle which is part of a fleet. For consistency, figures based on owner driver performance are used. The costs given in Table C.2 are for sealed roads. Owners indicate that operations on dirt roads increase costs approximately 10 cents per truck km.

Terminal and administrative costs

Road transport often provides a door-to-door service, as opposed to shipping and rail services which provide either a terminal-to-door or a terminal-to-terminal service. Road terminal-to-door costs are likely to be lower than for the other modes, but as delivery costs are difficult to estimate they have not been included for any mode.

Very little information is available on the operating costs of freight terminals. Obviously the cost will be a function of the city in which the terminal is located, its location within that city, the size distribution of the goods being handled, the quantity moving through the terminal and the number of alternative destinations.

A reliable cost estimate exists for the transfer of Northern Territory rail freight from standard gauge to narrow gauge at Maree. The freight is moved between wagons or can be held over in storage (a process not unlike the movement of freight within a major freight forwarder's terminal). The cost of this operation is $1.80 per tonne. An order of magnitude estimate of $5.00 would represent the total cost of terminal operations per tonne of road freight.

Administrative costs are also difficult to estimate. For large shipments the difference between freight forwarders' charges and the payment to the line haul operator can be as low as 3%, while for small consignments the freight forwarders' charges are more than double the line haul costs. The administrative costs for the shipping services are approximately 10% of total costs. Accordingly an estimate of 5% of total costs for administration would appear to be a reasonable estimate, given the competitive and entrepreneurial nature of the road transport industry.

Road maintenance costs

Road maintenance costs can be divided into two components:

- routine maintenance including resealing;
- reconstruction.

Evidence presented to the Parliamentary Works Committee[(1)] suggests that routine maintenance including resealing costs 1c per double axle km for the existing Northern Territory highway network. This corresponds to 4c per km for the type of heavy duty truck used for road transport in the N.T. This figure is an average and not a marginal cost and it has been assumed that one truck axle is equivalent to one car axle. The Commonwealth Bureau of Roads (CBR) incorporated a marginal road maintenance cost into their road evaluation program, RURAL. The marginal maintenance cost for a bitumen road with an annual average daily traffic of less than 500 cars is 0.25c per vehicle km in 1972 dollars, however, this cost estimate does not include resealing costs. In RURAL the CBR made the further assumption that one heavy truck equals ten cars. The CBR estimate of the marginal cost of routine maintenance of gravel roads is an order of magnitude higher than that of sealed roads. In lieu of better information it was decided to use average cost to approximate marginal costs and 4c per truck km was used for routine maintenance on a sealed road including resealing, and 40c per truck km for unsealed roads.

The marginal cost of road reconstruction for road transport is equally difficult to estimate. In an attempt to estimate the marginal cost of road freight transport on the road construction

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(1) Parliamentary Standing Committee on Public Works, Minutes of Evidence relating to the Proposed Second Three-Year Program for the Improvement and Maintenance of the Stuart and Barkly Highways, Northern Territory, (Canberra, 1976).

program, engineers of the Department of Construction responsible for the engineering oversight of the Northern Territory road network were asked the following question:

'What would be the impact on the reconstruction program of doubling the existing level of interstate road freight transport?'

The response suggested that such a charge would result in the complete collapse of all unstrengthened sections of the Stuart and Barkly Highways within 4 to 5 years, compared to the present anticipated life of 8 years; and the need to reconstruct 15% of the strengthened sections within 8 to 10 years compared to an anticipated 5% within the same period without extra traffic. After the initial impact the program would settle back to the usual cycle.

This information has been used as a basis for the calculation of the marginal cost of reconstruction for road freight transport. For strengthened sections of the highway it is estimated at 0.15c per tonne km, and for unstrengthened sections at 0.30c per tonne km.

RAIL RESOURCE COSTS

The rail link from Adelaide to Alice Springs must be considered in six sectors, each sector having its own cost structure, and being one of three gauges. The sectors are listed in Table C.3. The authorities, Trans Australia Railway (TAR), Central Australia Railway (CAR), and South Australian Railways (SAR), responsible for the different segments, are components of the Australian National Railways (ANR).

The resource costs appropriate to each segment vary according to the relationship of the Alice Springs freight traffic to the total volume of freight on the rail segment. Lines 1, 2, 3 and 5 carry considerable traffic beside the Alice Springs through traffic.

TABLE C.3 - CURRENT AND FUTURE CONFIGURATIONS OF ADELAIDE-ALICE SPRINGS RAILWAY LINK

No.	Sector	Operating Authority	Gauge (1)	Dist. (km)	Current Route	Future Route
1	Adelaide-Pt Pirie	SAR	B	218	Yes	Yes
2	Pt Pirie-Pt Augusta	TAR	S	85	Yes	Yes
3	Pt Augusta-Maree	CAR	S	344	Yes	(2)
4	Maree-Alice Springs	CAR	N	869	Yes	Closed
5	Pt Augusta-Tarcoola	TAR	S	419	-	Yes
6	Tarcoola-Alice Springs	CAR	S	831	not yet completed	Yes

(1) B = Broad, S = Standard, N = Narrow.
(2) Will not be used for Adelaide-Alice Springs traffic, but will remain open to Leigh Creek coal fields at least.

In no case on these lines is the Alice Springs traffic more than 10% of the total traffic on either a tonneage or tonne-km basis. If the Alice Springs traffic were discontinued, lines 1, 2 and 5 would continue to operate on much the same basis and there would be no change in administration, station staffing, signal maintenance and many other costs; that is, the Alice Springs traffic is marginal traffic. The appropriate resource costs to use under these circumstances are line haul and marginal track maintenance costs. This argument does not apply on the Port Augusta-Maree line, where the 100 km of track from the coal fields at Leigh Creek to Maree could be closed if the Alice Springs traffic ceased. Unfortunately no separated costs are available for the operation of the coal traffic, and in lieu of a better approach, marginal costs were used on this sector of the line also. The Maree-Alice Springs narrow gauge line is dedicated to the Alice Springs traffic and therefore the Alice Springs traffic must bear the full cost of operating this line; the same costing method must be applied to traffic on the Tarcoola-Alice Springs line, at present under construction. All costs quoted in the succeeding analysis are for 1975-76 unless stated otherwise.

Line haul costs for general freight

The line haul costs shown in Table C.4 have been calculated assuming that all trains must return empty[1], and the gross to net ratio (GNR) has been assumed to be 1.5 for a loaded train, giving an overall GNR of 3, counting the empty return train. The line haul costs for the Maree-Alice Springs narrow gauge line are included in Table C.4 but they are for comparative purposes only, average not marginal costs should be used on this sector.

Locomotive and rolling stock capital costs: These costs have been calculated using an annuity formula which spreads the capital cost evenly over the lifetime of the asset, the lifetime being taken as 25 years for both locomotives and rolling stock. The annual capital cost for each item of capital equipment is then converted to the per kilometre capital cost shown in Table C.4 by dividing by the annual kilometres run for that unit.

The capital cost of a single wagon is an average for the various wagons, flats, vans, refrigerated vans, etc., used on that gauge, and there is no sales tax component in the capital costs of either rolling stock or locomotives.

Locomotive and rolling stock maintenance: Locomotive and rolling stock maintenance is a function of many factors, but it is most strongly related to distance travelled, and this is the formulation adopted for both locomotive and rolling stock maintenance. The costs in Table C.4 are averages taken from 1975-76 data classified on a gauge basis.

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(1) In 1975 the total general freight traffic on the CAR narrow gauge was split 86% north, 14% south. Large differentials also exist between east and west flows on the TAR.

TABLE C.4 - MARGINAL RAIL LINE HAUL AND TRACK MAINTENANCE COSTS

Railway	Adelaide to Pt Pirie	Pt Pirie to Pt Augusta	Pt Augusta to Tarcoola	Pt Augusta to Maree	Maree to Alice Springs
Operating statistics					
Locomotive km per annum	107 177	180 000	180 000	180 000	55 242
Wagon km per annum	144 000	144 000	144 000	144 000	55 242
Train information					
Gross weight (tonnes)	1 568	3 500	3 500	1 000	800
Net weight (tonnes)	784	1 750	1 750	500	400
Number of locos	1	2	2	1	1
Power loco (kW)	1 343	2 237	2 237	1 343	-
Number of wagons	356	69	69	19.7	20
Transit time (hours)	6.0	2.5	9.0	7.58	29.75
Unit costs					
Loco capital cost ($/unit)	640 000	750 000	750 000	640 000	445 000
Wagon capital cost ($/unit)	28 000	28 000	28 000	28 000	24 000
Crew ($/hour)	21.62	39.17	39.17	21.00	43.20
Loco maintenance (cents/km)	16.86	21.9	21.9	21.9	44.0
Wagon maintenance (cents/km)	3.8	1.27	1.27	1.27	2.2
Fuel (cents/100 GTK)	21.5	16.8	16.8	11.42	34.4
Track maintenance (cents/GTK)	0.05	0.04	0.04	0.05	0.432 (2)
Loaded train (cents/km)					
Train capital	151.5	255.6	255.6	86.8	196.7
Train maintenance	152.1	131.4	131.4	46.9	88.0
Crew	59.5	115.2	84.6	45.5	147.9
Fuel	31.7	58.8	58.8	11.42	27.5
Track	78.4	140.0	140.0	50.0	345.6
TOTAL Loaded train (cents/km)	473.2	701.0	670.4	240.6	805.7
TOTAL Empty train (cents/km) (1)	418.1	601.6	571.0	209.9	619.1
TOTAL Round trip (cents/km)	891.3	1302.6	1241.4	450.5	1424.8
Cost per net tonne km (cents)	1.137	0.744	0.709	0.901	3.562

(1) Empty train line haul costs are as for loaded except for fuel and track maintenance, which are halved.

(2) For Maree-Alice Springs, this is the full average ways and works cost not the marginal track maintenance.

Fuel: Fuel costs have been calculated on a gross tonne km (GTK) basis for each class of locomotive, using 1975-76 system data for individual railways. Fuel costs do not include exise duty.

Crew Costs: These were based on 1975-76 data from the relevant railways and include a weighting to allow for rostering, shift work etc.

Track Maintenance: The track maintenance figure shown in Table C.4 is the marginal track maintenance cost and is based on internal Bureau estimates.

Maree-Alice Springs

In this case all operating costs must be included. The itemised 1975-76 operating costs for freight on the Maree-Alice Springs railway are available, and these give an estimate of 1.36 cents per GTK. This figure excludes the cost of operating the freight exchange at Maree, which is estimated on a per net tonne basis.

The overall GNR including return of train, for freight on this sector of the rail link is 4.38. This is probably due to the very old equipment in use and the weight restrictions in force on the dilapidated track. The cost for freight per net tonne km is therefore 1.36 x 4.38 = 5.98cents. This cost is nearly six times as large as the costs used on the other sectors, but these costs are average not marginal, and the line is old, in poor condition and extremely costly to maintain and operate.

Tarcoola-Alice Springs

This segment is not yet completed and the plans of operation are not yet finalised. ANR expects to be able to operate this segment at approximately the same cost per GTK as the TAR, however two factors militate against this:

- examination of operating costs for various lines suggests that labour costs per GTK increase on low volume lines;

- the crew scheduling system (double crewing) at present under consideration is more expensive than the crew scheduling used on TAR.

However in lieu of better information, all operating costs except ways and works were taken from the TAR. This gave an operating cost, excluding ways and works, of 0.365 cents per GTK. The Commonwealth Department of Transport estimates the cost for ways and works for the Tarcoola line at $1.49m per annum for 47 kg rail.

Assuming a volume of 0.2m net tonnes per annum, an average cost of 0.650 cents per GTK was calculated. Given a GNR of 3.15(1) a cost of 2.05 cents per net tonne km was obtained for the Alice Springs-Tarcoola line. It must be borne in mind that this is only an estimate, a larger tonneage than 0.2m tonnes could decrease this cost substantially, or conversely if some of the costs counted as variable are actually fixed then the cost per net tonne could be substantially higher. However reasonable confidence may be placed in the cost estimate as a lower limit. Assuming that the estimate of fixed versus variable costs is correct, the minimum costs per net tonne km displayed in the first column in Table C.5 apply.

TABLE C.5 - ALICE SPRINGS-TARCOOLA, ESTIMATED RESOURCE COST

Annual net tonnes ('000)	Resource Cost(1) (cents/net tonne km)	
	Lower Limit	Three trains/week
100	2.94	4.57
200	2.05	2.35
300	1.75	1.68

(1) Not including terminal costs (unloading at Alice Springs).

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(1) Bureau of Transport Economics estimate.

However this calculation is based on fully loaded trains, and is unrealistic if it is assumed that a reasonable level of service is to be maintained. If three 3500 gross tonne freight trains are operated weekly then the capacity of the service is approximately 0.29m tonnes per annum, and most costs including wages etc, can be regarded as fixed for volumes below this tonneage. The second column of Table C.5 shows the resource cost of operating a service of a minimum of three freight trains, assuming that the only variable costs are fuel and wagon and locomotive maintenance. It can be seen that for low annual tonneages the cost per tonne increases sharply.

Gauge changes

There are two gauge changes on the current rail link to Alice Springs, one at Port Pirie from the broad to the standard gauge, and one at Maree from the standard to the narrow gauge. The exchange at Port Pirie is mainly a bogie exchange handling the Perth bound traffic, and less than half the Alice Springs traffic is bogie exchanged, the rest being handled manually. The costs at Port Pirie are $1.40 per tonne for bogie and $2.54 per tonne for manual exchange. An average of $2.00 per tonne was assumed for the Port Pirie exchange, and costs of operating the manual exchange at Maree are estimated at $1.80 per net tonne. Both estimates are obtained from itemised ANR accounts for 1975-76.

Total costs

A comparison of the total cost per net tonne for the present and proposed lines are shown in Table C.6.

RESOURCE COST OF THE SHIPPING SERVICES

The coastal shipping services which serve Darwin are both operated by public enterprises. These public enterprises keep financial accounts which can be used as an approximation to

TABLE C.6 - TOTAL RESOURCE OPERATING COST FOR THE ADELAIDE-ALICE SPRINGS LINE

	Cost er NTK(cents) (1)	Distance (km)	Total Cost ($/net tonne)
Route (old)			
Adelaide-Pt Pirie	1.137	218	2.48
Pt Pirie-Pt Augusta	0.744	85	0.63
Pt Augusta-Maree	0.901	344	3.10
Maree-Alice Springs (2)	5.98	869	51.94
Gauge change Pt Pirie	-	-	2.00
Gauge change Maree	-	-	1.80
Loading Adelaide	-	-	2.50
TOTAL COST (per tonne)			64.45
Route (new)			
Adelaide-Pt Pirie	1.137	218	2.48
Pt Pirie-Pt Augusta	0.744	85	0.63
Pt Augusta-Tarcoola	0.709	419	2.97
Tarcoola-Alice Springs (3)			
" " low	1.75-1.68 (4)	831	14.54-13.96 (4)
" " medium	2.05-2.35	831	17.04-19.53
" " high	2.94-4.57	831	24.43-37.98
Bogie Exchange (Pt Pirie)			2.00
Loading and unloading			5.00
TOTAL COST low			27.62-27.04
medium			30.12-32.61
high			37.51-51.06

(1) NTK = net tonne kilometre.
(2) Includes unloading at Alice Springs.
(3) Low, medium and high costs correspond to flows of 0.3m, 0.2m and 0.1m tonnes of freight per annum.
(4) Three trains per week, see Table C.5.

resource costs in most areas. It is only in the area of the cost of capital that the financial and resource costs are significantly different.

Darwin Trader - ANL

The resource cost of the Darwin Trader is within the range of \$3.9m to \$4.8m per year plus \$25.6 per tonne of general cargo. These costs are made up as follows:

manning costs	-	$3.55\ 10^3$ \$/day;
running costs	-	$3.51\ 10^3$ \$/day;
administrative costs	-	$1.21\ 10^3$ \$/day;
capital costs	-	$2.40\ 10^3$ \$/day;
port and terminal costs	-	$86.3\ 10^3$ \$/voyage;
stevedoring	-	4.9 \$/tonne;
cargo gear & commission	-	20.7 \$/tonne.

Ideally the capital costs should be based on the realisable value of the Darwin Trader but this is not feasible given the lack of any second hand market for a specialised vessel such as the Darwin Trader. The figure used was calculated as follows:

- The cost of replacing the Darwin Trader with a new vessel of the same specifications built overseas is \$18m;
- the vessel has a life of 16 years after which its value is \$0.84m, calculated as a function of its DWT and the price of scrap steel;
- its value v, drops exponentially according to the formula:

$$v = ke^{-t/5.22}$$

  where k is the capital cost of the vessel and t is the number of years from the time of commissioning;
- the vessel is 6 years old, giving a present value of \$5.7m;
- this present value is equal to the capital cost expressed as an annuity (over the life of the vessel) of \$0.93m per annum, given a discount rate of 10% per annum.

The capital cost of replacing the Darwin Trader at the end of its life is \$2.17m per annum over the life of the replacement vessel. The capital cost of a new vessel is greater because much of the capital on the present vessel is sunk.

Besides servicing Darwin, the Darwin Trader backloads ore from Groote Eylandt to southern ports. Although this increases the revenue paid to ANL it is likely to increase the costs of operating the Darwin Trader. If the backloading operation is financially viable then the revenue earned must be greater than the marginal costs incurred in carrying the ore. By assuming the revenue equals the marginal cost, a minimum estimate of the cost of servicing Darwin can be calculated by subtracting the revenue of \$0.9m earned by carrying ore from the total operating costs. This gives a minimum cost estimate of \$3.9m per year plus \$25.6 per tonne, assuming the vessel makes ten voyages per year. If it is assumed that the marginal cost of carrying ore is zero then the maximum cost estimate of servicing Darwin is \$4.76m per year plus \$25.6 per tonne.

WASS

The resource cost of the service to Darwin provided by the Western Australian State Shipping Service is within the range of \$2.00m to \$2.42m per year plus \$25.00 per tonne. These costs are made up as follows:

manning costs	2.25 10^3 \$/vessel/day;
running costs	1.91 10^3 \$/vessel/day;
administration costs	3.44 10^3 \$/day;
capital costs	0.93 10^3 \$/vessel/day;
port costs	0.31 10^3 \$/vessel/day;
terminal costs	0.18 10^3 \$/day;
claims and commission	10.0 10^3 \$/year;
stevedoring	25.0 \$/tonne.

The capital cost shown above was calculated using the method outlined for the <u>Darwin Trader</u>. The information used to estimate the figure includes:

- the replacement of each vessel is $10m;
- a life of 20 years for each vessel;
- the age of the vessels, one 13 years and two 10 years;
- a scrap value of $0.5m per vessel.

As each vessel is replaced the capital cost changes as the capital cost of a new vessel is $1.1m per annum.

The WASS service exists to service the W.A. ports north of Perth. The extension of the service to Darwin is due to the political pressures to maintain a Perth-Darwin link and the economic advantages of the extra business generated both for the Perth based business community and for the shipping service. Approximately one-third of all cargo carried is either for Darwin or originates in Darwin.

The resource cost for the WASS service can either be considered as the marginal cost of the third ship which is $2.0m per year plus $25.0 per tonne, or one-third of the operational cost of the total WASS service, which is $2.4m per year plus $25.0 per tonne. These two cost estimates represent the minimum and maximum cost of the Darwin-Perth WASS service.

INVENTORY COSTS

Although inventory costs would seem to be a significant component of the cost of supplying goods to the N.T. community, the business community in the Territory was generally unable to quantify inventory costs. The figures presented below represent an estimate of those costs, based on information on inventory levels supplied by members of the N.T. business community.

The aim has been to calculate the cost difference between operations in the N.T. and an equivalent operation in southern Australia. There are two reasons for higher inventory levels in the Territory:

- increased time between the placement of an order and receipt of goods, leading to the maintenance of higher inventory levels throughout the year;
- the possibility of disruptions to the transport system which can occur over a period of approximately four months each year.

To account for this disruption inventories are built up before the wet season and run down during the wet. Estimates of the increase in inventory levels for each commodity due to each factor are given in Table C.7. The variation between commodities is due to a variety of factors such as the percentage of their supply which comes by ship, and the time between consecutive manufacturing runs of a particular product.

TABLE C.7 - INVENTORY COSTS

Commodity	Increase in Inventory Level in weeks due to:		Value $/Tonne
	Distance from Source	Disruptions to Transport	
Food non-perishable	6	4	1000
Food perishable	4	0	1000
Timber	0	0	100
Hardware	16	0	1000
Steel	12	0	400
Petroleum products	0	0	200
General	6	12	2000
Machinery	8	12	4000

An estimate of the inventory costs, IC, can be obtained from the equation:

$$IC = m(v_i . c_i . t_i) + w(v_i . t_i)$$

where i represents the commodity,

v_i the tonnes consumed per person per year,

t_i the increase in inventory levels,

c_i the value per tonne of commodity i,

w the costs of warehousing 1 tonne of freight, and,

m the interest rate corresponding to the opportunity cost of capital.

This equation can be used to calculate both components of the inventory costs. Estimates of c_i and v_i are provided in Table C.7. The cost of warehousing is assumed to be $25 per tonne which is based on the assumption that 1 tonne occupies 1 m^2 of warehouse space costing $25 per m^2 year. For consistency between the discount rate and the opportunity costs of capital, m must be 10% per annum. The inventory levels to compensate for disruptions to the transport service are maintained for approximately three months, hence the opportunity costs must be divided by four when calculating the costs of the inventory held for the wet season.

With these estimates the two components of the total inventory cost are $71 and $30 per person respectively, due to the distance and disruption to transport services during the wet season.

PERCEIVED CONSUMER BENEFIT

The N.T. community considers itself to be at a disadvantage in many respects as compared with communities in southern Australia. Most of these disadvantages can be partly attributed to the distance between the N.T. and the southern capitals and to the disruption of transport services during the wet season.

One of the most commented upon manifestations of these problems is the quality, price and availability of perishables, particularly during the wet season. Obviously it is possible to air freight perishables into the Territory, but the community is not prepared to pay the costs of this. Hence the costs of air freighting perishables into the Territory provides a maximum estimate of the perceived consumer loss associated with the problem.

The cost of air freight is $1 per kg and the wet is assumed to last 3 months, so that with the annual requirement of 220 kgs per person, the cost of air freight would be $55 per person per annum.

This can be used as an order of magnitude estimate of the latent consumer benefit of the provision of an all-weather transport system into the Northern Territory.

ANNEX D

ROAD AND RAIL: COMPARISON OF TOTAL RESOURCE COSTS

Rail is characterised by a high fixed cost, both capital and operating, and a low variable cost per tonne moved. On the other hand road has lower fixed costs, but a higher variable cost per tonne. For large volumes of traffic therefore, rail is a lower cost mode than road, and the following analysis attempts to determine at approximately what volume of freight the construction of a new railway is preferable to the construction of a new road.

In the succeeding argument the fixed costs are assumed to be the capital costs of constructing a new railway and a new road. These costs are converted to an annuity at 10% over 25 years. In the case of rail, track maintenance is also counted as a fixed cost. The variable costs are the per tonne kilometre operating costs of rail and road. The rail costs are taken from the estimates for operating the proposed Alice Springs-Tarcoola line, and the road operating costs assume sealed roads (for the derivation of costs quoted below see Annex C). Road and rail are assumed to be the same length.

Given that:

F = fixed rail cost (dollars per km)
  = 17 890 (including 1793 track maintenance)
f = fixed road cost (dollars per km)
  = 7230
R = variable rail cost (dollars per net tonne km)
  = .0115
r = variable road cost (dollars per net tonne km)
  = .0294
t = net tonneage.

For rail to be a more economic carrier than road it is required that;

$$F + Rt > f + rt$$

$$t > \frac{F - f}{r - R}$$

$$t > 0.60\text{m tonnes per annum.}$$

It can be seen that at least 0.6m tonnes of freight per annum would be required for rail to be competitive with road. In fact the figure is even greater when it is considered that a railway line is usually dedicated to freight, whereas a road will have other users who will also benefit from its construction[1]. Furthermore the construction costs quoted are for an entirely new rail and an entirely new road, and a road of some sort will often already be in existence, substantially reducing road construction costs. To extend this analysis to the general case it would be necessary to explicitly include variables such as terrain, operating philosophy and corridor length, all of which strongly affect costs.

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(1) The Stuart Highway Corridor Study concluded that a new alignment and sealing for the Stuart Highway from Pimba to the S.A. border could be justified on benefits generated from traffic, even allowing for the diversion of most through road freight to the Tarcoola Alice Springs railway.