Development of a Rail Freight Terminal at Acacia Ridge

Report

This is a Report on the proposed terminal facility at Acacia Ridge. It is becoming increasingly apparent that terminal facilities are a key to the efficient operation of the Australian railway system. In many cases, however, the layout and structures do not permit modern. Methods to be employed effectively, so that serious delays occur. As the problems are so serious at Acacia Ridge, this report was compiled in 3 months.

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DEVELOPMENT OF A

RAIL FREIGHT TERMINAL

AT ACACIA RIDGE

FOREWORD

It is becoming increasingly apparent that terminal facilities are a key to the efficient operation of the Australian railway system. Advances in equipment and techniques for loading, unloading and transhipping have been so great that, in a modern terminal, these operations bear little resemblance to those of twenty or thirty years ago. In many cases, however, the layout and structures do not permit modern methods to be employed effectively, so that serious delays occur. This is the situation at the northern terminus of the Sydney to Brisbane standard gauge railway. Because the problem is serious, this report on the proposed terminal facility at Acacia Ridge has been produced as a matter of urgency in little more than three months.

To assess the problem and to project future traffic, it has been necessary to compile a great deal of data that have not previously been collected in any ordered form. On the basis of these data and an analysis of the operations and financial benefits, the study team in co-operation with Queensland Railways officials have been able to prepare revised proposals for the Acacia Ridge terminal and to recommend an accelerated rate of development.

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(J.H.E. Taplin)
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SUMMARY

Excessive delays to rolling stock moving north to Brisbane are evidence that improved rail freight terminals are needed in Brisbane. In the near future these delays are expected to exceed 4,000 wagon days per week. This total represents a fleet of wagons worth over ten million dollars. A new terminal could, in time, permit their diversion to other tasks and hence reduce the need for new wagon procurement.

On the basis of this need, the BTE has examined the requirements for new facilities and has developed a proposal for the development of a new terminal complex at Acacia Ridge, an area already set aside for this purpose.

The freight task has been estimated by projecting the traffic over the next ten years and assigning a part of this traffic to Acacia Ridge. The northbound volume is expected to be about 872,000 tonnes per year in 1983 and the southbound volume about 358,000 tonnes.

The proposed terminal is designed to employ modern techniques and equipment. Containers and unit loads will be handled by gantry crane and special fork lift trucks. Handling of mixed goods will be mechanised as far as possible. The terminal areas will be arranged to promote an unimpeded flow of rolling stock and road vehicles. The marshalling yard is designed to manage classification, storage and movement of wagons without interference to main line or terminal operations. In the event of major breakdown in railway operations, the classification yard can store over one month's flow of wagons and thereby avoid congestion of other rail facilities.

The cost of the proposed development is expected to be about nine million dollars. The works could be completed in less than five years.

The capital costs and part of the benefits of the terminal development have been examined. The net present value of the capital costs of the 5 year development project is estimated to exceed the net present value of the previously planned 15 year development (at constant prices) by $2,217,000 when both are discounted at 7 per cent per annum.

Only part of the financial benefits attributable to the associated project have been assessed; these are savings in the future wagon fleet, direct shunting cost savings and the value of land (South Brisbane, Clapham and Yeerongpilly) which would be made available by the transfer of activities to Acacia Ridge. The direct saving of commodity inventories in transit has also been estimated.

Discounted financial benefits of the five year development are estimated to exceed financial benefits of the 15 year development by $6,092,000 at 7 per cent discount rate and constant prices. If the saving of commodity delays to shippers is included, the assessable benefits will be $8,861,000. When costs are subtracted from benefits, the net present value to the railways of the accelerated project is $3,875,000 at 7 per cent discount rate and constant prices.

The accelerated development schedule would also generate other benefits that have not been assessed; these include reduced terminal costs, reduced main line operating costs and increased traffic promoted by faster transit times.

It is concluded that the accelerated 5 year development plan is economically attractive when compared to the 15 year plan. Furthermore, the nature of the benefits indicates that Acacia Ridge should be developed as soon as possible.

CHAPTER 1 - INTRODUCTION

At the July 1973 meeting of the Australian Transport Advisory Council, the Ministers agreed that the Bureau of Transport Economics should be asked to survey the needs for investment in rail freight operations including terminals. The Chairman recognised the States' desire to see the report on terminals completed without delay. The New South Wales submission to ATAC indicated that the terminal of highest importance was the one planned by Queensland Railways at Acacia Ridge, Brisbane. The existing rail terminal facilities at South Brisbane, which serve interstate traffic, are cramped and inadequate, leading to excessive delays to interstate rolling stock. This has become the key issue of concern, not only to State railway authorities but to their customers as well.

STUDY OBJECTIVES

In view of the urgency of the Acacia Ridge problem and current demands on its resources, the BTE decided to confine the initial rail terminal study to an evaluation of proposals for the development of Acacia Ridge. For the study, the BTE established the following objectives:

- collect data on the capacities, limitations, delays and operating costs for the existing facilities
- develop computer programs to analyse the delay data
- identify delays in transit and in terminals resulting from congestion at Brisbane
- review the initial proposals for the Acacia Ridge terminal and further develop the design of the terminal, giving particular attention to materials handling aspects
- assess the economic viability of the proposed improvements

SCOPE OF THE STUDY

Preliminary investigations revealed two parameters of terminal design that could be eliminated. First, the location of the terminal was assumed to be fixed. Although optimising the location would ordinarily be a major part of a terminal study, it was found that, in the case of this terminal, the site had been purchased some 20 years previously and land use planning had resulted in the development of a number of industries in the vicinity on the assumption that the terminal would be provided. A superficial examination of alternative site possibilities indicated that no alternative location could reasonably be considered.

Second, a bogie exchange facility was considered impractical because of the incompatibility of loading gauges for the Queensland Railways and the standard gauge railway systems.

The limiting constraint on the study has proved to be the time available for completion. The collection of data on wagon delays and commodity movements proved to be very time consuming, largely because available data was not in a convenient form for analysis and required considerable interpretation and verification. Arising from these difficulties, the following aspects could not be evaluated in the current study:

- delays attributable to particular types of unloading facilities
- values of all commodity categories
- delays for particular commodities
- materials handling costs of the component parts of existing terminal facilities

For the most part, inability to identify these elements of the present freight system has limited the economic evaluation. Although the economic justification for the proposed terminal can be assessed on the basis of those costs and benefits that could be identified, the BTE cannot say that the terminal as proposed in this report represents an optimal investment. The benefits omitted from the evaluation, particularly those of inventory savings and reduction of out-of-stock costs accruing to consignees, could possibly justify a more rapid or more extensive development of Acacia Ridge.

The study constraints did not allow for the forecasting, in depth, of the changes in commodity flows likely to follow from improving facilities at Acacia Ridge. In time, changes due to this factor may alter the task of the terminal facilities as now planned, with some effect on the detailed design of the terminal.

CHAPTER 2 - EXISTING STANDARD GAUGE TERMINALS

The southern part of the Brisbane Metropolitan area is served by both standard and narrow gauge rail systems. The part of the narrow gauge system south of the city centre is isolated by the Brisbane River with the nearest crossing at Indooroopilly.

The standard gauge system is essentially a single-track line from the NSW border to South Brisbane with short spurs servicing the industrial area adjacent to Acacia Ridge. Inter-system transfer facilities now exist at Clapham and, in limited form, at Acacia Ridge.

There are several terminals within the metropolitan area on the standard gauge line: South Brisbane, Park Road, Yeerongpilly, Clapham, Salisbury and Acacia Ridge (Figure 2.1).

SOUTH BRISBANE

The South Brisbane terminal is located about one kilometre from the centre of the City on the southern side of the Brisbane River. It covers an area of approximately 7.8 hectares (Figure 2.2).

South Brisbane is the freight and passenger terminus for the standard gauge line from NSW and is combined with a suburban passenger terminal of the narrow gauge system which serves the southern part of the metropolitan area. Proposals are in hand to extend both the standard and narrow gauge lines across the river and into the Roma Street station area. This extension is planned for completion by mid-1976 and it is expected that the South Brisbane interstate passenger terminal will be closed. A portion of the suburban system facilities at South Brisbane would probably become redundant.

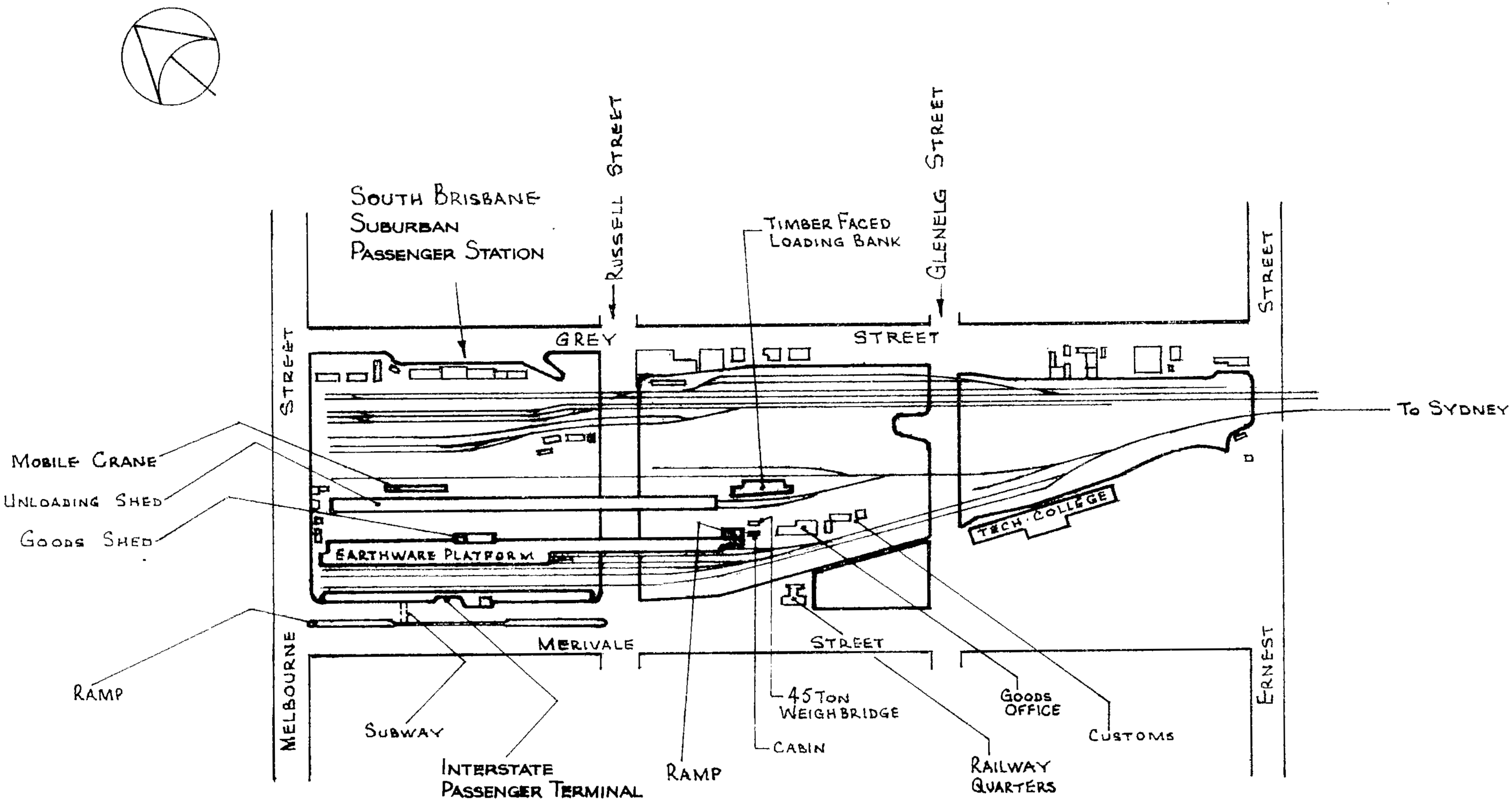


FIG. 2·2 SOUTH BRISBANE INTERSTATE TERMINAL

SCALE: 1" = 100m

The freight terminal comprises three main sections. The first consists of a small goods shed combined with a covered loading and unloading platform about 275 metres long, the southern end of which is used by freight forwarders. The northern end is used for the unloading of mixed freight from louvre wagons for distribution in the Brisbane area and for the transfer of mixed freight through Roma Street to northern Queensland. The platform is also used for loading interstate mixed freight.

The second section consists of a covered loading platform about 275 metres long which is used mainly by freight forwarders for handling of louvre van cargo.

The remaining section consists of a gantry crane installation serving an area about 183 metres long. It is used for the transhipment of (mainly) 20 ft dry-freight containers to road vehicles for delivery to consignee premises. At the northern end of the crane is a facility for unloading grain from small containers. At the southern end of the crane runway is a timber-framed loading bank and a small siding.

A narrow gauge siding runs into the freight terminal from the suburban passenger lines. This siding is used mainly for short haul grain destined for the Brisbane area.

Truck access is by a steeply inclined road from the lower level of the street system, where goods offices, check cabin, customs office and weighbridge are located.

Freight Movements

An analysis of freight movements for the 12 months to July 1973 shows that 411,000 tonnes of mixed freight destined for Roma Street or local distribution were handled at South Brisbane by Queensland Railways. No data are available on the labour force used during that period and the rate of handling is not known. Loading and unloading for bulk goods by consignee or consignor is carried out with their own labour and no handling rates are known. 11,150 containers were handled during this period, giving a rate of approximately 46 per day.

Goods handled at present include steel, grain, bulk goods and mixed general freight. Containers are transferred from rail to road using the gantry. These are essentially full container loads moving to and from consignor premises. Freight forwarders and consignees carry out most of the loading of freight into louvre vans. Approximately 5 per cent of handling operations represent work by rail employees in stowing and unstowing of mixed freight for transfer to Roma Street or distribution in Brisbane.

The lack of manoeuvring space between the two covered goods areas and the proximity of the gantry to the eastern covered shed leads to road traffic congestion in the yard. This is aggravated by the disinclination of consignors to palletise goods and achieve faster turnaround of road vehicles in the yard.

Potential for Increased Throughput

From inspections of the South Brisbane freight terminal and statements by senior rail officers, it is understood that the current load is only just being handled; no further increase in throughput could be managed under the existing conditions. Container traffic is nearly the maximum that can be carried.

There are limited possibilities for increasing throughput by improvements in layout, methods or equipment. An additional crane would increase the rate of handling containers but road congestion would negate any improvements in throughput. The handling of mixed freight by rail employees has not been critically examined but there do not appear to be any promising avenues for improvement. It was noted, however, that more could be done at the origin to sort goods to simplify handling on receipt. At present, goods are sorted on the South Brisbane platform and there is extreme congestion on the platform. There appears to be little that could be done to layout as the facilities seem to be located in their best position within the terminal.

The possibility of expansion of the terminal to increase throughput, while being feasible, does not commend itself as the facility is in a built-up area. Expansion would involve the acquisition and demolition of commercial buildings on the perimeter of the terminal area, possibly with encroachment on to street reserves. Redevelopment would be complicated by the fact that streets providing access to the area are at a lower level than the goods yard operating area. Further, such a move would not fit in with current Queensland Railways proposals to extend the narrow gauge railway across the Brisbane River to link up with the Roma Street terminal. When South Brisbane Station is closed down as planned, more land could be provided for freight purposes but the problems of operating the freight terminal in the business centre of the city, continuing with transhipment of freight at Clapham and operating two widely separated facilities would still remain.

CLAPHAM

Clapham is situated about 7.2 kilometres from South Brisbane and about 4 kilometres north of Acacia Ridge. It is served by standard and narrow gauge lines. The site covers approximately 12 hectares (Figure 2.3).

The terminal is essentially a facility in which transhipment operations take place from standard gauge rail to narrow gauge rail. Other operations also take place; they centre on freight forwarders' use of flexivans, containers and louvre vans. Clapham is built around the main standard-gauge line which bisects the terminal; standard and narrow gauge sidings are located on each side of the main line. On the eastern boundary there is a narrow gauge passenger line and station. On the western boundary are a number of buildings including a storage shed and flour mill, a large covered siding and storage building and a two-storey building occupied by freight forwarders (TNT). There are also several small office buildings, fettlers' sheds, amenity buildings, etc.

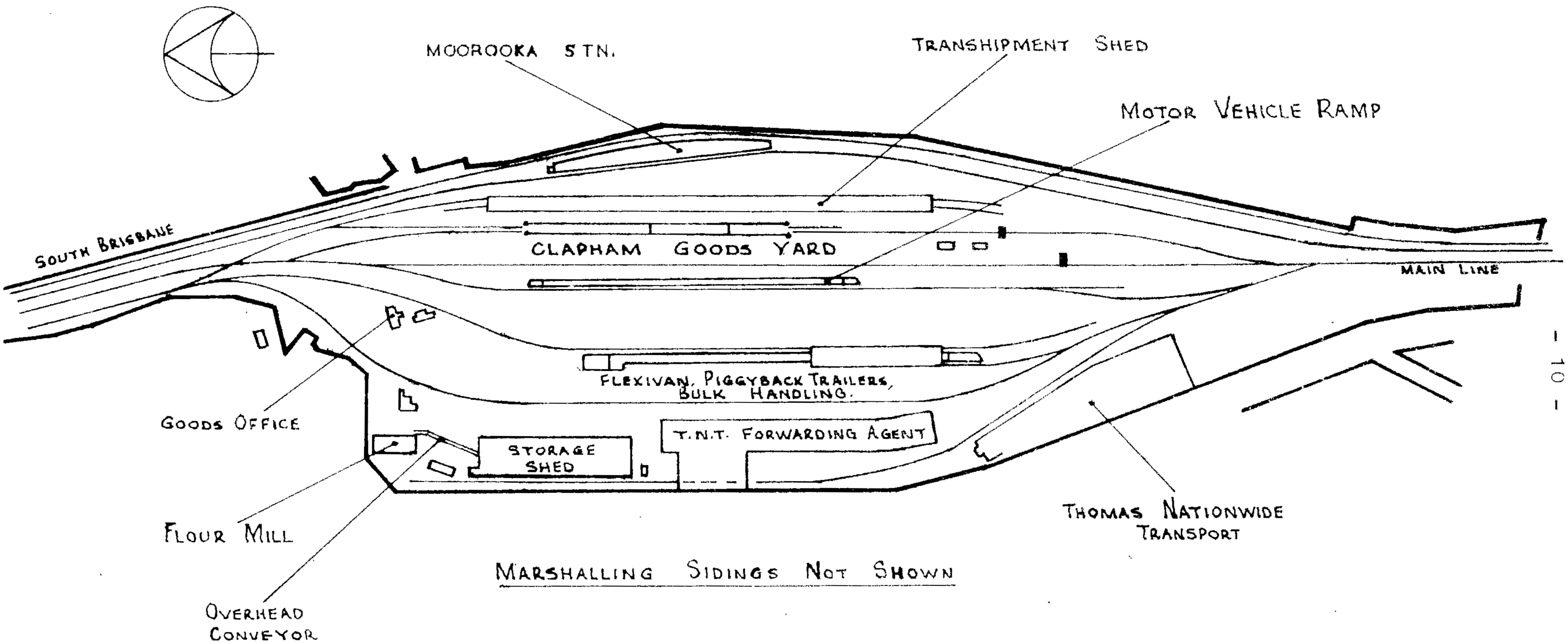


FIG. 2·3 CLAPHAM RAIL TRANSHIPMENT TERMINAL

SCALE : 1″ = 100 m

There are two important railway facilities. One is a covered platform, flanked by standard and narrow gauge lines, used for manual transhipment of goods. The other facility incorporates two gantry cranes, spanning standard and narrow gauge lines, used for transhipment of heavy machinery, containers, grain and steel.

A partly covered platform, served by both gauges, is used for the handling of grain not otherwise transhipped under the cranes. Two ramps provide for the unloading of mobile items (primarily cars). A small timber structure is used for transhipment of cattle. Provision is also made for unloading cars from special freight wagons.

Road access is available to the area with one entrance serving TNT and the other the main transhipment area. There are no road-rail transhipment facilities except within the TNT terminal and at the car unloading area.

Freight Movements

The terminal transhipped 380,000 tonnes during the 12 months ending July 1973. Commodities included steel destined for other parts of Queensland, motor cars destined for local distributors, fresh fruit and vegetables. Both dry containers and refrigerated containers were handled.

Apart from such operations as auger-transfer of grain or the odd transhipment of cattle from one wagon to another, goods are transhipped at Clapham either manually across the platform between the two rail lines, or mechanically by the two gantries.

Steel is transhipped from open or flat-topped wagons to equivalent Queensland wagons. On the heavier or longer lifts both gantries may be used. While the working speeds of the cranes are a little below those being used in some recently constructed terminals, the operation is reasonably satisfactory. The same applies to the handling of individual items such as machinery and 20 ft containers. Fruit and vegetables are handled manually by transfer across the platform between the two rail gauges. This is time consuming and costly as some fruit, water melons for instance, require very careful handling to avoid bruising, subsequent deterioration and loss of market value.

TNT handles mixed goods in louvre vans, containers of various sizes and types and flexivans. TNT operates its own material handling equipment.

Ansett Freight Express also take delivery of flexivans at the TNT facility. BHP receives and discharges steel but the bulk of the BHP steel handling is at Acacia Ridge.

Potential for Increased Throughput

The potential for increased throughput lies in reducing or eliminating the manual handling of goods from one rail wagon to another. Associated with this problem at Clapham is inability to get wagons into position. This is due to inadequacy of marshalling facilities and the necessity to use the main line for shunting purposes.

Improvement in marshalling capabilities would require additional land and a rearrangement of facilities. As can be seen from Figure 2.3, the Clapham area is hemmed in by commercial developments. Resumption of land would be costly, and expansion of either end would be difficult owing to the necessity of bridging or diverting watercourses. On the eastern side the area is effectively limited by the existing suburban passenger station.

ACACIA RIDGE

Acacia Ridge is located about 12 kilometres south of central Brisbane along the interstate standard gauge line. It covers an area of 51 hectares, is about 2.6 kilometres long and is 0.3 kilometres wide over about one-third of its length (Figure 2.4).

The only development of the site so far has been the provision of rail sidings through the site to service industry on the eastern boundary, some marshalling sidings along the eastern side of the main line and a rail siding with reinforced concrete hard-stand presently being operated by BHP as a steel storage and distribution area.

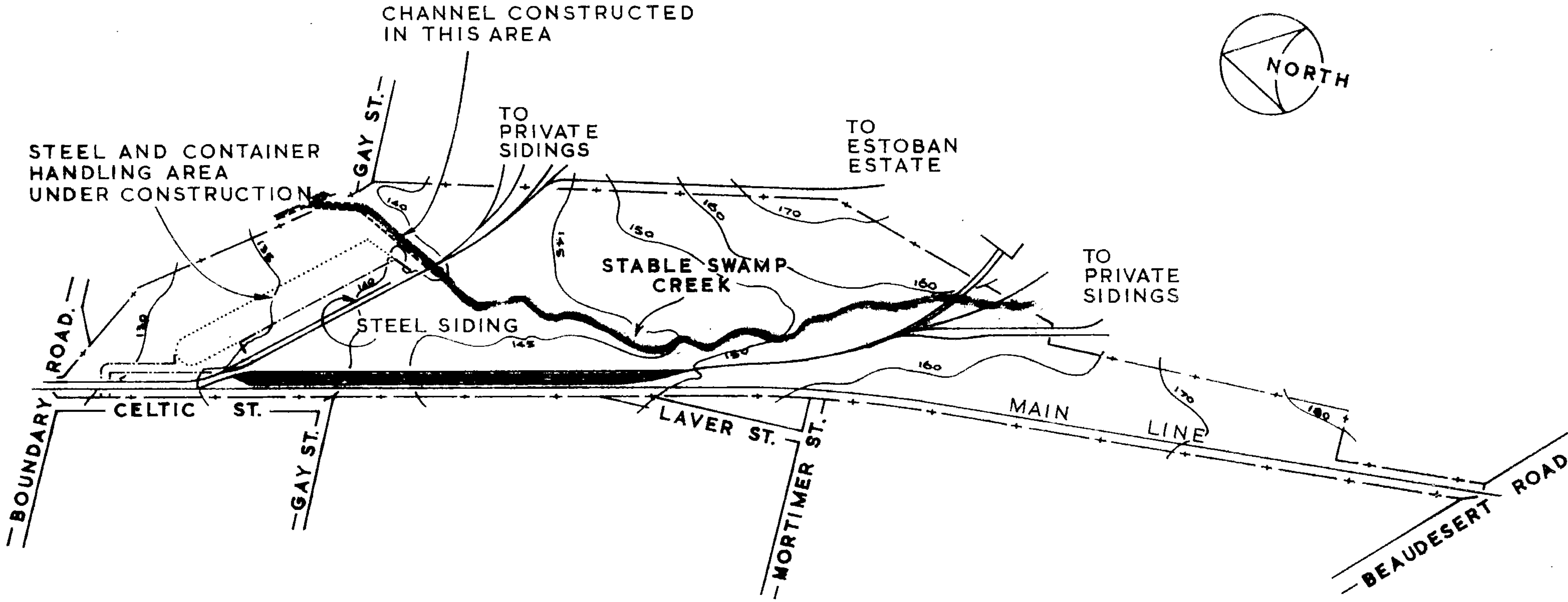


FIG. 2·4 EXISTING RAIL FREIGHT TERMINAL AREA ACACIA RIDGE

SCALE: 1" = 250m

SALISBURY AND PARK ROAD

These two terminals serve freight forwarders. Park Road is scheduled for closure within two years and the occupants plan to transfer their operations to Salisbury, 0.6 kilometre north of Acacia Ridge. There are no plans for Queensland Railways investment in these facilities.

YEERONGPILLY

Standard gauge locomotives are serviced at Yeerongpilly, and minor repairs to wagons are also carried out at this site. It is the intention of Queensland Railways to replace the depot by new facilities at the proposed Acacia Ridge terminal.

CHAPTER 3 - TRAFFIC TO BE ASSIGNED TO ACACIA RIDGE

To define the various tasks of the Acacia Ridge developments, it is necessary to determine the quantity of each load form (container, LCL, private bulk loading, etc.) that will be handled by each functional area of the terminal complex. Historical data have been used to estimate recent freight movements to the existing Brisbane terminal areas (Annex A) and from these the traffic has been assigned to the parts of Acacia Ridge. Growth rates have then been assumed to estimate future traffic.

Several sources of data have been used; these originate from records of the Queensland Railways and the Public Transport Commission of New South Wales. These data were neither entirely sufficient nor entirely consistent. The estimates of traffic assignable to Acacia Ridge are thus subject to revision.

TRAFFIC PROJECTIONS

There are a number of factors affecting volume changes over a period. These include changes in routing of commodities, competition from other transport modes, increases or decreases in industrialisation, policy decisions of government, speed and efficiency of service, freight rate structures, seasonal conditions and population growth. Obviously, some commodity flows may vary over the years more than others; this makes it extremely difficult to make a projection based on modal split analysis.

In the circumstances, the approach taken has been to extrapolate the yearly interstate traffic over a 10 year period. The simplest possible trend line has been drawn based on recent increases in the northbound and southbound volume. This projection (Figure 3.1) indicates a ten year growth of 1.6 times the 1972-73 northbound flow and 1.25 times the southbound. The annual increases are thus 6% and 2.5% of 1972-73 traffic, respectively.

ASSIGNMENT OF TRAFFIC

The traffic assignable to the Acacia Ridge terminal represents, in general, traffic now passing through South Brisbane and the Clapham transhipment facility. Other traffic now passing through Brisbane is handled by private sidings.

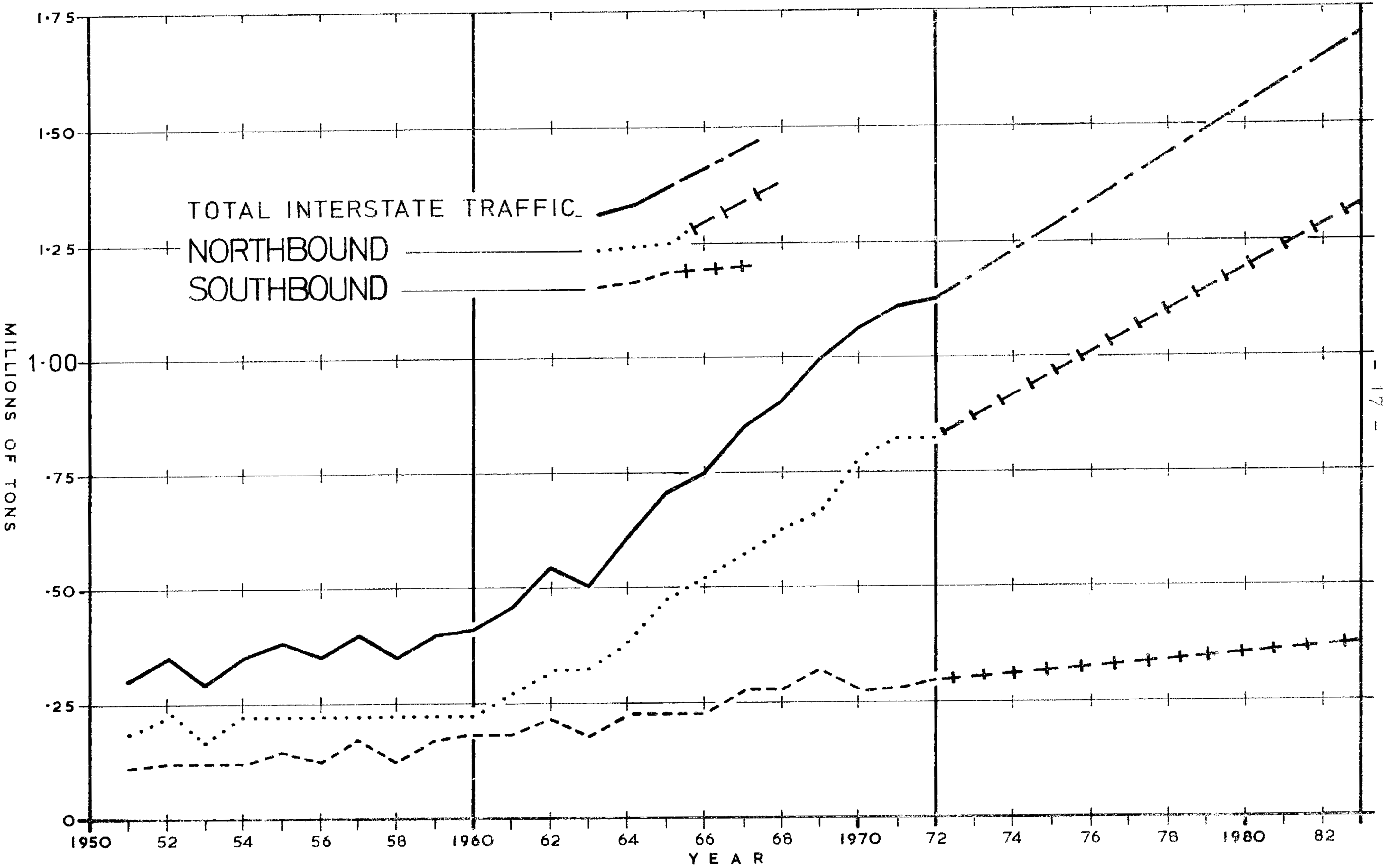
On the basis of the data presented in Annex A, the 1982-83 traffic estimates for Acacia Ridge are presented in Table 3.1. Also shown are the number of equivalent 20-foot containers to handle this traffic.

TABLE 3.1 - ACACIA RIDGE: PROJECTED MAXIMUM DAILY THROUGHPUT

Operation	Five year projection		Ten year projection		Remarks
	Tonnes per day	Equiv. no. of cont-ainers(a)	Tonnes per day	Equiv. no. of cont-ainers(b)	
NORTHBOUND					
Goods shed	279	7	343	17	Rail to road
Break bulk - goods shed	51	1	63	3	Rail to rail
Yard - bulk loading	648	16	798	40	
Crane-handled goods	414	10	510	26	Rail to road
Fruit and vegetables	41	1	50	3	
Grain	7	-	8	-	
Steel	616	15	758	38	
Bulk fertilizer	7	-	9	-	
Transhipment	1,456	36	1,792	89	Crane and general goods
Cars	169	-	208	-	
SOUTHBOUND					
Goods shed	49	1	55	3	Road to rail
Break bulk - goods shed	5	-	6	-	Rail to rail
Yard - bulk loading	77	2	85	4	
Crane-handled goods	200	5	223	11	Road to rail
Fruit and vegetables	73	2	81	4	
Grain	186	5	206	10	
Steel	17	-	19	1	
Bulk fertilizer	-	-	-	-	
Transhipment	906	23	1,006	50	Crane and general goods
Cars	96	-	106	-	

(a) 30% of goods. (b) 60% of goods.

FIG. 3·1 RAIL FREIGHT TRAFFIC – ACACIA RIDGE RAIL TERMINAL
TEN YEAR PROJECTION 1973 – 1983



CHAPTER 4 - WAGON UTILIZATION

The need for the proposed Acacia Ridge development has been based on the view of experienced railway officials that wagon delays are intolerably high. To assess the required terminal investment, it is necessary to estimate the magnitude of these delays.

Delays to standard gauge wagons bound for Brisbane arise in three ways: excessive idle time at the Brisbane terminals, storage en-route and excessive transit time for slow moving trains. Although the first delay is almost entirely attributable to the congested condition of the Brisbane terminals, only part of the second source of delay and none of the third can be eliminated by improved facilities. There are several interacting causes for these delays:

- inadequate wagon classification and storage facilities at Brisbane terminals;
- inadequate loading and transhipment facilities;
- unsuitable zoning of trains at their point of origin;
- limitations on trailing load and train length over part of the route;
- use of 4-wheel wagons.

As only the first two of these causes can be eliminated by investment in Acacia Ridge, the analysis has centred on the identification of terminal and en-route delays arising from these two causes alone.

ANALYSIS OF EN-ROUTE DELAYS

All of the enumerated causes of delay generate en-route delays; to isolate those caused by terminal deficiencies, several assumptions have been made about train operations. First, although wagons may be delayed, trains are not. Trains run through to their destination in conformity with their schedule, even though wagons have been dropped off or picked up. This assumption defines the 'non-delayed' wagon running time to be the train running time actually experienced, given the existing constraints other than those imposed by the Brisbane terminals. That is, recent train running times reflect the effect of the last three enumerated causes of delay but not those arising from Brisbane terminal deficiencies.

This assumption is simplistic; train running times must necessarily be affected by the prevailing terminal capacity. Therefore, the en-route delays thus calculated should represent the lower bound of wagon delay estimates. The assumption is seen to be reasonable by comparing the actual running time with those of the master train diagram for the Grafton district (Table 4.1). These running time delays will have little effect on possible wagon savings.

TABLE 4.1 - TRAIN RUNNING TIMES, TAREE TO BRISBANE

Train number	Master diagram time	Actual time (a)
	hours	hours
241	13.00	15.17
243	15.00	17.50
245	14.00	16.00
249	14.30	16.50
343	14.00	16.44
345	10.30	11.69
641	15.00	16.00

(a) Mean times for trains during July and August 1973

A corollary assumption is that train running time is affected by the need to remarshal trains at Grafton due to trailing load limitations north of Grafton. It is not affected by the rezoning that is undertaken there to relieve the task of Clapham.

Lastly, it has been assumed that wagons are delayed only during their northbound run and then only within the Grafton district. This is believed to be reasonable although it is recognised that occasional delays do occur south of Taree.

On the basis of these assumptions, the en-route delays to wagons caused by Brisbane terminal problems have been estimated by the use of computational rules discussed in Annex D.

ANALYSIS OF TERMINAL DELAYS

'Wagon delay', when applied to terminal turnaround time, cannot be defined on the basis of analytical techniques. Terminal delay can be accurately estimated only by a case study of a large sample of wagons over a long period of time; analysis of delay is complicated by such factors as terminal working rules and hours, disruption due to industrial disputes, equipment failure, wagon priorities (and contractual arrangements) and the disparity between north and south bound commodity movements.

As a basis for assessing the magnitude of terminal delays, it has been estimated that when the proposed development is completed, the maximum time for a wagon to pass through will be 48 hours in normal circumstances. This would allow for the complexities of terminal operations, for the wagons that arrive on weekends, and for the large differences between terminal times experienced by containerised goods and LCL goods. The increasing use of cargo consolidation outside the terminal should make the estimated terminal delay benefits, based on a projected 48 hour turnaround time, conservative.

SUMMARY OF RESULTS

The summary of wagon trip characteristics for two sample weeks is pressnted in table 4.2. The transit times and turn-around times are those actually experienced during these two periods.

TABLE 4.2 - TRAVEL CHARACTERISTICS, STANDARD GAUGE WAGONS ARRIVING IN BRISBANE FROM TAREE

Statistic	Travel time category			Delay time category		
	Transit	Terminal (a)	Total	Transit	Terminal (b)	Total
JULY 1973 SAMPLE WEEK (c)						
Number of wagons	679	704	596	679	704	596
Mean time (hrs)	52	82	130	34	41	76
Std. error	3.11	2.98	4.26	3.15	2.68	4.34
AUGUST 1973 SAMPLE WEEK (d)						
Number of wagons	708	714	637	708	714	637
Mean time (hrs)	72	100	168	53	59	109
Std. error	3.87	3.22	5.39	3.80	2.99	5.11

(a) actual terminal time. (b) actual terminal time less 48 hours.
(c) 971 wagons arriving. (d) 918 wagons arriving.

NOTE : The sample numbers of wagons shows are those for which each travel characteristic could be calculated; the samples are slightly different and the columns are not entirely consistent.

Each travel characteristic can be applied to the total number of wagons arriving in the sample period with little error. Thus the total delay to all 971 wagons arriving in the July week is 971 times 76 hours, or 73,800 hours. Similarly, the total delay to the 918 wagons in the August week is 100,060 hours.

After discussions with personnel of Queensland Railways and the Public Transport Commission (Grafton), the BTE believes that the delays experienced during the August sample week are a conservative representation of future delays if there are no Brisbane terminal improvements.

Details of the delay analysis and more comprehensive results are shown in Annex D.

WAGON SAVINGS DUE TO REDUCED DELAYS

Given that a certain commodity flow exists between Sydney and Brisbane, any reduction in total trip time due to shorter transit or terminal time will permit an increase in the number of trips in a given time period, while simultaneously reducing the number of wagons required to carry the commodity flow. The reduction in the size of the wagon fleet can be obtained only once during the life of the project. Using recent market prices for wagons, this 'once and for all' wagon utilisation saving is presented in Annex D. Based on the July and August sample weeks the total savings are $7,738,700 and $10,236,400 respectively.

The total saving cannot be obtained at once; the completion of various facilities will generate savings in stages. The net present value of wagon savings is calculated in Annex D. Based on the August sample week, they are $1,654,000 at 7 percent discount rate and $2,770,000 at 10 percent.

The growth in the wagon fleet required to serve the terminal will not be as large for the accelerated development schedule as for the schedule planned by Queensland Railways. The net present value of growth associated wagon saving will be $2,620,000 at 7 percent and $3,116,000 at 10 percent.

CHAPTER 5 - PROPOSED TERMINAL DEVELOPMENT AT ACACIA RIDGE

SITE DESCRIPTION

Acacia Ridge, located about 12 kilometres south of central Brisbane, covers an area of 51 hectares, is about 2.6 km long and is 0.3 km wide over about one-third of its length (Figure 5.1). In view of the difficulties in expanding either Clapham or South Brisbane, the area was set aside many years ago for a new rail freight terminal.

There has been considerable industrial development nearby, culminating in the development of two industrial estates on the eastern boundary. Contiguous with these new estates are a number of large organisations including General Motors Holden, Lysaghts, Brambles and Kimberley-Clark. A new terminal facility is being planned in the same area by Ansett Freight Express (and Wridgeways). The rail terminal site has thus become part of the overall development, and Queensland Railways have not considered an alternative.

Road access has been provided by way of Beenleigh and Boundary Roads. There are plans for linking the terminal with other main roads which provide a direct route to the city.

Site Limitations

The boundaries extend from Boundary Road on the north, Beaudesert Road on the south, the main standard gauge rail line on the west and the industrial area on the east. At the northern end a four lane overhead bridge to take Boundary Road across the main line is proposed and will restrict expansion in this direction.

At the southern end, there is a similar situation; a four lane overhead bridge for Beaudesert Road is needed to eliminate road-rail interference. Grade changes would also make it difficult to use additional land to the south.

The proposed development of the existing terminal, as described in this report, requires approximately 39 hectares. The remaining undeveloped land would be inthree parcels:

- 4.5 hectares in the sidings area
- 4.1 hectares in the goods yard area
- 1.0 hectares to the south of the wagon storage areas

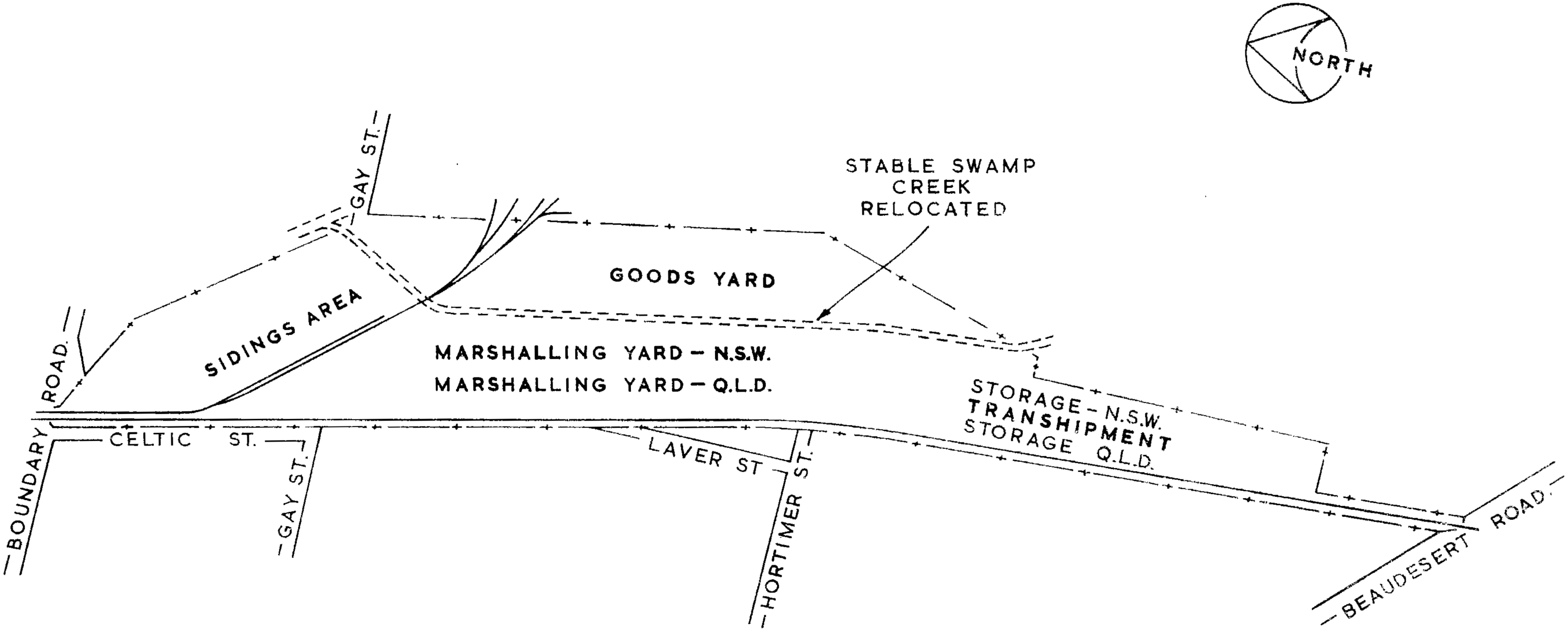


FIG. 5·1 PROPOSED LOCATION OF MAIN FACILITIES ACACIA RIDGE-Q.L.D.

SCALE: 1" = 250m

These areas, together with 2.0 hectares just north of Beaudesert Road, which could be resumed, provide room for expansion of the terminal areas if required. Further expansion, while technically straightforward, would require resumption of adjoining residential land west of the terminal.

Drainage

Stable Swamp Creek drains an area to the south of the terminal, passes through the site and finally discharges into the Brisbane River.

It has already been channelled to the north of the elevated rail spur serving the Estoban Estate. South of this spur the creek could be trained by cutting an open channel between the goods yard and the marshalling yard. The proposed location of the channel (Figure 5.1) permits the most effective use of the marshalling and goods area as presently planned, but the channel could be built over subsequently.

Queensland Railways advise that site drainage has been examined and there are no serious hydraulic problems. However, effective drainage of the area depends on completion of drainage works to the north of Acacia Ridge by the Brisbane City Council.

It is not expected that this additional drainage work would be carried out concurrently with the construction of Acacia Ridge. However, this will not be a problem as interim drainage can be managed by the construction of dissipating weirs. Forty thousand dollars has been provided for this task in the project cost estimate.

SITE PREPARATION

The area between the creek and the standard gauge line on the western boundary is at a lower level than the area between the creek and the eastern boundary. The northern area between the siding and the boundary is also too low for development at present. Surplus fill, which would result from levelling the goods area, will be used to raise the level of the siding, marshalling and storage areas.

Soil foundation tests have not yet been carried out. Soil condition in the low lying parts may necessitate pile foundations for crane runways. Concrete slabs will be required for cargo storage and truck manoeuvring areas. Normal reinforced concrete construction is proposed.

TERMINAL DESIGN CONCEPT

Quick turnaround of rolling stock is essential to make effective use of a rail terminal. Generally, trains of wagons must wait on the loading and unloading of individual wagons. This type of delay is being reduced in railway operations by the greater use of large freight containers and container flats, which can be handled very quickly, allowing wagons to be in almost continuous service.

Furthermore, the organisation of consignments into unit loads, consolidated in accordance with destination, promotes faster stowage of containers and louvre vans, faster unstowing at the destination and, therefore, more effective use of both containers and vans.

These practices, together with the use of modern materials handling equipment would form the basis for an efficient terminal operation at Acacia Ridge.

TERMINAL FACILITIES

The proposed development would provide for the handling of all classes of freight, including containers and container flats. The type and extent of the proposed facilities has been based on the projected daily maximum tonnages in 1984. Daily maximum tonnages forecast to 1979, the proposed completion year for the scheme, have also been considered.

The disposition of the major operational areas (mixed goods, transhipment, marshalling and storage sidings, steel siding and car siding) is shown on Figure 5.1. This layout, which evolved from discussions between BTE and Queensland Railways, would provide a satisfactory relationship between the various terminal installations, subject to the constraints imposed by the shape of the site and the presence of Stable Swamp Creek.

The goods area has been planned to accommodate two main sidings. One would serve a goods shed and a container handling area. The other would be reserved for bulk loading activities. The container handling area and the goods shed would be served by two semi-gantry cranes. The goods shed is planned to permit handling of mixed freight from both louvre vans and containers.

The transhipment area is designed with two runways, four gantry cranes, two platform transhipment sidings, an emergency cattle transhipment siding and a grain transfer facility.

Queensland Railways are currently procuring a 40-tonne gantry crane for the handling of steel in the northern sidings area. An additional 10-tonne gantry crane operating on the same runway is proposed. A motor vehicle siding is also planned for this area.

Figure 5.2 shows the layout of the proposed terminal, and Figure 5.3 shows a cross section through the goods shed and container handling area. A detailed list of materials handling equipment, setting out the handling rates and specific functions of each item, is shown in Tables B.1, B.2 and B.3.

The planned train marshalling and sorting area contains 10,260 metres of standard gauge track arranged in 19 sidings, with available length ranging from 460 metres to 680 metres.

There are 4,740 metres of narrow gauge track in 9 sidings with lengths ranging from 490 metres to 600 metres. These areas would hold approximately 1500 standard gauge wagons and 700 narrow gauge wagons (4-wheel, 6.7 m, i.e. 22 ft).

The main shunt line, as now designed, would accept an 830 metre train whereas the present train length limit on the main line north of Grafton is about 365 metres. Minor changes to the marshalling yard would allow it to accept 1500 metre trains.

The planned standard gauge wagon storage siding area would contain a total of 3630 metres of track arranged in 6 sidings. The narrow gauge storage area would contain 1330 metres of track in 2 sidings. These would be sufficient for 540 standard gauge wagons and 200 narrow gauge wagons (4-wheel, 6.7 m, i.e. 22 ft).

OPERATIONS

Classification Yard

Incoming unit-trains would be taken immediately to the appropriate terminal area and stored, as a train, if terminal space were not available. Other incoming trains would be sorted according to destination, stored if required and then the various rakes moved to the appropriate terminal as space became availalble.

Unit trains bound for Clapham or private sidings would not normally pass through the classification yard at Acacia Ridge. As far as possible, other trains also should be zoned at their place of origin to bypass all intermediate yards and reduce sorting and shunting movements at the destination. This would cause greater delays in the yard of origin, but the cost would be saved many times over by reductions in travel time, intermediate marshalling and final sorting.(1)

Goods Yard

The planned goods shed would receive louvre vans in sidings adjacent to the platform. LCL containers would be removed from wagons by the 35-tonne gantry crane and placed on the platform. A second 35-tonne gantry crane, on the same rails, would extend beyond the goods shed and would handle full containers (FCL) between wagons and road vehicles. The two gantry cranes would serve two dual-gauge rail tracks and also two-high container storage bays on each side of the rail tracks.

Bulk loads would be transferred between wagons and road vehicles at the outdoor sidings designated in Figure 5.2. Mobile cranes and fork lifts would be used to handle unit loads and goods in open top wagons. Parts of the sidings have been planned for receiving fruit and vegetables. Awnings would be provided for operation during wet weather.

Several methods of sorting and handling in the goods shed have been considered in this study, but further investigation is necessary to select the best system. Such a study would include examination of methods employed at major freight terminals overseas where the sorting of various types, weights and sizes of goods, for many destinations, is involved.

Transhipping Area

Transhipment of containers (FCL) would take place

(1) F.E. Shaffer and R. Roberts, 'Hump Yards: Are the Critics Right?', Modern Railroads, July 1973.

under two 35-tonne gantry cranes running on a common track. Other goods would be transhipped by two 10-tonne gantry cranes running on a common track adjacent to the larger cranes.

Fruit, vegetables and some general goods would be manually transhipped across a platform using gravity roller conveyors. The plan indicates that grain transhipment would be handled by direct transfer from narrow gauge hopper wagons to elevated bins, and thence to standard gauge wagons. Grain handling is discussed in more detail in Annex B.

Sidings Area

Steel would be unloaded from wagons by a 40-tonne gantry crane (with two 20-tonne hooks) and a 10-tonne gantry crane using a common track. The car siding planned for this area would be fitted with loading ramps so that cars could be driven from wagons under their own power.

Cattle Transhipment

Cattle transhipment (on an emergency basis) would take place on a siding adjacent to the marshalling area. Three mobile races would be used for direct transhipment between standard and narrow gauge wagons.

CAPACITY OF EQUIPMENT

The materials handling equipment has been designed for the projected traffic in 1982-83, on a one shift basis. The details of equipment capacity are discussed in Annex B. Each of the terminal areas would have surplus capacity during some stages of the project, resulting from the indivisibility of equipment items. The excess capacity will depend on the mix of individual commodity tonnages. No attempt has been made to forecast variations in individual goods and therefore the degree of excess capacity has not been estimated.

The maximum demand that would be placed on the fully developed terminal depends on long term changes in commodities and load forms. However, there is room for expansion in the goods area where only about half the area would be required under present proposals. There is little reserve space in the planned transhipment area but, if containerisation increases beyond the estimated 60% over 10 years, one pair of the manual transhipment sidings would become redundant and could be converted to gantry crane operation. In addition, the siding planned for emergency cattle transhipment could also be converted to gantry operation, yet still be available for cattle transfer.

Increased throughput could also be achieved by two shift operation or overtime. The additional capacity has not been estimated but would be substantially increased so long as the shunting and marshalling facilities were adequate.

PROPOSED CONSTRUCTION SCHEDULE

The need to integrate the developing facilities at Acacia Ridge with the existing facilities at South Brisbane and Clapham has largely determined the proposed construction schedule shown in Figure 5.4. On the assumption that detailed planning commenced by July 1974, the time to complete the terminal development would be approximately 57 months.

The first development tasks would be site survey, soil testing, the design of major installations, creek diversions and associated hydraulic works. If these tasks are undertaken by Queensland Railways, the completion date will be dependent on available technical staff and the demands of other urgent work. The use of consultants would shorten this preliminary design and construction phase. The schedule of costs outlined in Chapter 6 allows for this procedure.

Earthworks, including cuts, fills, drainage and underground utilities, would be the next phase of construction. The earthworks for the entire site should be completed in one stage to allow for the simultaneous development of interacting facilities.

The most urgent task is the relief of congestion at South Brisbane and the reduction in train handling work at Clapham. An initial step in solving these problems has already been taken by Queensland Railways; the 40-tonne gantry in the northern sidings area at Acacia Ridge will be completed by the end of 1974. It is being installed so that steel and road-rail container traffic can be transferred from South Brisbane to Acacia Ridge. This will produce immediate benefits by reducing congestion at South Brisbane.

In order to relieve Clapham of train handling, the first construction task should be the Acacia Ridge classification yard. Completion of this yard should be followed by completion of the goods yard in order to integrate the work of these facilities while South Brisbane is being phased out. Ideally, the South Brisbane freight activities should be transferred to Acacia Ridge at the same time as the present interstate passenger terminal is closed.

Two short term methods of reducing congestion at South Brisbane and Clapham were considered. First, the 20-tonne gantry at Clapham could be reconditioned or replaced in order to handle additional traffic. But the cost could not be justified by the short term savings.

Secondly, sorting and consolidation equipment could be installed at South Brisbane to handle mixed freight or, if the mixed freight were containerised, the equipment could be installed at Roma Street. However, the transfer of unsorted mixed freight to Roma Street would exacerbate the critical situation there. The installation of sorting and consolidation equipment at South Brisbane would need to be tailored to the existing terminal arrangements; it could not be used efficiently at Acacia Ridge. Therefore this idea was also discarded.

CHAPTER 6 - COSTS AND BENEFITS OF THE PROPOSED TERMINAL

DEFINITION OF PROJECT AND BASE CASES

The economic evaluation of the Acacia Ridge Terminal requires the formulation of appropriate base and project cases.

The project case is defined as the fastest practicable development of Acacia Ridge, constrained only by construction capabilities. This requires a continuous staging over 5 years, the minimum completion time.

The base case is defined as the most likely rate of development of Acacia Ridge if it were to be financed solely from Queensland Railways' sources. After reviewing past, current and likely future levels of capital expenditure by Queensland Railways, the most reasonable base case is identified as a construction period of 15 years with work being carried out in equal annual instalments over that period.

COSTS

The costs of the Acacia Ridge project are the capital costs, terminal operating costs, the costs of land acquisition and the planning and design costs of the project. Capital costs can be divided into initial and recurrent. The initial capital costs are the construction costs of the terminal plus the cost of the materials handling equipment required to operate the terminal (as described in Chapter 5 and Annex C). Recurrent capital costs are defined as those costs associated with the replacement of materials handling equipment as it wears out, up to 15 years, when the base case is completed.

All of these costs are attributable to both the base and project cases. However, the different timing involved causes a net cost to be attributable to the project case equal to the difference between the discounted present values of the cost streams.

If we assume that land acquisition, planning and design take place in year zero, for <u>both</u> the project and base cases then we need only be concerned with the initial and recurrent capital costs. It seems reasonable for all land acquisition to be included in the initial investment because of the economies involved in completing all the earthworks simultaneously, due to the cut and fill nature of the earthworks.

Discount rates of 7 per cent and 10 per cent have been used for present value calculations. Table 6.1 shows the results of discounting the capital costs for the base and project cases, using the two discount rates. The net present values show the net cost that must be attributed to the project case. The procedure involves the assumption that the capital investment schedule is linear i.e. one fifth of the total capital expenditure is spent each year in the project case and one fifteenth per annum is spent in the base case.

A more detailed explanation of the cost calculations and the breakdown between initial and recurrent costs appears in Annex C.

TABLE 6.1 - PRESENT VALUES OF CAPITAL COSTS (a)

	Project case present values ($'000)		Base case present values ($'000)		Net present values ($'000)	
	7%	10%	7%	10%	7%	10%
Initial capital costs	7490	6925	5546	4632	1944	2302
Recurrent capital costs (b)	-5	30	-278	-175	273	205
TOTAL	7485	6955	5268	4457	2217	2507

(a) 1973-74 prices. (b) Including salvage values of initial capital items and recurrent capital items as a negative cost.

Non-Assessable Costs

The available data did not permit an evaluation of the operating costs of the existing Brisbane terminals. Therefore, all the operating costs of the proposed development at Acacia Ridge have not been examined; this would have required an analysis of the joint costs of operating existing and developing facilities during the construction phase of the project. However, as part of the study of materials handling, the operating costs of items of capital equipment were estimated. These are outlined in Annex C.

BENEFITS

Economic benefits from accelerated development of Acacia Ridge include: wagon utilisation savings, savings in land occupied by Queensland Railways, shunting savings, inventory savings to railway customers, economies in terminal operations, and the alleviation of congestion at North Grafton.

With the time and data available, it has only been possible to quantify the first four of the benefit items, and indeed, it has not been possible to fully assess all the possible inventory savings.

Savings From Improved Wagon Utilisation

These savings, which have been discussed in greater detail in Annex D are of two types: savings resulting from step improvements in facilities and savings attributable to the different growth rates of project wagon fleet and the base case wagon fleet.

The former is the reduction in the number of wagons required in the Sydney to Brisbane rail circuit to maintain the required wagon flow rate. The wagon savings associated with growth represent the additional wagons that would no longer be required.

The savings have been calculated on the basis of the August sample week delay, round trip time and wagon flow rate for those classes of wagon that would benefit most from a reduction in delay times. BTE and Queensland Railways believe that this sample is representative of congestion levels likely to prevail in the immediate future.

In the analysis the procedure has been to allocate the wagon time savings in three equal steps after 2.5, 3.5 and 5 years for the project case and 7.5, 10.5 and 15 years for the base case (Figure D.2). This is regarded as the most appropriate allocation given the Acacia Ridge construction schedule (Figure 5.4).

It is believed that all the wagon savings can be exploited because of the extensive wagon procurement programs of the State railways. These programs reflect the current situation and should be recuced by the development of Acacia Ridge.

The net present values of wagon savings attributable to the accelerated development of Acacia Ridge are outlined in Table 6.2.

TABLE 6.2 - NET PRESENT VALUES OF WAGON SAVINGS

	Net present value (a) ($'000)	
	7%	10%
Step saving (once and for all)	1,654	2,770
Growth associated saving	2,620	2,117
TOTAL	4,274	4,886

(a) 1973-74 prices.

Land Opportunity Cost

Several of the existing goods yards will have their functions taken over by Acacia Ridge, thereby enabling this land to be surrendered for alternative uses. The value of the individual land parcels in question is shown in Table 6.3. Accelerated development of Acacia Ridge brings forward the time when this land can be converted to alternative uses, and Table 6.3 also illustrates these benefits. It can be seen that the benefit amounts to $1,009,000 and $1,098,000 for 7 per cent and 10 per cent discount rates respectively.

TABLE 6.3 - OPPORTUNITY COST OF LAND

	Valuation ($'000)	Net present value of accelerated release ($'000)	
		7%	10%
South Brisbane	1,794	629	675
Yerrongpilly	315	111	120
Clapham	768	269	293
TOTAL	2,877	1,009	1,098

Shunting Savings

Another significant component of the direct savings from reduced trip-times and more efficient marshalling and sorting is the real saving in shunting time and direct shunting costs.

Queensland Railway officials consider that the most probable saving will be 50% of present shunting costs. This saving will result from a reduction in the number of terminals involved in shunting operations, the reduced distances between terminals and improved terminal layout. This is calculated in Annex C as $101,000 per annum.

It is also expected that one shunting locomotive, with a capital value of approximately $150,000, will become available because the reduced shunting times and improved arrival distribution will permit more intensive use of the shunters. This latter benefit is a once and for all saving which is assumed to come into effect on completion of the capital construction programme. This estimate allows for partial equilibrium improvements to work themselves out during the construction period (i.e. 5 years and 15 years for the project and base cases respectively).

On the other hand, the direct shunting cost savings are annual benefits which must be increased by a traffic growth factor.

As with the previous annual costs and benefits the assumed growth is at an annual rate of 6% of the base traffic. Applying this rate to the annual shunting cost savings and discounting to get net present values, the total net shunting savings attributable to the accelerated development of the project are $756,000 at 7% and $590,000 at 10%. The net present value of the locomotive saving is $53,000 at 7% and $57,000 at 10%. These figures are discussed in greater detail in Annex C.

Inventory Savings

An inventory of products is required to fill the transport 'pipeline' (in this case, rail wagons travelling between Sydney and Brisbane). This inventory may be described as a 'transit inventory'.

The annual savings as outlined in Annex E are discounted to produce the net present value of the transit inventory benefits attributable to the project. For the more relevant August sample week the net present values were $2,769,000 and $2,110,000 for 7 per cent and 10 per cent discount rates respectively.

Non-Assessable Benefits

There will be economies of scale in many facets of terminal operations once the facilities are completed and operating smoothly. Specifically, these will result from the ability to co-ordinate all goods operations under one roof, a central administration and communications facility, and the advantages associated with separating the classification and terminal operations. Furthermore the larger marshalling and sorting areas should permit quicker breakdown of trains and improved distribution to the appropriate terminal areas. Only part of this benefit has been assessed in the reduced turnaround times of wagons and the shunting savings associated with the improved track layout.

Benefits will also result from the reduced average and marginal costs of handling wagons in the new terminal areas. Insufficient data on operating costs is available to allow an assessment of this saving.

The operational improvement will generate benefits to the users of railway services: more reliable service, reduced trip time variance, fewer losses and more efficient handling of goods. These benefits have not been assessed, nor has the increased patronage of rail services that will follow these benefits.

The development of Acacia Ridge will improve the conditions on the main line as well as in the terminal. Marshalling costs at Grafton have not been examined, nor has the effect of reduced congestion on train schedules and running times. These savings could well be significant.

SUMMARY OF RESULTS

The assessable financial benefits that accrue to the accelerated development of Acacia Ridge have been listed in Table 6.4 At a discount rate of 7 per cent, their total is $6,092,000; at 10 per cent it is $6,631,000.

When the net present value of project costs, estimated to be $2,217,000 at 7 percent and $2,507,000 at 10 percent (Table 6.1) is subtracted, the net present value to the railways of carrying out the accelerated project is thus estimated to be $3,875,000 at 7 percent or $4,124,000 at 10 percent.

The direct transport inventory saving is a social benefit that should be included to assess the economic merit of the accelerated project. If these benefits ($2,769,000 at 7 percent; $2,110,000 at 10 percent) are added to the financial results the benefit-cost ratio is 4.0 and 3.5 for discount rates of 7 percent and 10 percent respectively.

These specific benefits arise only if the 5 year and 15 year construction schedules are compared. The distribution of benefits tends to indicate that an even shorter construction period would be warranted.

TABLE 6.4 - FINANCIAL BENEFITS OF THE ACACIA RIDGE TERMINAL

	Net present value ($'000)	
	7%	10%
Wagon utilisation savings		
- once and for all	1,654	2,770
- growth associated	2,620	2,116
Opportunity cost of land	1,009	1,098
Shunting savings		
- direct cost savings	756	590
- locomotive savings	53	57
TOTAL	6,092	6,631

ANNEX A

COMMODITY MOVEMENTS

YEARLY COMMODITY MOVEMENTS

The volume of all commodities on the NSW rail system that cross the Queensland border are listed in Table A.1. The explanation of the commodity group codes is given in Table A.2. The monthly movements of principal commodity groups are presented in Tables A.3 to A.6. For convenience in examining the monthly variations in the main groups, the maximum and minimum monthly percentages of annual traffic have been listed in Table A.7.

Several facets of the 1972-73 traffic pertain to the analysis of the proposed terminal:

- 1.45 million tonnes passed through Brisbane standard gauge terminals in 1972-73; 29% of the total was southbound.
- Steel comprised 41% of northbound traffic but was a negligible part of southbound traffic.
- Private northbound bulk loading and container traffic were of similar importance (20% and 17% of all northbound goods respectively), but their effects on the terminal are different; bulk loading requires greater space and less capital equipment than do containers. It is possible that a significant portion of bulk loading will be containerised in the future.
- Southbound container traffic was 53% of the total while private bulk loading was only 16%.
- Farm products were 43,521 tonnes northbound and 97,815 tonnes southbound. Furthermore, these categories experienced large monthly variations.
- In aggregate, southbound traffic exhibited wide monthly variations; the peak month had twice the flow of the slack month.

STUDY OF TRAFFIC DURING SAMPLE PERIOD

The gross data discussed above are not sufficient to estimate the task to be imposed on various parts of the proposed terminal. In order to estimate these detailed traffic movements, an analysis has been made of the train consist lists covering interstate freight trains through the Brisbane area during the week 19-25 August 1973. This is considered a typical week; fifty-two times the freight tonnes carried during this week exceeds 1972-73 annual tonnes by 12.9 per cent for northbound traffic and by 8.7 per cent for southbound traffic.

The train consist lists show for each wagon its type, origin and destination, gross weight and a brief commodity description. Although some commodities (steel, fruit, explosives) are clearly indicated, other commodities like forwarders' and container traffic are not consistently recorded. Hence, much traffic carried by forwarders (especially into Brisbane) is included in 'other'; some forwarders' traffic is included with container traffic.

Net tonnes in each wagon were determined by subtracting from the gross weight the average tare weight of that particular wagon type. Wagons carrying load which did not record at least one tonne after subtracting tare weight were considered as empty wagons for this analysis.

As wagons are shunted between the various Brisbane yards, some yards appear in this analysis to receive far more wagons from interstate than they despatch, e.g. Park Road. Tables A.8 to A.13 present the results of this analysis. Tables A.8 to A.10 show the distribution of northbound commodities and wagons to each Brisbane terminal. Tables A.11 to A.13 repeat this for southbound traffic.

The study of traffic during the August sample week showed that of 862 freight wagons arriving in Brisbane, 10 were empty, while 409 out of a total of 899 southbound wagons were empty. Also, 66 four-wheel wagons were received, 8% of the total. Brake vans are not indicated in these tables.

INTRASTATE TRAFFIC MOVEMENTS

A small quantity of intrastate goods was also handled through Clapham Junction and associated sidings; this traffic is shown in Table A.14. Presumably, this task would be handled by Acacia Ridge in the future. Of these movements, 80% were outbound and 72% of these were steel.

ASSIGNMENT OF TRAFFIC TO BRISBANE TERMINALS

In addition to the data discussed above, traffic returns for South Brisbane and Clapham (and associated sidings) were used to impute the traffic that goes to various Brisbane standard gauge terminals.

This assignment, as shown in Table A.15, reveals several features of the tasks of various facilities:

- South Brisbane handles 30% of northbound freight and 25% of southbound freight.
- Goods transhipped between gauges represent 21% of northbound freight and 40% of southbound freight.
- Private siding and freight forwarders handle 50% of northbound traffic but only 35% of southbound traffic.

ACACIA RIDGE TRAFFIC ASSIGNMENT

On the basis of the data of Tables A.3 to A.15 and the assumed growth rates (northbound: 6% of 1972-73 traffic; southbound: 2.5% of 1972-73 traffic), the traffic through the proposed terminal at Acacia Ridge has been estimated as shown in Table A.16.

To determine the type and extent of materials handling equipment required to efficiently handle this freight task, it is necessary to determine the range of daily commodity movements. It is not economical to cater for infrequent extreme peaks; these could be handled by double or triple shifts. Because of the difficulty in conducting a risk analysis of the cost of not meeting peak period demand, the data of Table A.7 have been used to estimate the peak monthly flow factor for which equipment must be specified. This factor has been estimated to be 1.25 for northbound goods and 1.20 for southbound goods. These factors have been applied to all commodities.

The capacity of various terminals has been designed to allow for an increase in the use of 20 ft freight containers with payloads of 12 tons. These are assumed to take 30% of certain classes of traffic in five years and 60% in 10 years.

Other assumptions and calculations used to prepare Table A.16 are:

- Locality distribution of goods will be:
  - goods shed 75%
  - crane handled 20%
  - yard handled 5%
- Load form distribution of fertilizer:
  - bagged 90%
  - bulk 10%
- General goods, class rate goods and traffic N.O.S. are all considered as general freight.

- Equivalent number of containers = $\dfrac{\text{daily tonnes}}{12}$

- 1982-83 daily tonnage = $\dfrac{(\text{annual tonnage})\ (1.25)\ (\text{G.F.})}{(12 \text{ months})\ \ (20 \text{ days/month})}$

G.F. = 1.60 for northbound goods

G.F. = 1.25 for southbound goods

TABLE A.1-COMMODITY FLOW TO/FROM QUEENSLAND ON STANDARD GAUGE RAIL

(tonnes)

Commodity[(a)] code	Northbound		Southbound	
	1971-72	1972-73	1971-72	1972-73
1	15,846	10,990	364	95
2	24	3,502	0	60
3	6,212	5,490	2,052	1,790
4	1,691	1,416	620	351
5	4,999	4,938	860	1,132
6	1,889	2,177	578	693
7	3,435	4,058	1,056	1,195
8	69	95	153	129
9	0	0	24	1
11	1,728	540	0	0
12	43	581	6	249
13	232	348	9	1
14	450	53	0	15
15	1,864	2,326	0	118
16	0	0	0	0
17	0	0	14	0
18	796	914	0	0
19	0	458	32	8
20	1	19	59	6
21	99	2	39	2
22	0	2	0	0
23	0	32	0	3
24	3	0	0	0
25	0	0	0	0
26	0	0	0	0
27	3,019	1,673	149	182
29	87	57	150	32
40	0	0	0	0
42	37,605	54,255	80,929	116,314
43	64,612	45,874	73,763	47,528

(a) For N.S.W. codes, see table A.2.

TABLE A.1 (continued)

Commodity[(a)] code	Northbound		Southbound	
	1971-72	1972-73	1971-72	1972-73
44	15,922	70,290	14,793	53,891
45	204,817	210,597	66,687	54,306
46	0	0	0	0
47	2,213	2,985	694	306
48	7,303	7,088	14,887	31,668
49	9,657	11,170	0	848
51	14,567	20,351	63,384	64,592
52	1,019	1,855	206	0
53	54	0	39	63
56	0	0	0	0
57	843	801	1	0
58	1,885	2,356	0	0
60	0	0	0	0
61	494	6,592	0	0
62	1,453	1,653	0	0
64	2,156	2,669	0	0
67	0	0	488	245
70	0	0	0	0
71	21,785	24,682	17,462	16,618
72	36	0	151	34
73	318,518	417,454	3,357	2,936
74	0	2	320	346
75	30,533	31,369	1,185	2,366
79	59,158	77,142	15,722	15,700
80	2,124	2,831	0	0
81	0	0	0	0
82	28	23	0	0
83	0	0	0	0

(a) For N.S.W. codes, see table A.2

Source: Public Transport Commission of New South Wales

TABLE A.2 - NEW SOUTH WALES COMMODITY CODES

Goods	Code
Fertilizers	1
Misc.class rate (excluding items shown separately elsewhere)	2
. "A" class rate (excluding items shown separately elsewhere)	3
. "B" class rate (excluding items shown separately elsewhere)	4
. "C" class rate (excluding items shown separately elsewhere)	5
. 1st class rate (excluding items shown separately elsewhere)	6
. 2nd class rate (excluding items shown separately elsewhere)	7
. including any plus or minus percentages	
Empty returns	8
General goods (N.O.S.) excluding empty returns.	9
Wheat (bagged or bulk) - at grain rate	11
Grain (excluding wheat), agricultural and mill products (excluding flour), stock feed - at grain rate	12
Hay, straw and chaff - at "A" rate less 15%	13
Flour - at grain rate	14
Fruit and vegetables - at wagon rates (tables "A", "B" or "C")	15
Milk and cream in hired or owners' wagons - at wagon rates	16
Butter - wagon loads	17
Meat, pork, poultry, rabbits (fresh, chilled or frozen) - at "A" rate	18
Timber - wagon loads	19
Wool - at bale rate	20
Crude ores	21
Metal, sand, gravel and other minerals - at coal rate less 2½%	22
Cement - wagon loads	23
Petrol, kerosene, diesel fuel, furnace oil, heating oil, L.P. gas in owners' or departmental tank wagons, or in drums in wagon loads	24
Tar, asphalt, bitumen, bituminous emulsion in tank wagons or drums	25
Water - departmental tank wagons	26
Manufactured iron and steel - wagon loads	27
Road vehicles and motor boats, including motor cars, motor lorries, caravans, trailers, buggies, drays and carts	29

TABLE A.2 - NEW SOUTH WALES COMMODITY CODES (contd)

Goods	Code
Goods charged at contract rates	
Trailer on flat car	40
Overseas containers	42
Container traffic (including flexi-van traffic) -at wagon load rates	43
Container traffic - at container rates	44
Bulk loading - private (excluding flexi-van traffic)	45
Bulk loading - departmental	46
Rice	47
Other grain, agricultural and mill products, stock feed, etc.	48
Products of N.S.W. country canneries (including Nestles and Horlicks)	49
Fruit and vegetables	51
Timber (including masonite, hardboard, pineboard, etc.)	52
Wool	53
Skins, hides, tallow, dripping, glue fleshings and neetsfoot oil	54
Zinc , lead and copper concentrates (Broken Hill to Cockle Creek and Cobar to Port Kembla)	56
Other ores as defined on page 188 of Merchandise and Livestock Rates Book including alumina, and including metal ingots and scrap other than iron and steel	57
Ashes, metal, sand, ballast, slag, etc. as defined on page 186 of the Merchandise and Livestock Rates Book	58
Limestone	60
Cement	61
Salt	62
Tar, asphalt, bitumen and bituminous emulsion in tank wagons or drums	64
Petrol, kerosene, diesel fuel, furnace oil, heating oil, L.P. gas in owner's or departmental tank wagons or in drums in wagon loads.	67
Gas in cylinders	70
Motor vehicles, chassis and bodies	71
Agricultural implements and parts, tractors and parts	72
Iron and steel (other than scrap)	73
Scrap iron and steel (including rejects, billets, blooms, cheeses, ingots, pig, slab and sheet bar)	74
Motor vehicle parts in cases	75
Traffic (N.O.S.)	79

TABLE A.3 - MOVEMENT OF MAJOR COMMODITIES TO QUEENSLAND, 1971-72

(tonnes)

Commodity group	Commodity code	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	April	May	June	1971-72
Steel	73,27	21656	24165	21600	23797	29218	30574	21219	28603	34204	22465	33489	30547	321537
Blk. loading pvt.	45	19328	19081	19092	17175	18455	17864	10421	18365	17674	13531	18566	15265	204817
Containers, flexi	42,43,44	10612	9420	9265	9407	11695	8750	9281	8383	10681	10887	11291	8461	118139
Traffic NOS	79	5046	5188	5630	5231	6658	5775	3543	4962	4827	3833	4503	3962	59158
Car parts	75	2913	1777	3113	3909	3408	2220	900	2112	2793	2353	3236	2799	30533
Smalls	3,4,5,6, 7,49	2113	2189	2066	2574	2705	2459	1818	2720	2719	2290	2267	1963	27883
Cars	71	1829	2376	2294	1266	1622	2511	932	1098	1860	1638	2640	1728	21785
Fruit, vegs.	15,51	1523	1074	804	724	1432	1284	2144	2210	2622	705	768	1123	16431
Fertilizer	1	2204	1415	1832	2350	2350	753	378	445	714	1010	1758	637	15846
Grains	11,47,48	1032	1135	936	895	774	712	567	744	1009	836	916	1691	11244
Total of groups		68256	67820	66632	66346	78317	72902	51203	69630	79109	59548	79434	68176	827373
All commodities		69220	68749	67592	67104	79013	73954	51876	70474	80078	60533	81308	69368	839269

Source : Public Transport Commission of New South Wales

TABLE A.4-MOVEMENT OF MAJOR COMMODITIES TO QUEENSLAND, 1972-73

(tonnes)

Commodity group	Commodity code	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	1972-73
Steel	73,27	33443	37417	38248	32759	38434	38484	43914	34496	37055	33694	34261	20731	419127
Blk. loading pvt.	45	17847	17040	16384	15363	19659	15623	13541	14491	20518	18440	23483	18208	210597
Containers, flexi.	43,42,44	10939	11883	19750	15679	12789	12169	13343	13465	15650	16952	16941	17859	170419
Traffic NOS	79	4495	5358	8158	5557	5829	5567	4846	6060	8402	6327	8183	8360	77142
Car parts	75	3005	2900	2732	2975	2907	1461	1448	3115	2924	2153	3004	2727	31369
Smalls	3,5,7,6, 4,49	2139	2232	2090	2358	2470	2908	2007	2283	2707	2302	3147	2606	29249
Cars	71	2149	1980	1633	2364	2699	2097	722	1587	2591	2144	2462	2254	24682
Fruit,vegs	51,15	1285	1406	1058	1216	1695	1440	2592	3121	4028	2566	1256	1014	22677
Fertilizer	1	1470	1506	2148	3504	1205	1157	0	0	0	0	0	0	10990
Grains	48,47,11	986	1046	770	869	991	688	660	731	750	900	1007	1215	19613
Total of groups		77758	82848	83971	82644	85789	82594	83073	79349	94643	83478	93744	74974	1006865
All commodities		79685	84421	85040	83489	86675	83442	84910	80887	96361	87358	96429	83484	1032181

Source : Public Transport Commission of New South Wales

TABLE A.5 – MOVEMENT OF MAJOR COMMODITIES FROM QUEENSLAND, 1971/72

(tonnes)

Commodity group	Commodity code	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	1971-72
Containers	42,43,44	18885	11182	12846	11155	15094	15362	13328	11534	19128	13470	16348	11153	169485
Blk. loading pvt.	45	4766	4948	6023	7410	8036	8717	6051	6850	5020	2984	3203	2697	66687
Fruit, vegs	51	8893	8040	9803	11412	7971	4132	1907	864	1081	1780	3091	4410	63384
Cars	71	1654	1317	1594	1026	1073	1715	886	1400	1883	1564	1719	1631	17462
Traffic NOS	79	1546	1173	1199	1489	1378	892	505	1122	1672	1832	1505	1409	15722
Grains	45,47	913	592	418	317	1354	154	1023	846	1598	3117	2051	3198	15581
Smalls	2,7,5,4	475	474	451	445	464	378	389	384	308	301	329	308	4588
Steel	73	303	180	317	268	423	145	197	191	172	311	375	375	3357
Car Parts	75	159	63	67	31	21	87	57	89	184	105	188	134	1185
Total of groups		37567	27967	32718	33553	35814	31582	24343	23280	31046	25464	28809	25297	357451
All commodities		37688	28401	32856	33825	36415	31805	24559	23469	31192	25591	29037	25395	360233

<u>Source</u> : Public Transport Commission of New South Wales

TABLE A.6 – MOVEMENT OF MAJOR COMMODITIES FROM QUEENSLAND, 1972-73

(tonnes)

Commodity group	Commodity code	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	1972-73
Containers	42,43,44	16048	17772	20330	22415	21306	19612	18807	18664	19951	11894	18867	15067	217733
Fruit, vegs.	51	6393	7871	9433	9906	7433	4571	2560	1244	1786	2278	4575	6542	64592
Blk. loading pvt.	45	3040	3065	5087	6867	6168	5254	5996	5575	3910	2946	3965	2433	54306
Grains	12,48,47	5299	8816	8299	3830	364	183	1184	254	462	2282	1032	1218	33223
Cars	71	1621	1143	1176	1549	1128	1758	694	1359	1995	1180	1401	1614	16618
Traffic NOS	79	1133	767	1355	901	753	2902	406	1967	2073	935	1190	1318	15700
Smalls	49,6,3,4 5,7	435	369	471	439	435	580	550	411	595	495	591	638	6009
Steel	73	300	66	405	311	232	250	179	397	99	131	486	80	2936
Car Parts	75	160	152	87	111	76	164	213	402	288	224	162	327	2366
Total of groups		34429	40021	46643	46329	37895	35274	30589	27273	31159	22365	32369	29237	413483
All commodities		34633	40304	46668	46378	37947	35303	30653	27389	31302	22600	32398	29333	414908

Source : Public Transport Commission of New South Wales

TABLE A.7 - MONTHLY VARIATIONS IN STANDARD GAUGE TRAFFIC TO QUEENSLAND

Commodity Group	Code	1971-72 Maximum Month	%	1971-72 Minimum Month	%	1972-73 Maximum Month	%	1972-73 Minimum Month	%
NORTHBOUND									
Steel	73,27	Mar	10.6	Jan	6.6	Dec	9.2	June	4.9
Blk loading pvt	45	Jul	9.4	Jan	5.1	May	11.2	Jan	6.4
Containers, flexi	42,43 44	Nov	9.9	Feb	7.1	June	10.5	Sept	6.3
Traffic NOS	79	Nov	11.3	Jan	6.0	Mar	10.9	Jul	5.8
Car parts	75	Oct	12.8	Jan	2.9	Feb	9.9	Jan	4.6
Smalls	3,4,5, 6,7, 49	Feb	9.8	Jan	6.5	May	10.8	Jan	6.9
Cars	71	May	12.1	Jan	4.3	Nov	10.9	Jan	2.9
Fruit, vegs	15,51	Mar	16.0	Apr	4.3	Mar	17.8	June	4.5
Fertilizer	1	Oct & Nov	14.8	Jan	2.4	Oct	31.9	Jan & June	0.0
Grains	11,47 48	June	15.1	Jan	5.0	Aug	9.9	Jan	6.2
Total of groups		May	9.6	Jan	6.2	Mar	9.4	June	7.4
All commodities		May	9.7	Jan	6.2	May	9.3	Jul	7.7
SOUTHBOUND									
Containers	42,43 44	Mar	11.3	June	6.6	Oct	10.3	Apr	5.5
Blk loading pvt	45	Dec	13.1	June	4.0	Oct	15.3	Feb	1.9
Fruit, vegs	51	Oct	18.0	Feb	1.4	Oct	12.6	June	4.5
Cars	71	Mar	10.8	Jan	5.1	Aug	26.5	Dec	0.6
Traffic NOS	79	Apr	11.7	Jan	3.2	Mar	12.0	Jan	4.2
Grains	45,47	June	20.5	Dec	1.0	Dec	18.5	Jan	2.6
Smalls	3,7, 5,4	Jul	10.4	Apr	6.6	June	10.6	Jul & Nov	7.2
Steel	73	Nov	12.6	Dec	4.3	May	16.6	Aug	2.2
Car parts	75	May	15.9	Nov	1.8	Feb	17.0	Nov	3.2
Total of groups		Jul	10.5	Feb	6.5	Sep	11.3	Apr	5.4
All commodities		Jul	10.5	Feb	6.5	Sep	11.2	Apr	5.4

NOTE: Average month should be 8.4% of yearly total

TABLE A.8 - LOADED WAGONS RECEIVED IN BRISBANE FROM INTERSTATE BY YARD OF DESTINATION, WEEK 19-25 AUGUST 1973

Brisbane yard	Bogie wagons					4-wheel wagons	Total wagons
	Flat	Open	Closed	Tank	Car carriers		
NUMBER OF WAGONS							
Acacia Ridge	23	89	29	-	1	-	142
Clapham	76	35	91	1	36	8	247
Park Road	8	29	35	7	-	-	79
South Brisbane	30	85	120	-	-	-	37
Brisbane stations on 3'6" gauge system (a)	8	4	4	-	-	29	45
Stations north of Brisbane (a)	12	18	8	-	-	19	57
TOTAL	157	265	319	8	37	66	852
FREIGHT TONNES							
Acacia Ridge	730	2799	662	-	4	-	4195
Clapham	2854	1128	2340	30	401	69	6822
Park Road	304	1104	808	238	-	-	2454
Salisbury	-	205	866	-	-	-	1071
South Brisbane	727	2342	2795	-	-	82	5946
Brisbane stations on 3'6" gauge system (a)	177	17	157	-	-	257	608
Stations north of Brisbane (a)	425	721	130	-	-	409	1685
TOTAL	5217	8316	7758	268	405	817	22781

(a) Presumably unloaded or transhipped at Clapham.

TABLE A.9 - LOADED WAGONS RECEIVED IN BRISBANE FROM INTERSTATE BY COMMODITY CARRIED, WEEK 19-25 AUGUST 1973

Commodity carried	Bogie wagons					4-wheel wagons	Total wagons
	Flat	Open	Closed	Tank	Car carriers		
NUMBER OF WAGONS							
'Forwarders' (a)	57	-	-	-	-	-	57
'Containers'	26	8	-	-	-	32	66
Cars	4	1	-	-	37	-	42
Steel	38	90	27	-	-	15	170
Explosives	-	-	11	-	-	-	11
Other	32	166	281	8	-	37	506
	157	265	319	8	37	66	852
FREIGHT TONNES							
'Forwarders' (a)	2201	-	-	-	-	-	2201
'Containers'	550	129	-	-	-	287	966
Cars	23	16	-	-	405	-	444
Steel	1554	4177	1183	-	-	375	7289
Explosives	-	-	86	-	-	-	86
Other	889	3994	6489	268	-	155	11795
	5217	8316	7758	268	405	817	22781

(a) Incomplete; also included in 'Containers' and Other.

TABLE A.10 - LOADED WAGONS RECEIVED IN BRISBANE FROM INTERSTATE BY COMMODITY CARRIED AND YARD OF DESTINATION, WEEK 19-25 AUGUST 1973

Brisbane yard	Commodity						Total
	'Forwarders' (a)	'Containers'	Cars	Steel	Explosives	Other	
NUMBER OF WAGONS							
Acacia Ridge	-	-	5	50	-	87	142
Clapham	57	2	37	26	10	115	247
Park Road	-	2	-	24	-	53	79
Salisbury	-	-	-	-	-	37	37
South Brisbane	-	25	-	26	-	194	245
Brisbane stations on 3'6" gauge system (b)	-	33	-	-	-	12	45
Stations north of Brisbane (b)	-	4	-	44	1	8	57
TOTAL	57	66	42	170	11	506	852
FREIGHT TONNES							
Acacia Ridge	-	-	32	2397	-	1766	4195
Clapham	2201	64	412	1165	79	2901	6822
Park Road	-	78	-	1000	-	1376	2454
Salisbury	-	-	-	-	-	1071	1071
South Brisbane	-	394	-	1161	-	4391	5946
Brisbane stations on 3'6" gauge system (b)	-	421	-	-	-	187	608
Stations north of Brisbane (b)	-	9	-	1566	7	103	1685
TOTAL	2201	966	444	7289	86	11795	22781

(a) Incomplete; also included in 'Containers' and Other.
(b) Presumably unloaded or transhipped at Clapham.

TABLE A.11 - LOADED WAGONS DESPATCHED INTERSTATE FROM BRISBANE BY YARD OF ORIGIN, WEEK 19-25 AUGUST 1973

Brisbane yard	Bogie wagons					4-wheel wagons	Total wagons
	Flat	Open	Closed	Tank	Car carriers		
NUMBER OF WAGONS							
Acacia Ridge	13	24	17	-	42	-	96
Clapham	69	27	105	1	11	48	261
Park Road	-	-	2	-	-	-	2
Salisbury	-	-	1	-	-	-	1
South Brisbane	12	34	84	-	-	-	130
	94	85	209	1	53	48	490
FREIGHT TONNES							
Acacia Ridge	115	241	562	-	391	-	1309
Clapham	2417	200	1742	30	111	677	5177
Park Road	-	-	5	-	-	-	5
Salisbury	-	-	42	-	-	-	42
South Brisbane	305	360	1616	-	-	-	2281
	2837	801	3967	30	502	677	8814

TABLE A.12 - LOADED WAGONS DESPATCHED INTERSTATE FROM BRISBANE BY COMMODITY CARRIED, WEEK 19-25 AUGUST 1973

Commodity carried	Bogie wagons					4-wheel wagons	Total wagons
	Flat	Open	Closed	Tank	Car carriers		
	NUMBER OF WAGONS						
'Forwarders' (a)	62	24	5	-	-	-	91
'Containers'	15	-	-	-	-	46	61
Cars	11	2	-	-	53	-	66
Fruit	-	-	108	-	-	-	108
Other	6	59	96	1	-	2	164
	94	85	209	1	53	48	490
	FREIGHT TONNES						
'Forwarders' (a)	2135	271	181	-	-	-	2587
'Containers'	576	-	-	-	-	666	1242
Cars	44	22	-	-	502	-	568
Fruit	-	-	1823	-	-	-	1823
Other	82	508	1963	30	-	11	2594
	2837	801	3967	30	502	677	8814

(a) Incomplete; also included in 'Containers' and Other.

TABLE A.13 - LOADED WAGONS DESPATCHED INTERSTATE FROM BRISBANE BY COMMODITY CARRIED AND YARD OF ORIGIN, WEEK 19-25 AUGUST 1973

Brisbane yard	Commodity					Total
	'Forwarders (a)	'Containers'	Cars	Fruit	Other	
			NUMBER OF WAGONS			
Acacia Ridge	1	-	53	-	42	96
Clapham	67	56	13	91	34	261
Park Road	-	-	-	-	2	2
Salisbury	-	-	-	-	1	1
South Brisbane	23	5	-	17	85	130
	91	61	66	108	164	490
			FREIGHT TONNES			
Acacia Ridge	33	-	435	-	841	1309
Clapham	2117	1041	133	1641	245	5177
Park Road	-	-	-	-	5	5
Salisbury	-	-	-	-	42	42
South Brisbane	437	201	-	182	1461	2281
	2587	1242	568	1823	2594	8814

(a) Incomplete; also included in 'Containers' and Other.

TABLE A.14 - QUEENSLAND RAILWAYS FREIGHT MOVEMENTS TO AND FROM CLAPHAM AND SIDINGS OVER 3'6" GAUGE LINE 1972/73

('000 tonnes)

Commodity	Consigned to Queensland stations	Received from Queensland stations
Steel	61	-
Bulk loading	17	19
Cars	6	-
Containers (a)	1	2
TOTAL	85	21

(a) Tonnages estimated on basis of average weight of all interstate containers to and from Brisbane.

Note: Interstate tonnages transhipped are excluded.

TABLE A.15 - TRAFFIC ASSIGNMENT TO BRISBANE STANDARD GAUGE TERMINALS 1972-73

('000 tonnes)

Commodity	South Brisbane yard	Clapham and other Brisbane yards		Total
		Sidings	Transhipments	
NORTHBOUND				
Steel	91	205	123	419
Bulk loading	83	128	-	211
Flexivans	-	58	-	58
Containers, overseas	19	-	35	54
Containers, other	31	27	-	58
General goods	39	-	38	77
Cars	-	25	-	25
Motor vehicle parts	-	31	-	31
Fertilizer	11	-	-	11
Class rate goods	10	-	19	29
Fruit and vegetables	6	17	-	23
Grains	1	10	-	11
Other	16	9	-	25
TOTAL	307	510	215	1,032
SOUTHBOUND				
Steel	3	-	-	3
Bulk loading	13	41	-	54
Flexivans	-	64	-	64
Containers, overseas	15	-	101	116
Containers, other	18	20	-	38
General goods	6	2	8	16
Cars	-	17	-	17
Motor vehicle parts	-	2	-	2
Class rate goods	6	-	-	6
Fruit and vegetables	13	-	52	65
Grains	29	-	4	33
Other	1	-	-	1
TOTAL	104	146	165	415

NOTE: Dissections of the total tonnage figure for each commodity are BTE estimates based on data supplied by Queensland Railways and PTCNSW.

TABLE A.16 - RAIL TRAFFIC ASSIGNED TO ACACIA RIDGE (NORTHBOUND)

(tonnes)

	Goods Shed									
	Rail to road	Break-bulk(a) rail to rail	Yard	Crane rail-road FCL	Fruit & vege-tables	Grain	Steel	Bulk fertilizer	Tranship crane & general	Cars
				1972-73 TRAFFIC						
Steel							91,000		123,000	
Bulk loading			83,000							
Container - overseas				19,000					35,000	
Container - other				31,000						
General goods	21,750	7,500	1,950	7,800					38,000	
Cars										25,000
Fertilizer			9,900					1,100		
Class rate goods	7,500		50	200					19,000	
Fruit & vegs					6,000					
Grains						1,000				
Traffic NOS	12,000		800	3,200						
TOTAL	41,250	7,500	95,700	61,200	6,000	1,000	91,000	1,100	215,000	25,000

(a) Includes goods moved by road from S. Brisbane to Roma Street.

TABLE A.16 (Cont.) - RAIL TRAFFIC ASSIGNED TO ACACIA RIDGE (NORTHBOUND)

(tonnes)

	Goods Shed									
	Rail to road	Break-bulk(a) rail to rail	Yard	Crane rail-road FCL	Fruit & vege-tables	Grain	Steel	Bulk fertilizer	Tranship crane & general	Cars
5 YEAR PROJECTION										
Annual	53,625	9,750	124,410	79,560	7,800	1,300	118,300	1,430	279,500	32,500
Daily	279	51	648	414	41	7	616	7	1,456	169
Containers(b)	7	1	16	10	1	-	15	-	36	-
10 YEAR PROJECTION										
Annual	66,000	12,000	153,120	97,920	9,600	1,600	145,600	1,760	344,000	40,000
Daily	343	63	798	510	50	8	758	9	1,792	208
Containers(c)	17	3	40	26	3	-	38	-	89	-

(a) Includes goods moved by road from S. Brisbane to Roma Street. (b) Estimated number of 20 ft containers (12 tonne pay load) required per day - assume 30% of tonnage is containerisable. (c) Estimated number of 20 ft containers (12 tonne pay load) required per day - assume 60% of tonnage is containerisable.

NOTE : Daily maximum tonnages provide for 25% increase on average daily throughput.

TABLE A. 16 (Cont.) - RAIL TRAFFIC ASSIGNED TO ACACIA RIDGE (SOUTHBOUND)
(tonnes)

	Goods Shed		Yard	Crane rail-road FCL	Fruit & vegetables	Grain	Steel	Bulk ferti-lizer	Tranship crane & general	Cars
	Rail to road	Break-bulk(a) rail to rail								
1972-73 TRAFFIC										
Steel							3,000			
Bulk loading			13,000							
Containers - overseas				15,000					101,000	
Containers - others				18,000						
General goods	4,050	450	300	1,200					8,000	
Cars										17,000
Class rate goods	4,050	450	300	1,200						
Fruit & vegetables					13,000				52,000	
Grains						33,000				
Traffic NOS	675	75	50	200						
TOTAL	8,775	975	13,600	35,600	13,000	33,000	3,000		161,000	17,000

(a) Includes goods moved by road from S. Brisbane to Roma Street.

TABLE A.16 (Cont.) - RAIL TRAFFIC ASSIGNED TO ACACIA RIDGE (SOUTHBOUND)

	Goods shed		Yard	Crane rail-road FCL	Fruit & vegetables	Grain	Steel	Bulk fertilizer	Tranship crane & general	Cars
	Rail to road	Break-bulk(a) rail to rail								
5 YEAR PROJECTION										
Annual	9,872	1,097	15,356	40,050	14,625	37,125	3,375		181,125	19,125
Daily	49	5	77	200	73	186	17		906	96
Containers(b)	1	-	2	5	2	5	-		23	-
10 YEAR PROJECTION										
Annual	10,969	1,219	17,062	44,500	16,250	41,250	3,750		201,250	21,250
Daily	55	6	85	223	81	206	19		1,006	106
Containers(c)	3	-	4	11	4	10	1		50	-

(a) Includes goods moved by road from S. Brisbane to Roma Street. (b) Estimated number of 20 ft containers (12 tonne pay load) required per day - assume 30% of tonnage is containerisable. (c) Estimated number of 20 ft containers (12 tonne pay load) required per day - assume 60% of tonnage is containerisable.

NOTE: Daily maximum tonnages provide for 25% increase on average daily throughput (see text).

ANNEX B

MATERIALS HANDLING CONSIDERATIONS

TRENDS IN FREIGHT HANDLING

Functions of a Freight Terminal

In recent years the high cost of handling single items of freight, together with the accompanying experience of damage and delays, has led to a re-evaluation of load forms and of what the functions of a freight terminal should be. Terminals are now widely coming tc be regarded as transfer zones in a movement of goods from source to user. Only where special circumstances apply should the break-bulk function and final distribution of goods take place inside this transfer zone. The emphasis in modern freight handling is on a fast flow of goods from origin to destination in the original load form.

Freight Movement by Sea

Recent changes in freight movement by sea have been a response to the high labor costs of stowing goods in ships' holds, congestion at the waterfront and the associated high costs of delays, damage, deterioration and theft of cargo. As well, there are substantial problems associated with the historical procedure of sorting and consolidation at the wharf or in adjoining cargo sheds. Another important factor in stimulating change has been the inefficient use of capital invested in ships and wharf-related operating equipment, due to the slow turnaround of ships in port. These problems have led to the rapidly expanding use of large containers; the replacement, to a large extent, of general cargo vessels by specialised vessels which can handle unit loads and freight containers efficiently; and the use of specialised container handling equipment, both ship and shore based.

Freight Movement by Rail

While this revolution has taken place in moving freight by sea, corresponding changes have not generally occurred in rail transport. In Australia, many rail terminals have the same disadvantages as the old-style shipping terminal. These facilities were built in an era in which freight volumes were lower, fast service was less important than now, congestion was less severe, manpower was readily available and at lower cost, and the effective use of facilities and rolling stock was of less public concern than at present.

In this regard, the recent changes in shipping may be seen as a pointer to emerging changes in rail transport. At Acacia Ridge, in particular, the opportunity presents itself to update rail freight methods and equipment, and to plan for a flexible expansion of facilities which will be adaptable to future changes in commodity flows.

Freight Containers

The most important current change taking place in freight handling is the use of containers and unit loads, and the associated use of specialised handling equipment at load transfer points. In Australia, this trend is expected to continue through the rationalisation of pallet sizes so that pallet loads can be accommodated two abreast in containers, by increased care in the preparation of loads to minimise handling of individual items, and by the use of unit trains (with the one type of load or load form).

MATERIALS HANDLING AT ACACIA RIDGE

General Improvement Measures

Although limited cost data are available, the high cost areas in Brisbane freight terminals appear to be in the sorting, consolidating, and handling of mixed freight (due to poor presentation of goods at source terminals) and in the lack of suitable facilities at South Brisbane. The transhipment of commodities such as fruit and vegetables also appears to be a high cost area at Clapham. Other factors contributing to high costs and slow turnaround of wagons are congestion of road traffic in manoeuvring areas at South Brisbane and limited marshalling facilities and shunting problems at Clapham.

To reduce costs in these areas and to improve turnaround of wagons in the proposed development of Acacia Ridge, consideration should be given to adoption of the following:

- Operational measures
  - increased use of 20 ft ISO containers for the handling of mixed freight, fruit and vegetables and certain other commodities
  - increased use of palletisation for individual loads and the use, where suitable, of unit loading in containers
  - preparation of consignments at origin to simplify handling, sorting and distribution at destination terminals
- Facility installations
  - provision of a goods yard at Acacia Ridge to combine a goods shed and handling area for containers
  - provision of sorting and consolidation equipment to handle mixed freight
  - provision for stowing louvre vans and open vans in the goods yard
  - provision of semi-gantry cranes for loading of 20 ft and 40 ft containers (end and side loading) : rail to road, rail to two - high storage and rail to stock level for unstowing and stowing
  - provision of gantries in the transhipment area
  - provision of gantries in the steel siding area
  - provision of a grain transhipment facility

Handling of Individual Commodities

Steel: This is the most important item received from interstate, accounting for about 40 per cent of total northbound traffic. Most steel is transhipped at Clapham using a gantry. Although generally steel cannot be containerised, the use of container flats wherever possible should greatly increase the turnaround time of wagons and reduce handling costs.

Grain: The bulk of grain moves south from Queensland. It is transhipped at Clapham by lifting Queensland Railway wagons over the top of standard gauge wagons and transferring the wheat by gravity flow. Some grain is also transferred by mobile augers from wagon to wagon but, owing to slow rates of handling, this is confined to use as a supplementary loading measure during peak conditions. The use of 20 ft containers was considered as a possible alternative means of handling grain. However, this was found to be impractical in view of the light axle load limits on rail lines serving grain sources in some areas of Queensland, which would result in low payloads in containers. The method could have application in some cases such as for short hauls from the Darling Downs. The cost of upgrading the rail system to allow for higher axle loads was beyond the scope of the Acacia Ridge study. A more promising procedure could be the use of existing hopper wagons discharging into an elevating conveyor with temporary bin storage before discharge into NSW rail wagons. Further examination of this alternative appears merited.

Motor vehicles: These are essentially a northbound movement using special wagons. Motor vehicles are unloaded onto ramps under their own power and driven to their local destination. It is assumed that a similar system will be used at Acacia Ridge.

Cattle: Cattle cannot be moved south from Queensland owing to the tick problem. Most cattle trucks are unloaded at the Wallangarra terminal at the NSW border and the cattle driven over land to meat works. Provision is being made at Acacia Ridge for transhipment in times of climatic emergency. Envisaged is a simple form of fixed or mobile race for transfer from standard to narrow gauge cattle wagon.

Containers: Traffic containers are mainly 20 ft with some smaller units about 8 ft to 10 ft long. They are presently transhipped at Clapham and moved from rail to road at South Brisbane. It is intended that the 35 tonne gantry cranes in the goods yard will handle 20 ft and 40 ft FCL containers from rail to road and LCL containers to dock level for unstowing. The gantry cranes in the transhipment area will tranship all containers from rail to rail.

Mixed freight: This type of freight usually involves a high labor content for handling, as is the case in sorting and transfer from South Brisbane to Roma Street, and in deliveries to local areas. Receipt and handling of goods at South Brisbane for movement interstate is understood to involve high costs.

A simple sorting and consolidation system which should be suitable for use in conjunction with louvre vans and containers is proposed for the Acacia Ridge goods shed. Increased use of unit loading and greater care in the sorting and consolidation of loads should help in reducing handling costs for mixed freight.

Approximately 60% of the freight to be handled through the Acacia Ridge goods shed will consist of multiple items to the same consignee. For efficiency of operation it is necessary for this type of consignment to be kept together. This cannot be done if the freight is unloaded directly on to a sorting conveyor.

Therefore, there is a need for multiple consignments to be consolidated immediately on removal from the rail van or road truck. As time has to be spent in consolidating the consignment it is considered that consolidation with other consignments bound for the same destination should take place at the same time.

This can be done by consolidating directly into a 'container' which, on being filled, can be easily moved to the point at which the contents have to be transferred into a rail van or road truck for further movement. Particular station sorting can be carried out as the freight is being transferred.

This is only one solution, however, and the problem of sorting and consolidation of mixed freight needs further study.

Materials Handling Rates

The handling rates listed in Table B.1 have been used as a basis for determining the capacities of various facilities. No allowance has been made for time lost in shunting wagons into position at their respective sidings.

TABLE B.1 - FREIGHT HANDLING RATES

Item	Operation	Time
	GOODS SHED	
Louvred van (40 tonne)	Unload goods and reload	9 hours
Container - 20 ft (12 tonne)	Unload from rolling stock and reload another container	10 minutes
Container - 20 ft (12 tonne)	Unload goods and reload with goods	3 hours

TABLE B.1 (Cont.)

	CONTAINER AREA	
Container - 20 ft	Unload from rolling stock to road vehicle or storage; reload another container	10 minutes
	BULK HANDLING SIDING	
Louvred van (40 tonne)	Unload goods and reload with goods (not unit loads)	$8\frac{3}{4}$ hours
	TRANSHIPMENT AREA	
Steel from open wagon (40 tonne)	Tranship with gantry crane using 5 tonne sling lifts	48 minutes
Steel from open wagon (40 tonne)	Gantry crane with 10 tonne magnet	12 minutes
Mixed crane-handled goods from 40 tonne wagon	Gantry crane with 5 tonne sling lifts	48 minutes
Containers-20 ft	Gantry crane with lifting frame	$4\frac{1}{2}$ minutes
Containers-40 ft	Gantry crane with lifting frame	5 minutes
Louvred van (40 tonne) mixed goods or fruit and vegetables	Manually handled across roller conveyors	2 hrs 45 min
Open wagon (40 tonne)	Manually handled across roller conveyors	2 hrs 5 mins
Grain - 40 tonne bottom dump wagon	Tranship using bottom dump wagons, hoppers and conveyors	40 minutes
Cattle - 40 tonne wagon	Walk across mobile ramp	45 minutes
	STEEL AND CAR SIDING	
Steel from open wagon (40 tonne)	Gantry crane with 5 tonne sling lifts, rail to road vehicle or storage	48 minutes

TABLE B.1 (Cont.)

Steel from open wagon (40 tonne)	Gantry crane with 10 tonne magnet, rail to road vehicle or storage	12 minutes
Cars from MV transport wagon	Drive car from wagon to storage area	1 hr per wagon

Materials Handling Equipment Requirements

The requirements for equipment to handle the estimated 1982-83 freight tonnages have been based on the freight handling rates of Table B.1. These requirements are shown in Tables B.2 and B.3 for each of the terminal areas. Specifications for the grain facility have not yet been developed as more investigation of grain movements is needed.

Labour Requirements

Table B.4 sets out the estimates of labour costs for the goods yard and container area during one shift in 1982-83. The labour includes a shunting team for 50% of one shift. Overheads are included as 50% of direct labour cost.

TABLE B.2 - MATERIALS HANDLING FACILITIES: ACACIA RIDGE GOODS SHED AND GOODS YARD

Item	No. required	Capacity and specification	Design, procurement, installation	Purpose
Towmotors	6		9 months	
Cage and flat top trolleys	800	1 tonne	12 months	
Two-wheel hand trucks	20		Immediate	Handling and sorting of goods in goods shed
Fork lift truck	1	$1\frac{1}{2}$ tonne with sideshift and jib	12 months	
Portable gravity conveyors	6	Heavy duty	6 months	
Pallet trucks hand-operated	20	1 tonne	12 months	
Fork lift truck	5	5 tonne	12 months	
Mobile crane	7	7 tonne	12 months	Handling of goods in yard between open top wagons and road vehicles
Road trucks	2	7 tonne	12 months	
Semi-gantry crane and runway	2	35 tonne main hook 5 tonne auxiliary hook Main hook hoist speed 10 ft/min Aux. hook hoist speed 25 ft/min Travel speed 200 ft/min Traverse speed 50 ft/min	12 months	Handling of containers between rolling stock and goods shed, rolling stock and road vehicles, rolling stock or goods shed and storage area
Weighbridge	1		12 months	General use

TABLE B.3 - MATERIALS HANDLING FACILITIES: ACACIA RIDGE

TRANSHIPMENT AREA

Item	No. required	Capacity and specification	Design, procurement, installation	Purpose
Gantry crane	2	35 tonne main hook 5 tonne auxiliary hook Main hook hoist speed 10 ft/min Aux. hook hoist speed 25 ft/min Travel speed 200 ft/min Traverse speed 50 ft/min	12 months	Transhipment of containers, heavy items and crane-handled goods
Gantry crane	2	10 tonne Hoist speed 25 ft/min Travel speed 200 ft/min Traverse speed 75 ft/min	12 months	Transhipment of crane-handled goods
Grain transhipment plant	1		24 months	Transhipment of grain in wagon loads
Gravity roller conveyors	20	Mobile heavy duty	6 months	Transhipment of man-handled goods across dock
Mobile race for cattle transhipment	3		9 months	Transhipment of cattle between wagons
Steel and Car Area				
Gantry crane	1	Two 20 tonne hoists (specification by Queensland Railways)	9 months	Handling of steel between rolling stock and road vehicles or to storage area - procurement currently being arranged by Queensland Railways
Gantry crane	1	10 tonne Hoist speed 25 ft/min Travel speed 200 ft/min Traverse speed 75 ft/min	12 months	Handling of steel between rolling stock and road vehicles or to storage area
Car loading ramp	1		6 months	Cars between rail wagons and road

TABLE B.4 - LABOUR REQUIREMENTS, ACACIA RIDGE GOODS YARD AND CONTAINER AREA: 1982-83

	Number required	Wages ($)
Gantry and crane operators	2	
Mobile crane operators	7	
Fork lift drivers	5	
Road truck drivers	2	
Weighbridge operator	1	
	17 @ $4,420	75,140
Shunting team (50% of time)	3 @ $4,420 ÷ 2	6,630
Labourers	95 @ $4,160	395,200
Foremen	5 @ $5,200	26,000
Total		502,970
Plus 50% overhead		251,485
TOTAL		754,455

BENEFIT-COST ANALYSIS

CAPITAL COSTS

The initial capital costs are defined as those costs which must be undertaken to make the new Acacia Ridge facilities fully operational. These are detailed in Table C.1 , and include earthworks, bridges, buildings, roads and paving, trackwork, signalling, power and communications. A full set of materials handling equipment is also included as essential to the efficient operation of the facilities. The cost schedule, based on Queensland Railways and National Materials Handling Bureau (NMHB) estimates, is of a tentative nature. The total initial capital cost is $9,134,000. For the discounting procedure it is assumed that the capital expenditure schedule is linear over the construction period, i.e. approximately $1,827,000 per annum for five years and $608,900 per annum for fifteen years for the project and base cases respectively.

After discounting, the net present value of the initial capital costs attributable to the accelerated development of Acacia Ridge are $1,944,000 and $2,302,000 at 7 per cent and 10 per cent respectively.

A schedule of the materials handling equipment is shown in Table C.2. This table shows the recurrent capital cost requirements; it is based on projected annual traffic flow requirements for 1983-84. Recurrent capital costs have been defined as the capital costs of the equipment that must be replaced within the fifteen year base case construction period. The depreciation period is equated to economic life in this analysis. Salvage values have been subtracted from replacement costs to give total recurrent capital costs. As shown in Table C.2, any equipment which has a life expectancy greater than fifteen years does not require replacement but does have a salvage value.

TABLE C.1 - INITIAL CAPITAL COSTS OF THE ACACIA RIDGE TERMINAL[a]

Item	Item total ($'000)	Stage total ($'000)
STAGE I - EARTHWORKS AND MAIN DRAINAGE		
Creek diversion pitching	50.0	
Earthworks cut to bank and creek diversion and regrading	525.0	
Boundary Road Bridge	420.0	
Beaudesert Road Bridge	160.0	
Regrading and recessing lines	110.0	
		1,265.0
STAGE II - GOODS YARDS AND PART OF MARSHALLING YARDS		
Civil works		
. access roads	84.1	
. drainage and culverts	250.0	
. sewage and water supply	150.0	
. yards paving	425.2	
Buildings		
. goods shed	51.0	
. goods office	43.0	
. fruit and vegetable platform	20.0	
. bulk loading covered area	96.0	
. administration	165.6	
Materials handling equipment[b]	1226.5	
Trackwork		
. Sidings-dual gauge	219.6	
-standard gauge	82.4	
-narrow gauge	121.8	
. buffer stops	6.0	
. diamonds	25.0	
. turnouts-dual gauge	190.0	
-standard gauge	56.0	
-narrow gauge	27.0	
Signalling and interlocking	480.0	
Lighting and power	118.0	
Communications	52.0	
		4,348.2

TABLE C.1 - (Contd)

Item	Item total ($'000)	Stage total ($'000)
STAGE III - ADDITIONAL TRACK, MARSHALLING YARD		
Trackwork		
. Sidings-standard gauge	140.0	
-narrow gauge	150.5	
. turnouts-standard gauge	100.0	
-narrow gauge	36.0	
Signalling and interlocking	30.0	
Lighting and power	65.0	
Communications	25.0	
		546.5
STAGE IV - TRANSHIPMENT YARDS AND LOCO DEPOT		
Civil Works		
. drainage	100.0	
. yards paving	53.6	
Buildings		
. grain shed	170.0	
. shades	344.0	
. loco servicing	350.0	
. amenties	59.0	
Materials handling equipment (b)	740.0	
Trackwork		
. sidings-dual gauge	117.0	
-standard gauge	276.0	
-narrow gauge	136.5	
. buffer stops	1.2	
. turnouts-dual gauge	250.0	
-standard gauge	84.0	
-narrow gauge	30.0	
. diamonds	10.0	
Signals and interlocking	90.0	
Lighting and power	140.0	
Communications	23.0	
		2,974.3
TOTAL		9,134.0

(a) Capital costs are based on tentative Queensland Railway scheduling (1973-74 prices). (b) A break-down of the materials handling equipment appears in Table C.2.

TABLE C.2 - MATERIALS HANDLING COSTS

Stage	Area	Capital cost ($'000)	Salvage value ($'000)	Economic life (yrs)	Replacement schedule: Total cost (a) ($'000)		Replacement schedule: Time (b) (years)		Maintenance & running costs: (% of capital cost)	Maintenance & running costs: ($'000 p.a.)
					Project	Base	Project	Base		
II	Goods Yard & Container Area									
	5 5-tonne fork trucks	60.0	5.0	5	110.0	55.0	7,12	11	20	12.0
	1 1.5-tonne fork truck	10.0	0.8	5	18.4	9.2	7,12	11	20	2.0
	7 7-tonne mobile cranes	135.0	40.0	5	190.0	95.0	7,12	11	20	27.0
	2 7-tonne road trucks	20.0	6.0	5	28.0	14.0	7,12	11	20	4.0
	800 wheeled wire containers	120.0	16.0	7	104.0	104.0	9	13	10	12.0
	6 towing tractors	30.0	1.8	5	56.4	28.2	7,12	11	20	6.0
	20 pallet trucks	8.5	1.4	7	7.1	7.1	9	13	5	1.7
	20 2-wheel hand trucks	1.7	0.5	7	1.2	1.2	9	13	5	0.1
	2 35-tonne gantry and runway	350.0	17.5	20	-	-	-	-	15	52.5
	1 weighbridge	56.3	2.0	20	-	-	-	-	5	2.8
	SUB-TOTAL	791.5								

(a) Cost is calculated as (unit cost of equipment) x (number of replacements within 15 years from year zero).
(b) Time at which the replacement occurs, measured in years from year zero.

NOTE: Recurrent costs do not include the initial purchase of materials handling equipment.

Stage	Capital cost ($'000)	Salvage value ($'000)	Economic life (yrs)	Replacement schedule: Total cost (a) ($'000)		Replacement schedule: Time (b) (years)		Maintenance & running costs	
				Project	Base	Project	Base	(% of capital cost)	($'000 p.a.)
III <u>Steel & Car Area</u>									
2 20-tonne hook gantry and runway	225.0	12.0	20	-	-	-	-	15	33.8
1 10-tonne gantry and runway	200.0	10.0	20	-	-	-	-	15	30.0
1 car unloading ramp	10.0	0.8	20	-	-	-	-	5	0.5
SUB-TOTAL	1226.5								
IV <u>Transhipment Area</u>									
2 35-tonne gantry cranes and runway	300.0	15.0	20	-	-	-	-	15	45.0
2 10-tonne gantry cranes and runways	250.0	12.5	20	-	-	-	-	15	37.5
3 mobile races	15.0	1.2	10	13.8	13.8	14	-	5	0.8
20 gravity roller conveyor section	5.0	1.6	5	8.8	4.4	9,14	-	5	0.2
1 grain transhipment plant	170.0	7.0	20	-	-	-	-	10	17.0
TOTAL	1966.5								

(a) Cost is calculated as (unit cost of equipment) x (number of replacements within 15 years from year zero).
(b) Time at which the replacement occurs, measured in years from year zero.

<u>NOTE</u>: Recurrent costs do not include the initial purchase of materials handling equipment.

Recurrent costs are discounted from the year in which they are incurred while salvage values are calculated at year fifteen using a linear depreciation schedule in all cases and are then discounted to the present. Subtraction of salvage value from replacement cost (in present values) gives the present value for the total recurrent cost for each case i.e., costs of $30,000 and minus $5,000 for 10 per cent and 7 per cent in the project case and costs of minus $278,000 and minus $175,000 for 7 per cent and 10 per cent in the base case. The net present values then become net costs of $273,000 and $205,000 at 7 per cent and 10 per cent respectively. Some net costs are negative due to large salvage value bias, compared to the replacement cost, in these cases.

Some estimates of future running and maintenance costs have been included in Table C.2. They were not included in the study because comparable present operating cost data was not available.

SAVINGS IN SHUNTING COSTS

Shunting savings can be divided into two groups: direct shunting cost savings and locomotive saving.

The rate at which these benefits can be obtained will depend on the bottlenecks that remain during the construction period. It is estimated that the benefit streams will commence on completion of the project and base cases, after five and fifteen years respectively.

Queensland Railways data on shunting times at the various terminals now being used are shown in Table C.3. An average unit shunting time cost, which applies to the southern Brisbane goods line, is $6.96 per hour. Queensland Railways consider that a 50 per cent reduction in shunting costs will occur; consequently, the total direct shunting cost savings have been estimated as $101,000 in year zero. This must be increased by an annual growth factor of 6 per cent per annum. The net benefit will be the sum of each annual saving, between year five and year fifteen, discounted to the present. This results in a net cost saving of $756,000 at 7 per cent and $590,000 at 10 per cent. In addition,it is expected that one locomotive valued at $150,000 will be saved in year five and year fifteen for the project and base cases respectively. Therefore, the net present value of the locomotive saving is $53,000 at 7 per cent or $57,000 at 10 per cent. The total shunting savings attributable to the project case over and above the base case are $809,000 and 7 per cent and $647,000 at 10 per cent.

TABLE C.3 - PRESENT DIRECT SHUNTING COSTS AT VARIOUS TERMINALS

Terminal	Shunting time (hrs/week)	Unit costs ($)	Total cost ($ p.a)
South Brisbane (standard gauge)	90	6.96	32,000
Clapham (standard gauge)	239	6.96	86,000
Clapham (narrow gauge)	232	6.96	84,000
TOTAL	561	-	202,000

ANNEX D

ANALYSIS OF WAGON DELAY COSTS

CALCULATION OF WAGON DELAY

The principal assumptions required to estimate the portion of en-route delays attributable to Brisbane terminal congestion have been discussed in Chapter 4. Briefly restated, the assumptions are:

- trains run according to schedule and are unaffected by Brisbane congestion;
- wagon delays occur only to northbound wagons while in the Grafton district.

Computational Algorithm for Transit Delay

On the basis of the above assumptions, the lower limit of the en-route delay has been calculated by the use of the following algorithm:

- If a wagon stayed on the same train from Taree to Brisbane, that wagon was not delayed.
- If a wagon was taken off a through train, the wagon delay was the difference between the wagon arrival time and that of the train.
- If a wagon was on a train that terminated at Grafton, the imputed train running time was the sum of:
  - running time between Taree and Grafton;
  - running time between Grafton and Brisbane of the next through train originating at or passing through Grafton;
  - interval between the arrival in Grafton of the the first train and the departure from Grafton of the next train.

The wagon delay was thus the difference between the wagon arrival time and the arrival time of the next train from Grafton.

A similar method could have been used if a train terminated at any other intermediate station, but because of data acquisition problems a simplification has been used. If a train to which a wagon was originally attached terminated prior to Grafton, the intermediate station was said to be Taree. If the train terminated between Grafton and Brisbane, the intermediate station was said to be Grafton.

This algorithm has been structured for computer programming by means of the flow chart shown in Figure D.1.

Data Sources

Data used to determine wagon departure and arrival times were extracted from the PTC NSW form X2010 (train consist) and the train diagrams for the Grafton district and for the Brisbane area. The following items were extracted from the consists:

- wagon number and type
- station originating consist
- train number
- date of train departure.

Data extracted from the train diagrams were:

- train number
- date and time at various stations
- location of stations at which train originated or terminated.

This study of wagon delay was restricted to a sample of wagons arriving in Brisbane during two periods of one week each:

- 0600, 15 July to 0600, 22 July, 1973
- 0600, 19 August to 0600, 26 August, 1973

During the July 1973 period, 971 wagons were received at Brisbane; during the August 1973 period, 918.

Operating personnel of both Queensland Railways and the PTC NSW (Grafton) agreed that the July sample period experienced 'fairly low' to 'average' delays. The August week is believed to represent 'average' to 'moderately high' delays. There are no additional data to verify or quantify these impressions of congestion and delay. It is thought that the August delays would more fairly represent the delays in the near future if no additional facilities were built in Brisbane. Furthermore, the commodity movements during the August sample period support the judgement that this week was typical. The movement of various commodities during the sample week, when multiplied by 52, closely corresponds to the NSW yearly totals (excepting the sample of fruit and vegetables which matches the peak normally experienced during this month).

Results of Wagon Delay Analysis

Data permitting, the following travel characteristics were calculated for each wagon arriving within the sample periods:

- transit time = time for wagons to travel from Taree to Acacia Ridge signal box
- terminal time = time for a wagon to pass from Acacia Ridge northbound to Acacia Ridge southbound
- total time = sum of above times
- transit delay = delay experienced by wagon during its transit time
- terminal delay = terminal time minus the projected terminal time of 48 hours
- total delay = sum of above delays

Each of these individual times (and their square) were recorded and summed for each wagon type (KLX, etc.), each wagon class (bogie flat, etc.) and for all wagons for which data were available. The means, standard deviations, standard errors and histograms for each travel characteristic, wagon type and class were then derived. The figures in the histograms are the number of wagons that fall within the designated time interval.

Recording errors in the original data (primarily incorrect wagon serial numbers) did not permit the estimation of travel characteristics for all wagons arriving during the sample periods. For some wagons no transit time could be calculated, for others no terminal time and for still others neither could be calculated. Therefore, the sample of wagons used to calculate each characteristic is somewhat different (but as large as possible) in each case.

Comparison of the characteristics reveals no bias in the samples so that each travel characteristic can be applied to the total number of wagons arriving in the sample period with little error.

SAVINGS IN WAGON FLEET

Wagon savings were calculated from the July and August sample weeks, using data on mean total delay hours and the number of wagons involved each week. The unit cost for each wagon class was derived from vehicle and accessory procurement data for 1972-73, with the addition of $4,000 per wagon to allow for the extra cost of PTC NSW 2CM high-speed bogies.

The number of wagons that can be saved consequent to a saving in total trip time has been estimated on the basis of a network flow theorem: 'the number of units of transport required to service a circuit is the product of the flow rate of units by the period of circulation'. The units of transport in this case are the number of wagons on the Brisbane-Sydney circuit. The superposition principal allows us to ignore the fact that individual wagons are not actually 'captive' to this sub-circuit of the NSW rail netowrk; it is only required that the characteristics of these wagons are constantly required to service the commodity flow.

Accordingly, the number of wagons required to service the Brisbane-Sydney circuit is:

(wagon fleet) = (flow rate)(round trip time) and consequent to a saving in wagon delay, the reduction in fleet size is:

(wagon saving) = (flow rate)(reduction in total delay).

Using as an example, the case of 4-wheel wagons arriving during the July sample week:

. mean total delay = 44 hours = .262 weeks;
. required flow rate = 126.7 wagons per week;
. wagons saved = .262 x 126.7 = 33.2;
. cost to replace one 4 wheel wagon = $4,750,
. therefore, the savings in fleet cost = 33.2 x $4750 = $157,700.

The calculations for all classes of wagons in both sample weeks are shown in Table D.20.

For some wagon classes, the saving in wagons is larger than the flow rate. This is because in these cases the delay is the major portion of the total round trip time. The number of wagons required to service the circuit is thus considerably larger than the flow rate.

Brake vans and 'others' (specials) were not included in the estimation of wagon savings as available information did not allow full understanding of the circulation and utilization of these classes of rolling stock.

It is possible that the railways would be no worse off by discarding four-wheel wagons; in this case, there would be no savings due to reduced delays to these wagons. On the other hand it can be argued that the four wheel wagons are presently needed to service the current traffic, and therefore would need to be replaced by modern rolling stock. The most probable result is that half of these wagons will be replaced. This is reflected in the calculation of wagon delay savings (Table D.20).

For the remaining classes, the total value of the 565 wagons saved by reductions in delay is $10,236,411; a unit cost of $18,118.

This is the saving that would occur if Acacia Ridge opened now; it represents the saving, 'once-and-for-all', in the size of the fleet required to service the present flow of north-bound wagons. There will be growth, however, and the terminal development will generate savings in steps rather than at the end of construction.

Considering the construction schedule (Figure 5.4), it appears probable that the total savings in wagon delay would appear in three stages at years 2.5, 3.5 and 5 (7.5, 10.5 and 15 for the base case). It is assumed that the total delay saving of .6548 weeks appears in equal steps of .2183 weeks at those years.

The growth of the probable wagon fleet is shown in Figure D.2. The initial fleet size required to maintain the flow rate at year zero (863 wagons/week) is 1279 wagons(1).

The fleet will grow (6 percent yearly); at year 2.5 it will be 1470 wagons. The installation of marshalling facilities will then generate a step saving of .2183 weeks in the round trip time. The flow rate will be 992 wagons per week at this time. The time saving reduces the wagon fleet by 216 to 1254.

This process continues in steps until, at the completion of construction, the fleet is reduced to 928 wagons. It then grows until, at year 15, it comprises 1357 wagons.

The same growth process occurs in the 15 year base case but the savings are taken in years 7.5, 10.5 and 15 years. The final wagon fleet, based on a flow rate of 1640 wagons per week, is 1357 wagons.

There is also a growth associated wagon saving

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(1) The mean round trip time for the wagon classes considered has been estimated by summing the Sydney-Taree trip time of 9 hours, the Brisbane to Taree trip time of 14 hours, the mean Sydney terminal time of 48 hours and the known Taree-Brisbane total time from the August sample week. The total round trip time is 1.4821 weeks.

attributable to the project case. After the first step improvement, the wagon fleet required to service the project case grows at a smaller absolute rate than the fleet required for the base case. This difference, represented, represented by the hatched triangles (Figure D.2) is about 11.4 wagons per year. This growth induced fleet is not required by the project case.

The total savings are listed in Table D.21. The discounted net present number of wagons is a benefit to the project case. The value is $4,274,000 at 7 percent and $4,886,400 for 10 percent discount rate.

FIGURE D.1

COMPUTATIONAL ALGORITHM FOR WAGON TRANSIT DELAY

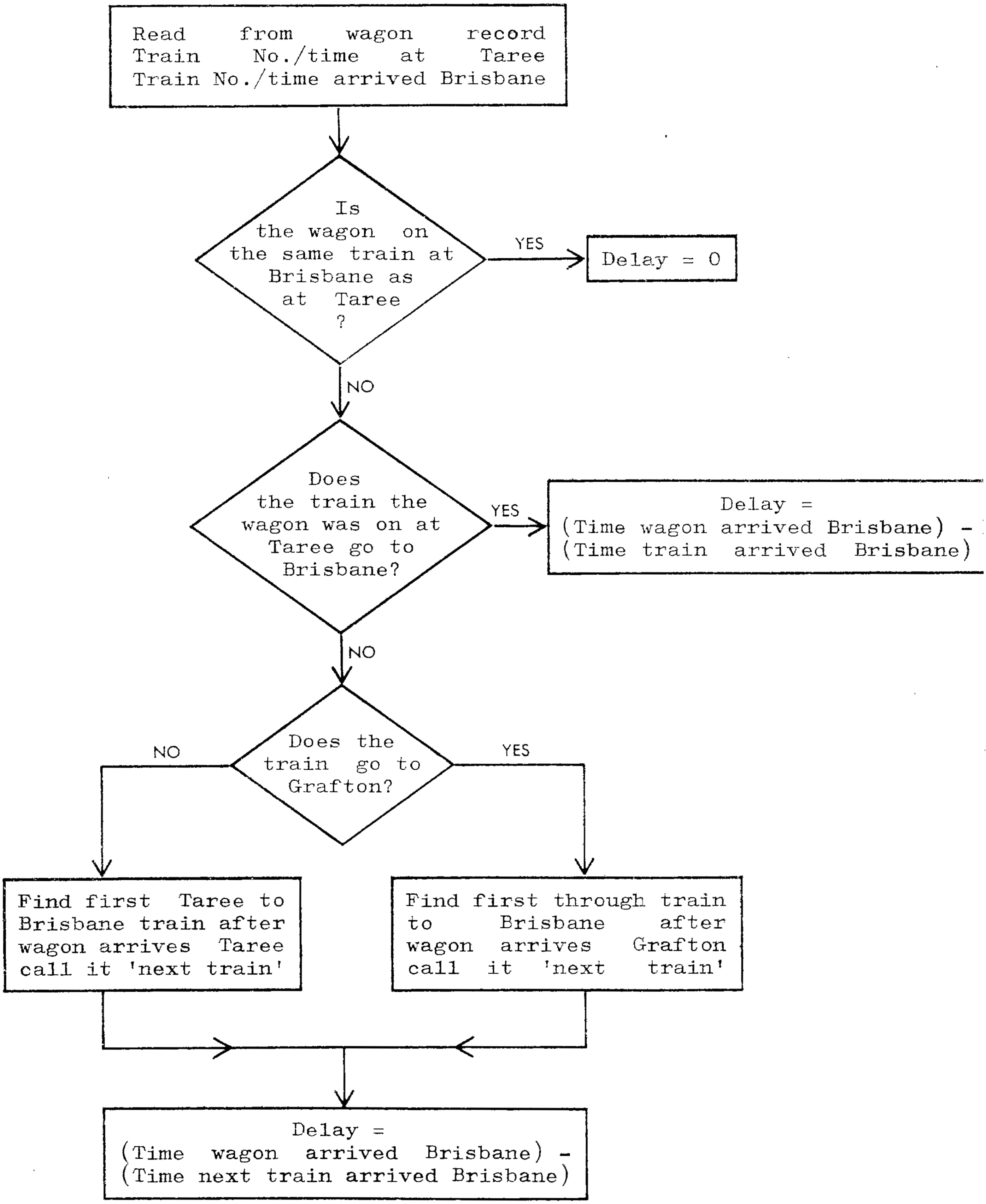
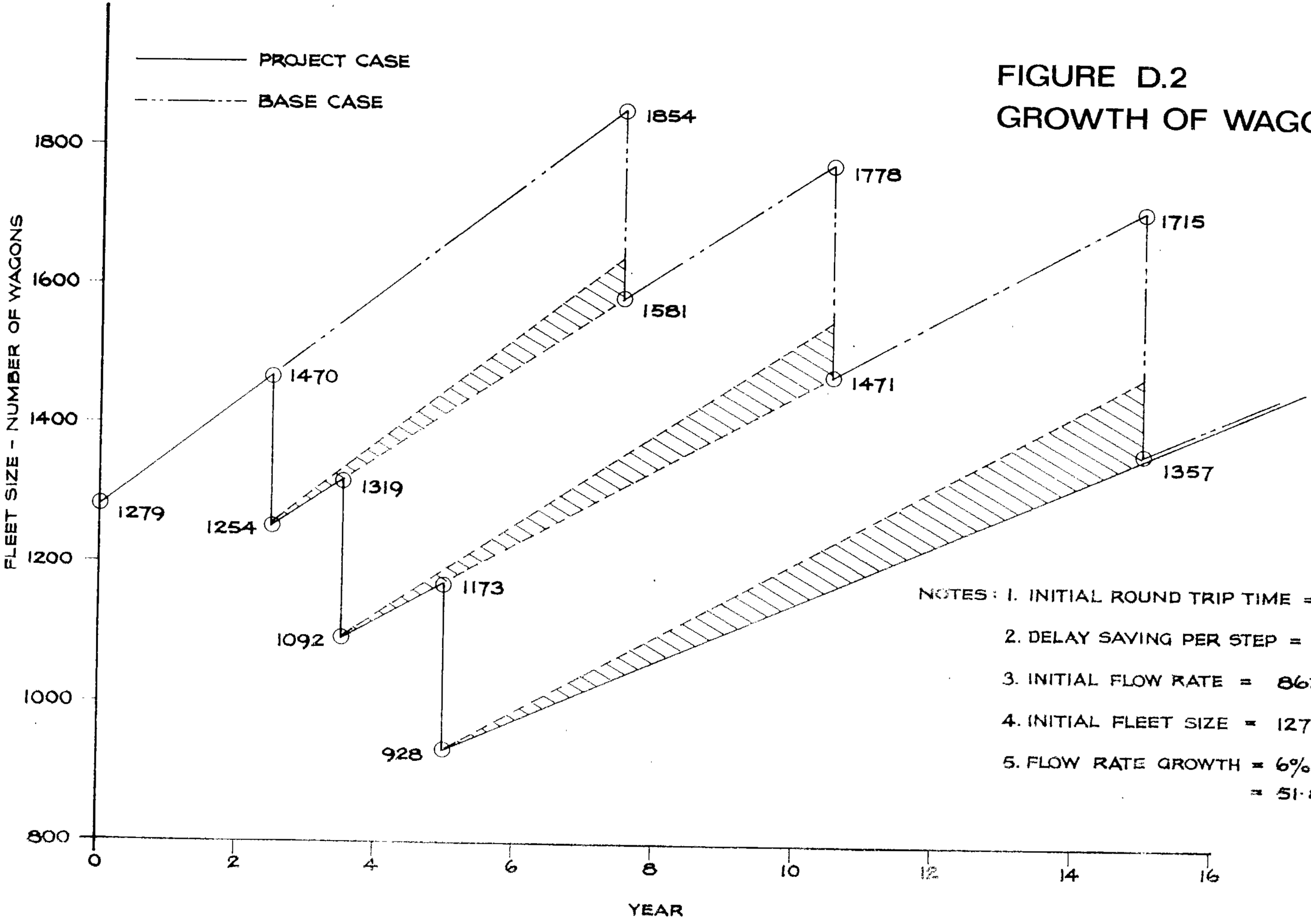


FIGURE D.2
GROWTH OF WAGON FLEET



NOTES: 1. INITIAL ROUND TRIP TIME = 1·4821 WKS.

2. DELAY SAVING PER STEP = ·2183 WKS.

3. INITIAL FLOW RATE = 863 WAGONS/WK.

4. INITIAL FLEET SIZE = 1279 WAGONS

5. FLOW RATE GROWTH = 6% P.A. OF 863
= 51·8 P.A.

TABLE D.2 - WAGON CLASS IDENTIFICATION

Class	Type of Wagon
1	4 Wheel Open
2	Bogie Open
3	Bogie Vans
4	Bogie Flat
6	Bogie Car Carriers
7	Bogie Guards Van
8	Specials
9	Bogie Tank Wagon

TABLE D.3 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE, SAMPLE WEEK IN JULY 1973 (ALL CLASSES OF WAGON)

SAMPLE CHARACTERISTICS

Statistic	Travel time category			Delay time category		
	Transit	Terminal	Total	Transit	Terminal	Total
Number of wagons	679	704	596	679	704	596
Mean time (hrs)	52	82	130	34	41	76
Std. deviation (hrs)	81	79	104	82	71	106
Std. error of mean	3.11	2.98	4.26	3.15	2.68	4.34

WAGON TIME HISTOGRAMS

Time interval (hrs)	Number of wagons in each time interval					
	Travel time category			Delay time category		
	Transit	Terminal	Total	Transit	Terminal	Total
Undelayed	n.a.	n.a.	n.a.	478	290	142
0-12	13	72		32	70	62
12-24	445	50	19	17	49	36
24-36	51	74	22	9	67	57
36-48	23	83	27	41	46	77
48-60	5	73	53	8	23	17
60-72	47	49	47	4	35	34
72-84	3	67	93	4	14	12
84-96	6	46	63	3	23	16
96-108	3	23	41	6	8	4
108-120	7	35	15	2	11	8
120-132	2	14	40	3	6	3
132-144	2	33	9	1	6	10
144-156	1	8	18	10	3	17
156-168	10	11	8	4	10	7
168-180	1	6	5	10	1	11
180-192	12	6	15	2	5	7
192-204	2	3	9	6	5	8
204-216	7	10	11	2	5	2
216-228	2	1	10		2	4
228-240		5	7	1	3	4
240-252		5	3	3	2	2
252-264	3	5	7	4	1	2
264-276	3	2	3	2	2	5
276-288	4	3	6	3	4	8
288-300	2	2	2	2	2	4
300-312	2	1	5	3		2
312-324	3	2	1	2		1
324-336	3	4	4	4		2
336-348	3	2	7	1	2	7
348-360	2		3	2	3	4
360-372	1		5	1		2
372-384	1		1	3	1	4
384-396	2	2		2	1	3
396-408	4	3	7		2	2
408-420			4	2		3
420-432	1	1	4		1	
432-444	1	1	4		1	
444-456		2	2	1		2
456-468	1		2	1		2
468-480		1	4			
Greater than 480	1	2	3			2

TABLE D.4 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE, SAMPLE WEEK IN AUGUST 1973 (ALL CLASSES OF WAGON)

SAMPLE CHARACTERISTICS

Statistic	Travel time category			Delay time category		
	Transit	Terminal	Total	Transit	Terminal	Total
Number of wagons	708	714	637	708	714	637
Mean time (hrs)	72	100	168	53	59	109
Std. deviation (hrs)	103	86	136	101	80	129
Std. error of mean	3.87	3.22	5.39	3.80	2.99	5.11

WAGON TIME HISTOGRAMS

Time interval (hrs)	Number of wagons in each time interval					
	Travel time category			Delay time category		
	Transit	Terminal	Total	Transit	Terminal	Total
Undelayed	0	0	0	414	243	135
0-12	53	24	0	25	40	29
12-24	348	81	30	30	55	36
24-36	57	56	16	12	44	35
36-48	14	78	41	31	42	38
48-60	32	44	32	40	46	59
60-72	12	55	44	1	45	39
72-84	36	44	32	10	28	16
84-96	4	43	47	18	27	21
96-108	12	46	42	11	19	15
108-120	22	45	27	7	14	14
120-132	6	28	48	4	6	11
132-144	6	27	25	7	6	7
144-156	9	19	19	6	10	7
156-168	2	14	15	4	11	8
168-180	5	6	19	3	5	5
180-192	3	6	7	3	11	16
192-204	4	10	7	10	8	15
204-216	3	11	10	6	6	13
216-228	10	5	6	4	5	9
228-240	6	11	8	2	2	11
240-252	4	8	11	1	7	8
252-264	2	6	10	8	2	10
264-276	1	5	20	1	3	1
276-288	7	2	9	2	3	3
288-300		7	12	2	8	8
300-312	4	2	6	6	6	3
312-324	3	3	7	1	3	7
324-336	5	3	9	2	5	6
336-348	1	8	2	5		2
348-360	4	6	2	13	2	7
360-372	10	3	8	3		2
372-384	5	5	2		1	6
384-396	2		7	6		2
396-408	2	2	10	1	1	4
408-420				5		5
420-432	7	1	5	3		6
432-444	1		5			1
444-456	1	1	4			1
456-468	1		3			1
468-480	3		2			2
Greater than 480	1		28			13

TABLE D.5 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK IN JULY 1973

WAGON CLASS= 1

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	95	107	93	95	107	93
MEAN HRS	39	65	98	12	31	44
STD.DEV.	24	57	39	22	45	36
0- 0	0	0	0	53	40	0
0- 12	0	28	0	2	14	14
12- 24	51	0	0	0	1	1
24- 36	2	1	0	0	1	17
36- 48	2	3	0	40	[illegible]	37
48- 60	0	14	0	0	[illegible]	0
60- 72	40	1	0	[illegible]	22	19
72- 84	0	19	43	0	[illegible]	0
84- 96	0	0	18	0	0	1
96-108	0	0	3	[illegible]	5	0
108-120	0	22	0		3	1
120-132	0	0	19	0	1	0
132-144	0	0	0	0	0	1
144-156	0	5	1	0	0	1
156-168	0	3	0	0	2	0
168-180	0	1	1	0	[illegible]	0
180-192	0	0	0	0	0	0
192-204	0	0	1	0	0	0
204-216	0	2	0	0	0	0
216-228	0	0	1	0	[illegible]	0
228-240	0	0	0	0	[illegible]	0
240-252	0	0	0	0	0	0
252-264	0	0	0	0	0	0
264-276	0	0	0	0	0	0
276-288	0	0	0	0	0	0
288-300	0	0	0	0	1	1
300-312	0	0	0	0	0	0
312-324	0	0	0	0	0	0
324-336	0	0	0	0	0	0
336-348	0	1	0	0	0	0
348-360	0	0	0	0	0	0
360-372	0	0	0	0	0	0
372-384	0	0	1	0	0	0
384-396	0	0	0	0		0
396-408	0	0	0	0	0	0
408-420	0	0	0	0	0	0
420-432	0	0	0	0	0	0
432-444	0	0	0	0	0	0
444-456	0	0	0	0	0	0
456-468	0	0	0	0		0
468-480	0	0	0	0	0	0
480-492	0	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	0	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0		0

TABLE D.6 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK IN AUGUST 1973

WAGON CLASS= 1

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	49	52	44	49	52	44
MEAN HRS	157	94	227	133	59	180
STD.DEV.	144	85	183	138	78	170
0- 0	0	0	0	0	25	0
0- 12	0	0	0	0	2	0
12- 24	0	15	0	0	1	0
24- 36	0	5	0	1	0	0
36- 48	0	5	0	0	0	0
48- 60	1	2	0	28	1	21
60- 72	0	0	0	0	5	0
72- 84	28	0	0	5	3	0
84- 96	0	0	14	3	3	2
96-108	5	1	5	0	1	1
108-120	3	6	0	0	2	0
120-132	0	3	2	0	2	0
132-144	0	3	0	0	0	4
144-156	0	1	0	0	0	0
156-168	0	3	2	0	1	0
168-180	0	2	1	0	1	0
180-192	0	0	0	1	0	2
192-204	0	0	0	0	1	0
204-216	1	1	4	0	1	1
216-228	0	1	0	0	0	0
228-240	0	0	0	0	0	0
240-252	0	2	2	0	0	1
252-264	0	1	0	0	0	1
264-276	0	0	0	0	0	0
276-288	0	0	1	0	0	0
288-300	0	0	0	0	0	1
300-312	0	0	0	1	2	0
312-324	0	0	1	0	0	0
324-336	1	0	1	0	0	1
336-348	0	0	0	0	0	0
348-360	0	2	0	4	0	0
360-372	4	0	1	0	0	0
372-384	0	0	0	0	0	0
384-396	0	0	0	0	0	0
396-408	0	0	0	0	0	1
408-420	0	0	0	2	0	1
420-432	1	0	0	2	0	1
432-444	0	0	1	0	0	0
444-456	0	0	0	0	0	0
456-468	1	0	0	0	0	1
468-480	3	0	0	0	0	0
480-492	1	0	1	0	0	0
492-504	0	0	0	0	0	2
504-516	0	0	1	0	0	1
516-528	0	0	1	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	2
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	1	0	0	0
588-600	0	0	1	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.7 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK IN JULY 1973

WAGON CLASS= 2

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	133	146	117	152	141	114
MEAN HRS	44	92	134	77	47	76
STD.DEV.	81	62	124	81	76	121
0- 0	0	0	0	116	74	35
0- 12	1	1	0	3	12	12
12- 24	104	22	1	5	13	11
24- 36	15	14	11	5	9	10
36- 48	0	31	5	1	4	5
48- 60	2	15	14	7	[illegible]	3
60- 72	1	13	8	4	1	2
72- 84	5	9	14	5	2	1
84- 96	5	4	14	0	7	3
96-108	1	7	4	[illegible]	1	1
108-120	2	7	2	[illegible]	3	1
120-132	0	2	5	[illegible]	3	1
132-144	1	7	0	0	5	5
144-156	0	1	4	0	0	2
156-168	0	5	1	0	3	0
168-180	0	3	1	1	1	1
180-192	1	3	1	0	0	1
192-204	0	0	2	0	1	1
204-216	0	3	3	0	1	0
216-228	0	1	4	0	1	1
228-240	0	0	2	0	3	3
240-252	0	1	0	0	1	1
252-264	0	0	1	0	0	0
264-276	0	1	1	0	0	0
276-288	0	3	0	0	0	0
288-300	0	1	1	0	0	0
300-312	0	0	3	1	0	0
312-324	1	0	0	1	0	1
324-336	1	0	1	1	0	0
336-348	1	0	1	1	0	1
348-360	1	0	0	1	0	3
360-372	0	0	0	0	[illegible]	0
372-384	1	0	1	1	0	1
384-396	0	0	0	1	0	1
396-408	2	2	1	0	0	0
408-420	0	0	2	1	0	1
420-432	1	0	2	0	0	0
432-444	0	0	1	0	1	0
444-456	0	0	0	0	[illegible]	0
456-468	0	0	1	0	[illegible]	0
468-480	0	0	0	0	0	0
480-492	0	1	0	0	[illegible]	0
492-504	0	0	0	0	[illegible]	0
504-516	0	0	0	0	0	0
516-528	0	0	0	0	[illegible]	0
528-540	0	0	0	0	[illegible]	0
540-552	0	0	0	[illegible]	[illegible]	0
552-564	0	0	0	0	[illegible]	0
564-576	0	0	0	0	[illegible]	0
576-588	0	0	0	0	[illegible]	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.8 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK IN AUGUST 1973

WAGON CLASS= 2

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	205	227	187	205	227	187
MEAN HRS	104	95	197	84	57	137
STD.DEV.	127	86	152	124	73	145
0- 0	0	0	0	106	87	42
0- 12	0	5	0	9	15	10
12- 24	90	34	1	6	10	7
24- 36	24	22	12	4	14	9
36- 48	2	25	12	11	5	7
48- 60	9	16	13	5	12	5
60- 72	8	10	12	1	10	9
72- 84	2	14	7	1	12	4
84- 96	2	5	12	4	12	6
96-108	2	14	5	6	7	6
108-120	6	10	3	1	5	1
120-132	3	12	4	7	1	4
132-144	2	12	11	2	7	1
144-156	3	7	7	4	9	1
156-168	2	5	4	3	4	3
168-180	2	1	3	0	1	1
180-192	3	2	2	1	5	10
192-204	0	3	3	10	1	8
204-216	2	4	1	2	3	5
216-228	0	1	0	1	1	5
228-240	5	6	4	0	0	3
240-252	0	1	6	0	4	2
252-264	0	3	4	6	0	7
264-276	0	1	12	1	1	0
276-288	6	0	1	2	0	1
288-300	0	4	6	0	2	2
300-312	3	0	3	1	2	0
312-324	0	1	3	0	1	0
324-336	1	0	6	1	0	1
336-348	1	2	0	3	0	2
348-360	2	2	0	2	0	3
360-372	5	1	2	2	0	0
372-384	5	0	0	0	0	4
384-396	1	0	1	6	0	2
396-408	1	0	5	0	1	3
408-420	0	0	0	2	0	3
420-432	6	0	0	0	0	1
432-444	0	0	2	0	0	1
444-456	1	1	3	0	0	1
456-468	0	0	3	0	0	0
468-480	0	0	2	0	0	2
480-492	0	0	2	0	0	1
492-504	0	0	2	0	0	2
504-516	0	0	0	0	0	0
516-528	0	0	1	0	0	1
528-540	0	0	1	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	1	0	0	0
564-576	0	0	0	0	0	1
576-588	0	0	3	0	0	0
588-600	0	0	1	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.9 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK JULY 1973

WAGON CLASS= 3

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	216	276	196	216	276	196
MEAN HRS	55	98	140	39	43	85
STD.DEV.	96	64	115	95	62	113
0- 0	0	0	0	158	55	36
0- 12	0	0	0	22	21	24
12- 24	174	3	0	0	21	13
24- 36	6	24	0	2	35	23
36- 48	1	78	10	0	26	20
48- 60	1	71	17	0	14	6
60- 72	0	23	21	0	7	7
72- 84	0	35	31	1	11	11
84- 96	1	26	23	0	12	6
96-108	0	14	20	0	1	1
108-120	0	7	7	0	2	1
120-132	0	11	9	1	2	2
132-144	1	12	6	1	[illegible]	3
144-156	1	1	10	0	7	2
156-168	0	2	4	2	3	2
168-180	1	2	1	3	1	4
180-192	3	3	1	1	2	2
192-204	2	2	2	5	2	3
204-216	5	3	2	1	1	1
216-228	1	0	3	0	1	3
228-240	0	2	4	0	0	0
240-252	0	2	2	3	1	1
252-264	2	1	3	3	0	0
264-276	2	1	1	2	[illegible]	1
276-288	4	0	2	1	2	4
288-300	0	1	1	2	0	3
300-312	2	0	1	2	1	2
312-324	2	0	0	1	1	0
324-336	2	2	1	3	0	2
336-348	2	0	1	0	1	3
348-360	1	0	3	1	2	1
360-372	1	0	5	1	[illegible]	2
372-384	0	0	0	1	0	1
384-396	1	0	0	1	0	2
396-408	2	0	4	0	1	1
408-420	0	0	1	0	0	2
420-432	0	0	1	0	1	0
432-444	0	0	3	0	0	0
444-456	0	1	1	0	0	0
456-468	0	0	1	0	0	1
468-480	0	1	2	0	0	0
480-492	0	0	1	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	1	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.10 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK AUGUST 1973

WAGON CLASS= 3

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	291	269	256	291	269	256
MEAN HRS	42	124	170	25	79	107
STD.DEV.	64	91	114	64	88	112
0- 0	0	0	0	199	47	26
0- 12	7	0	0	15	10	10
12- 24	189	7	0	16	24	17
24- 36	26	16	0	5	22	22
36- 48	10	23	10	17	25	24
48- 60	18	11	11	5	27	25
60- 72	3	24	15	0	20	22
72- 84	4	22	15	3	12	11
84- 96	1	25	18	5	8	8
96-108	4	27	23	2	10	7
108-120	5	23	18	2	5	7
120-132	0	12	21	0	2	2
132-144	2	6	10	5	2	1
144-156	5	10	11	1	2	5
156-168	0	5	8	0	6	4
168-180	1	2	8	3	2	2
180-192	0	2	3	0	[illegible]	2
192-204	3	2	2	0	5	7
204-216	0	6	4	2	2	6
216-228	1	2	3	0	4	4
228-240	1	5	2	2	2	8
240-252	1	5	2	1	3	5
252-264	2	2	6	1	1	1
264-276	0	4	7	0	2	1
276-288	1	2	7	0	2	1
288-300	0	3	6	1	5	5
300-312	0	1	3	4	2	2
312-324	3	2	2	0	2	6
324-336	2	2	1	0	5	3
336-348	0	5	2	2	0	0
348-360	1	2	2	0	1	3
360-372	1	2	4	0	0	2
372-384	0	5	2	0	1	1
384-396	0	0	4	0	0	0
396-408	0	1	4	0	0	0
408-420	0	0	0	0	0	0
420-432	0	1	4	0	0	4
432-444	0	0	2	0	0	0
444-456	0	0	0	0	0	0
456-468	0	0	0	0	0	0
468-480	0	0	0	0	0	0
480-492	0	0	2	0	0	0
492-504	0	0	2	0	0	1
504-516	0	0	0	0	0	1
516-528	0	0	0	0	0	0
528-540	0	0	0	0	1	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	2	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.11 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK JULY 1973

WAGON CLASS= 4

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	167	164	156	167	164	156
MEAN HRS	59	67	129	41	38	80
STD.DEV.	79	61	111	80	87	108
0- 0	0	0	0	112	100	56
0- 12	12	32	0	3	12	10
12- 24	74	35	13	9	11	9
24- 36	27	24	5	1	5	7
36- 48	11	10	11	0	10	9
48- 60	1	14	14	6	2	4
60- 72	6	11	17	0	5	6
72- 84	0	5	10	0	1	0
84- 96	0	10	8	2	3	5
96-108	2	2	8	3	1	2
108-120	3	5	6	2	1	3
120-132	2	1	3	0	1	0
132-144	0	3	2	0	0	1
144-156	0	1	2	10	1	11
156-168	10	1	3	2	1	2
168-180	0	0	2	6	0	6
180-192	8	0	11	1	2	3
192-204	0	1	4	3	2	4
204-216	4	1	5	1	1	1
216-228	1	0	2	0	0	0
228-240	0	2	1	1	0	1
240-252	0	2	1	0	0	0
252-264	1	1	2	1	0	1
264-276	1	0	1	0	2	4
276-288	0	0	4	2	1	3
288-300	2	0	0	0	1	0
300-312	0	0	1	0	0	0
312-324	0	2	0	0	0	0
324-336	0	1	2	0	0	0
336-348	0	1	4	0	2	3
348-360	0	0	0	0	0	0
360-372	0	0	0	0	0	0
372-384	0	0	0	1	1	2
384-396	1	2	0	0	1	0
396-408	0	0	2	0	1	1
408-420	0	0	1	0	0	0
420-432	0	1	1	0	0	0
432-444	0	1	0	0	0	0
444-456	0	1	1	1	0	1
456-468	1	0	0	0	0	1
468-480	0	0	2	0	0	0
480-492	0	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	1	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.12 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK AUGUST 1973

WAGON CLASS= 4

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	128	122	117	122	114	117
MEAN HRS	55	59	102	43	26	55
STD.DEV.	91	64	107	89	55	97
0- 0	0	0	0	91	74	57
0- 12	46	19	0	1	5	1
12- 24	49	22	29	2	12	10
24- 36	5	12	4	2	6	4
36- 48	2	12	15	2	10	6
48- 60	3	7	4	2	3	6
60- 72	1	12	3	0	5	5
72- 84	2	6	8	1	0	1
84- 96	1	10	7	1	4	5
96-108	1	3	0	2	1	1
108-120	2	6	3	4	1	2
120-132	3	0	9	2	1	4
132-144	2	4	4	0	2	1
144-156	1	1	1	1	0	1
156-168	0	0	1	0	0	0
168-180	1	1	3	0	1	2
180-192	0	0	3	1	0	2
192-204	1	0	1	0	0	0
204-216	0	0	1	2	0	1
216-228	1	1	2	3	0	0
228-240	2	0	2	0	0	0
240-252	3	0	1	0	0	0
252-264	0	1	0	1	0	1
264-276	1	0	1	0	0	0
276-288	0	0	0	0	1	1
288-300	0	0	0	1	1	0
300-312	1	0	0	0	0	1
312-324	0	0	1	1	0	1
324-336	1	1	1	1	0	1
336-348	0	1	0	0	0	0
348-360	1	0	0	1	1	1
360-372	0	0	1	1	0	0
372-384	0	0	0	0	0	1
384-396	1	0	2	0	0	0
396-408	1	1	0	0	0	0
408-420	0	0	0	1	0	0
420-432	0	0	1	0	0	0
432-444	1	0	0	0	0	0
444-456	0	0	1	0	0	0
456-468	0	0	0	0	0	0
468-480	0	0	0	0	0	0
480-492	0	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	0	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	1
588-600	0	0	0	0	0	0
600-612	0	0		0	0	0
612-624	0	0	0	0	0	0

TABLE D.13 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK JULY 1973

WAGON CLASS= 6

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	42	43	36	42	43	36
MEAN HRS	18	81	102	2	42	47
STD.DEV.	14	77	73	14	7[illegible]	72
0- 0	0	0	0	39	21	15
0- 12	0	1	0	2	1	2
12- 24	40	8	0	0	3	2
24- 36	1	1	6	0	0	0
36- 48	0	11	1	0	3	6
48- 60	0	1	0	0	5	4
60- 72	0	3	1	0	0	0
72- 84	0	0	3	0	0	0
84- 96	0	6	0	1	1	1
96-108	0	5	6	0	0	0
108-120	1	0	0	0	2	2
120-132	0	0	4	0	0	0
132-144	0	1	0	0	0	0
144-156	0	0	1	0	0	1
156-168	0	2	0	0	0	0
168-180	0	0	0	0	0	0
180-192	0	0	2	0	1	1
192-204	0	0	0	0	0	0
204-216	0	0	1	0	1	0
216-228	0	0	0	0	0	0
228-240	0	1	0	0	0	0
240-252	0	0	0	0	0	0
252-264	0	1	1	0	1	1
264-276	0	0	0	0	0	0
276-288	0	0	0	0	1	1
288-300	0	0	0	0	0	0
300-312	0	1	0	0	0	0
312-324	0	0	1	0	0	0
324-336	0	1	0	0	0	0
336-348	0	0	1	0	0	0
348-360	0	0	0	0	0	0
360-372	0	0	0	0	0	0
372-384	0	0	0	0	0	0
384-396	0	0	0	0	0	0
396-408	0	0	0	0	0	0
408-420	0	0	0	0	0	0
420-432	0	0	0	0	0	0
432-444	0	0	0	0	0	0
444-456	0	0	0	0	0	0
456-468	0	0	0	0	0	0
468-480	0	0	0	0	0	0
480-492	0	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	0	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.14 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK AUGUST 1973

WAGON CLASS= 6

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	32	33	31	32	33	31
MEAN HRS	36	60	95	19	16	34
STD.DEV.	37	25	52	36	21	48
0- 0	0	0	0	23	13	10
0- 12	0	0	0	0	5	6
12- 24	23	3	0	2	7	2
24- 36	2	0	0	0	2	0
36- 48	0	7	7	1	1	0
48- 60	1	8	4	0	3	2
60- 72	0	7	11	0	1	3
72- 84	0	2	2	0	1	0
84- 96	0	1	0	5	0	0
96-108	0	3	0	1	0	0
108-120	6	1	2	0	0	4
120-132	0	1	5	0	0	1
132-144	0	0	0	0	0	0
144-156	0	0	0	0	0	0
156-168	0	0	0	0	0	1
168-180	0	0	4	0	0	0
180-192	0	0	0	0	0	0
192-204	0	0	1	0	0	0
204-216	0	0	0	0	0	0
216-228	0	0	1	0	0	0
228-240	0	0	0	0	0	0
240-252	0	0	0	0	0	0
252-264	0	0	0	0	0	0
264-276	0	0	0	0	0	0
276-288	0	0	0	0	0	0
288-300	0	0	0	0	0	0
300-312	0	0	0	0	0	0
312-324	0	0	0	0	0	0
324-336	0	0	0	0	0	0
336-348	0	0	0	0	0	0
348-360	0	0	0	0	0	0
360-372	0	0	0	0	0	0
372-384	0	0	0	0	0	0
384-396	0	0	0	0	0	0
396-408	0	0	0	0	0	0
408-420	0	0	0	0	0	0
420-432	0	0	0	0	0	0
432-444	0	0	0	0	0	0
444-456	0	0	0	0	0	0
456-468	0	0	0	0	0	0
468-480	0	0	0	0	0	0
480-492	0	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	0	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.15 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK JULY 1973

WAGON CLASS= 7

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	43	49	39	43	49	39
MEAN HRS	56	37	91	33	9	47
STD.DEV.	92	39	102	92	39	97
0- 0	0	0	0	34	40	27
0- 12	2	10	0	1	2	1
12- 24	30	11	4	0	0	0
24- 36	3	11	0	0	2	1
36- 48	0	9	5	0	7	2
48- 60	0	2	10	1	1	1
60- 72	0	0	0	0	0	0
72- 84	1	0	0	0	1	0
84- 96	0	2	1	0	0	0
96-108	0	1	0	0	0	0
108-120	0	0	3	0	0	0
120-132	0	1	0	0	0	0
132-144	0	0	0	0	0	0
144-156	0	0	0	0	0	0
156-168	0	0	0	1	0	1
168-180	1	0	0	0	0	0
180-192	0	0	0	2	1	2
192-204	2	0	1	0	0	0
204-216	0	0	1	0	0	0
216-228	0	0	0	0	0	0
228-240	0	1	1	1	0	1
240-252	1	0	0	1	0	1
252-264	0	0	0	1	0	0
264-276	1	0	1	0	0	0
276-288	1	0	1	0	0	1
288-300	0	0	0	0	0	0
300-312	0	0	0	0	0	0
312-324	0	0	0	0	0	0
324-336	0	0	0	0	0	0
336-348	0	0	0	0	0	0
348-360	0	0	1	0	0	0
360-372	0	0	0	0	0	0
372-384	0	0	0	0	0	0
384-396	0	0	0	1	0	1
396-408	1	0	0	0	0	0
408-420	0	0	0	0		0
420-432	0	0	0	0	0	0
432-444	0	0	0	0	0	0
444-456	0	0	0	0	0	0
456-468	0	0	0	0	0	0
468-480	0	0	0	0	0	0
480-492	0	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	0	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.16 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK AUGUST 1973

WAGON CLASS= 7

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	45	44	40	45	44	40
MEAN HRS	27	30	57	10	7	15
STD.DEV.	37	58	51	33	30	43
0- 0	0	0	0	32	38	25
0- 12	5	15	0	9	4	8
12- 24	27	9	7	1	0	2
24- 36	9	8	8	2	0	2
36- 48	1	6	7	0	0	0
48- 60	1	4	7	0	0	0
60- 72	0	0	3	0	0	0
72- 84	0	0	4	0	0	0
84- 96	0	0	1	0	0	0
96-108	0	0	0	0	0	0
108-120	0	0	0	0	0	0
120-132	0	0	0	0	1	0
132-144	0	0	0	1	0	1
144-156	0	0	0	0	0	0
156-168	1	0	0	0	1	0
168-180	0	1	0	0	0	1
180-192	0	0	1	1	0	1
192-204	0	0	0	0	0	0
204-216	0	1	0	0	0	0
216-228	1	0	0	0	0	0
228-240	0	0	1	0	0	0
240-252	0	0	1	0	0	0
252-264	0	0	0	0	0	0
264-276	0	0	0	0	0	0
276-288	0	0	0	0	0	0
288-300	0	0	0	0	0	0
300-312	0	0	0	0	0	0
312-324	0	0	0	0	0	0
324-336	0	0	0	0	0	0
336-348	0	0	0	0	0	0
348-360	0	0	0	0	0	0
360-372	0	0	0	0	0	0
372-384	0	0	0	0	0	0
384-396	0	0	0	0	0	0
396-408	0	0	0	0	0	0
408-420	0	0	0	0	0	0
420-432	0	0	0	0	0	0
432-444	0	0	0	0	0	0
444-456	0	0	0	0	0	0
456-468	0	0	0	0	0	0
468-480	0	0	0	0	0	0
480-492	0	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	0	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.17 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK JULY 1973

WAGON CLASS= 8

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	2	0	0	2	0	0
MEAN HRS	16	0	0	0	0	0
STD.DEV.	0	0	0	0	0	0
0- 0	0	0	0	2	0	0
0- 12	0	0	0	0	0	0
12- 24	2	0	2	0	0	0
24- 36	0	0	0	0	0	0
36- 48	0	0	0	0	0	0
48- 60	0	0	0	0	0	0
60- 72	0	0	0	0	[illegible]	0
72- 84	0	0	0	0	0	0
84- 96	0	0	0	0	0	0
96-108	0	0	0	0	0	0
108-120	0	0	0	0	0	0
120-132	0	0	0	0	0	0
132-144	0	0	0	0	0	0
144-156	0	0	0	0	0	0
156-168	0	0	0	0	0	0
168-180	0	0	0	0	0	0
180-192	0	0	0	0	0	0
192-204	0	0	0	0	0	0
204-216	0	0	0	0	0	0
216-228	0	0	0	0	0	0
228-240	0	0	0	0	0	0
240-252	0	0	0	0	0	0
252-264	0	0	0	0	0	0
264-276	0	0	0	0	0	0
276-288	0	0	0	0	0	0
288-300	0	0	0	0	0	0
300-312	0	0	0	0	0	0
312-324	0	0	0	0	0	0
324-336	0	0	0	0	0	0
336-348	0	0	0	0	0	0
348-360	0	0	0	0	0	0
360-372	0	0	0	0	0	0
372-384	0	0	0	0	0	0
384-396	0	0	0	0	0	0
396-408	0	0	0	0	0	0
408-420	0	0	0	0	0	0
420-432	0	0	0	0	0	0
432-444	0	0	0	0	0	0
444-456	0	0	0	0	0	0
456-468	0	0	0	0	0	0
468-480	0	0	0	0	0	0
480-492	0	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	0	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.18 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK JULY 1973

WAGON CLASS= 9

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	4	4	3	4	4	2
MEAN HRS	275	277	638	251	229	561
STD.DEV.	220	63	103	216	83	98
0- 0	0	0	0	0	0	0
0- 12	0	0	0	0	0	0
12- 24	0	0	0	0	0	0
24- 36	0	0	0	1	0	0
36- 48	0	0	0	0	0	0
48- 60	1	0	0	0	0	0
60- 72	0	0	0	0	0	0
72- 84	0	0	0	0	0	0
84- 96	0	0	0	0	0	0
96-108	0	0	0	1	0	0
108-120	1	0	0	0	0	0
120-132	0	0	0	0	0	0
132-144	0	0	0	0	0	0
144-156	0	0	0	0	0	0
156-168	0	0	0	0	1	0
168-180	0	0	0	0	0	0
180-192	0	0	0	0	0	0
192-204	0	0	0	0	0	0
204-216	0	1	0	0	2	0
216-228	0	0	0	0	0	0
228-240	0	0	0	0	0	0
240-252	0	0	0	0	0	0
252-264	0	2	0	0	0	0
264-276	0	0	0	0	0	0
276-288	0	0	0	0	0	0
288-300	0	0	0	0	0	0
300-312	0	0	0	0	0	0
312-324	0	0	0	0	0	0
324-336	0	0	0	0	0	0
336-348	0	0	0	0	0	0
348-360	0	0	0	0	1	0
360-372	0	0	0	0	0	0
372-384	0	0	0	0	0	0
384-396	0	0	0	0	0	0
396-408	0	1	0	0	0	0
408-420	0	0	0	1	0	0
420-432	0	0	0	0	0	0
432-444	1	0	0	0	0	0
444-456	0	0	0	0	0	1
456-468	0	0	0	1	0	0
468-480	0	0	0	0	0	0
480-492	1	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	1	0	0	0
516-528	0	0	0	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.19 - TRAVEL TIMES AND DELAYS FOR WAGONS MOVING BETWEEN TAREE AND BRISBANE: SAMPLE WEEK AUGUST 1973

WAGON CLASS= 9

TIME INTERVAL	TRANSIT TIME	TERMINAL TIME	TOTAL TIME	TRANSIT DELAY	TERMINAL DELAY	TOTAL DELAY
NUMBER OF WAGONS	3	4	2	[illegible]	4	2
MEAN HRS	83	124	195	62	93	229
STD.DEV.	83	110	245	54	115	265
0- 0	0	0	0	0	0	0
0- 12	0	0	0	0	0	0
12- 24	1	0	0	0	2	0
24- 36	0	0	0	1	0	0
36- 48	0	0	0	0	1	1
48- 60	1	0	0	0	0	0
60- 72	0	0	0	0	0	0
72- 84	0	0	0	0	0	0
84- 96	0	0	0	0	0	0
96-108	0	0	0	0	0	0
108-120	0	0	1	0	0	0
120-132	0	0	0	0	0	0
132-144	0	0	0	0	0	0
144-156	0	0	0	0	0	0
156-168	0	0	0	1	0	0
168-180	1	0	0	0	0	0
180-192	0	0	0	0	0	0
192-204	0	0	0	0	0	0
204-216	0	0	0	0	0	0
216-228	0	0	0	0	0	0
228-240	0	0	0	0	0	0
240-252	0	0	0	0	0	0
252-264	0	0	0	0	1	0
264-276	0	0	0	0	0	0
276-288	0	0	0	0	0	0
288-300	0	0	0	0	0	0
300-312	0	1	0	0	0	0
312-324	0	0	0	0	0	0
324-336	0	0	0	0	0	0
336-348	0	0	0	0	0	0
348-360	0	0	0	0	0	0
360-372	0	0	0	0	0	0
372-384	0	0	0	0	0	0
384-396	0	0	0	0	0	0
396-408	0	0	0	0	0	0
408-420	0	0	0	0	0	1
420-432	0	0	0	0	0	0
432-444	0	0	0	0	0	0
444-456	0	0	0	0	0	0
456-468	0	0	0	0	0	0
468-480	0	0	0	0	0	0
480-492	0	0	0	0	0	0
492-504	0	0	0	0	0	0
504-516	0	0	0	0	0	0
516-528	0	0	0	0	0	0
528-540	0	0	0	0	0	0
540-552	0	0	0	0	0	0
552-564	0	0	0	0	0	0
564-576	0	0	0	0	0	0
576-588	0	0	0	0	0	0
588-600	0	0	0	0	0	0
600-612	0	0	0	0	0	0
612-624	0	0	0	0	0	0

TABLE D.20 - WAGON INVENTORY SAVINGS ATTRIBUTABLE TO ACACIA RIDGE

Wagon class	Mean total delay Hours	Mean total delay Weeks	Required flow rate (a) (wagons/week)	Wagons saved (b)	Unit replacement cost (c) ($'000)	Wagon inventory saving ($'000)
BASED ON JULY SAMPLE WEEK						
1	44	.262	126.7	33.2	4.8 (d)	157.7
2	76	.453	216.3	98.0	20.0	1,959.7
3	85	.506	297.7	150.6	20.0	3,012.7
4	80	.477	208.1	99.3	19.0	1,886.0
6	47	.280	57.0	16.0	21.0	335.2
7	47	.280	57.6	-	-	-
9	561	3.340	5.8	19.4	20.0	387.4
Other	-	-	2.3	-	-	-
Total			971	416.5	-	7,738.7
BASED ON AUGUST SAMPLE WEEK						
1	180	1.072	62.6	67.1	4.8 (d)	318.7
2	137	.816	269.2	219.8	20.0	4,393.4
3	107	.637	334.1	212.8	20.0	4,256.4
4	55	.328	153.8	50.4	19.0	958.5
6	34	.203	37.4	7.6	21.0	159.5
7	15	.090	54.8	-	-	-
9	229	1.363	5.5	7.5	20.0	149.9
Total			918	565.2	-	10,236.4

(a) calculated from one week sample and adjusted for total flow in each class. (b) wagons saved based on total fleet requirements; for excessively long turnaround times, savings may be larger than weekly flow rate. (c) 73/74 prices, estimated by assuming PTCNSW 2CM bogies add $4000 per wagon. (d) 4-wheel wagons assumed to be discontinued; 2 are replaced by one bogie flat wagon; it is estimated that only half this class will be replaced.

NOTE: Columns and rows may not quite agree due to rounding.

TABLE D.21 - DISCOUNTED PRESENT NUMBER OF WAGON FLEET SAVINGS

Year	Step Saving	Growth Saving			Discounted Present No.			
		Years		number per year	Step Saving		Growth Saving	
		from	to		7%	10%	7%	10%
2.5	216	2.5	7.5	11.4	182.5	170.4	39.5	34.1
3.5	227	3.5	10.5	11.4	179.2	162.8	48.5	39.6
5.0	245	5.0	15	11.3	174.7	152.1	56.6	43.1
7.5	-273				-164.5	-133.7		
10.5	-307				-151.0	-113.0		
15.0	-358				-129.7	- 85.7		
NET PRESENT NUMBER OF WAGONS					91.3	152.9	144.6	116.8

TRANSPORT INVENTORY SAVINGS

Goods sent from Sydney to Brisbane will generally pass through three stages of inventory: at the producers' warehouse in Sydney, during transport to Brisbane and at the customers' warehouses in Brisbane. There are direct costs associated with each stage: these are interest, depreciation, loss and damage. The costs are proportional to the value of the inventory and to the time in each stage; the producer and his customer will strive to reduce these costs. The right amount to hold is determined by the variability of production and demand: it can be shown that this amount is generally independent of transport time. Thus, the saving from reduced transport time, in general, arises only from the fall in the amount of goods in transit.

The development of Acacia Ridge is expected to generate substantial savings in the transit times of goods bound north for Brisbane. Consequently, there will be a saving in cost.

An estimate has been made of the direct transport inventory savings; they are based on the delays experienced during the August sample week (Annex D) and the estimated value of the 1972-73 rail traffic to Brisbane (Table E.1). The cost of holding these goods in transit is the cost of interest and depreciation, assumed to be 16 per cent per annum of the capital value(1).

Although northbound goods have the same transit delay as wagons, they suffer only a part of the terminal delay to wagons. The most probable value of terminal delay to goods is estimated to be two-thirds of wagon terminal delay because of the difficulty in placing northbound wagons and because of differences in handling times in various terminal areas. Thus, the saving in commodity travel time has been taken as the mean August transit delay plus two thirds of the mean terminal delay (Table D.4).

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(1) 10 per cent interest, 5 per cent depreciation, 1 per cent loss and damage.

TABLE E.1 - ESTIMATION OF NORTHBOUND COMMODITY FLOW VALUE

Commodity code (a)	Description	Approximate wholesale(b) ($/tonne)	1972-73 volume ('000 tonnes)	Estimated value ($'000)
1	Fertilizer	75	11.0	825
2-7	Class rates	400	21.6	8,640
11,12	Wheat and grain	71	1.1	78
15	Fruit and vegs	448	2.3	1,030
18	Meat	1,792	0.9	1,613
27	Manufactured steel	135	1.7	230
42	Overseas containers	200	54.3	10,860
43,44	Domestic containers	200	116.2	23,240
45	Bulk load	200	210.6	42,120
47	Rice	50	2.9	145
48	Other grain	55	7.1	391
49	Canned produce (NSW)	200	11.2	2,240
51	Fruit and vegs.	448	20.4	9,139
71	Cars, bodies and chassis	2,500	24.7	61,750
73	Iron and steel (c)	130	417.5	54,275
75	Car parts	2,500	31.4	78,500
	All other	200	96.9	19,380
	TOTAL	-	1,031.7	314,456

(a) For NSW codes, see Table A.2. (b) These are BTE estimates based on 1973 prices. Many commodities could not be isolated, so a conservative value of $200/tonne was used. (c) Includes approximately 90,000 tonnes of tinplate valued at $25,200,000.

NOTE: Columns may not add due to rounding.

The August transit delay for all commodities was 53 hours; two thirds of the terminal delay was 39.3 hours. The total delay is thus assumed to be 92.3 hours or 0.011 years. For a 16 per cent carrying charge, the annual direct transport savings are thus $553,000.

When these annual benefits are discounted over the life of the project case and the base case, the net present value attributable to the accelerated development schedule is $2,769,000 at 7 per cent and $2,110,000 at 10 per cent.