VFT-*N*:

THE SYDNEY - BRISBANE VFT

MARCH 1989

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by

J.P. Wild
Chairman,
VFT Joint Venture

and

J.F. Brotchie
Division of Building Construction
and Engineering, CSIRO

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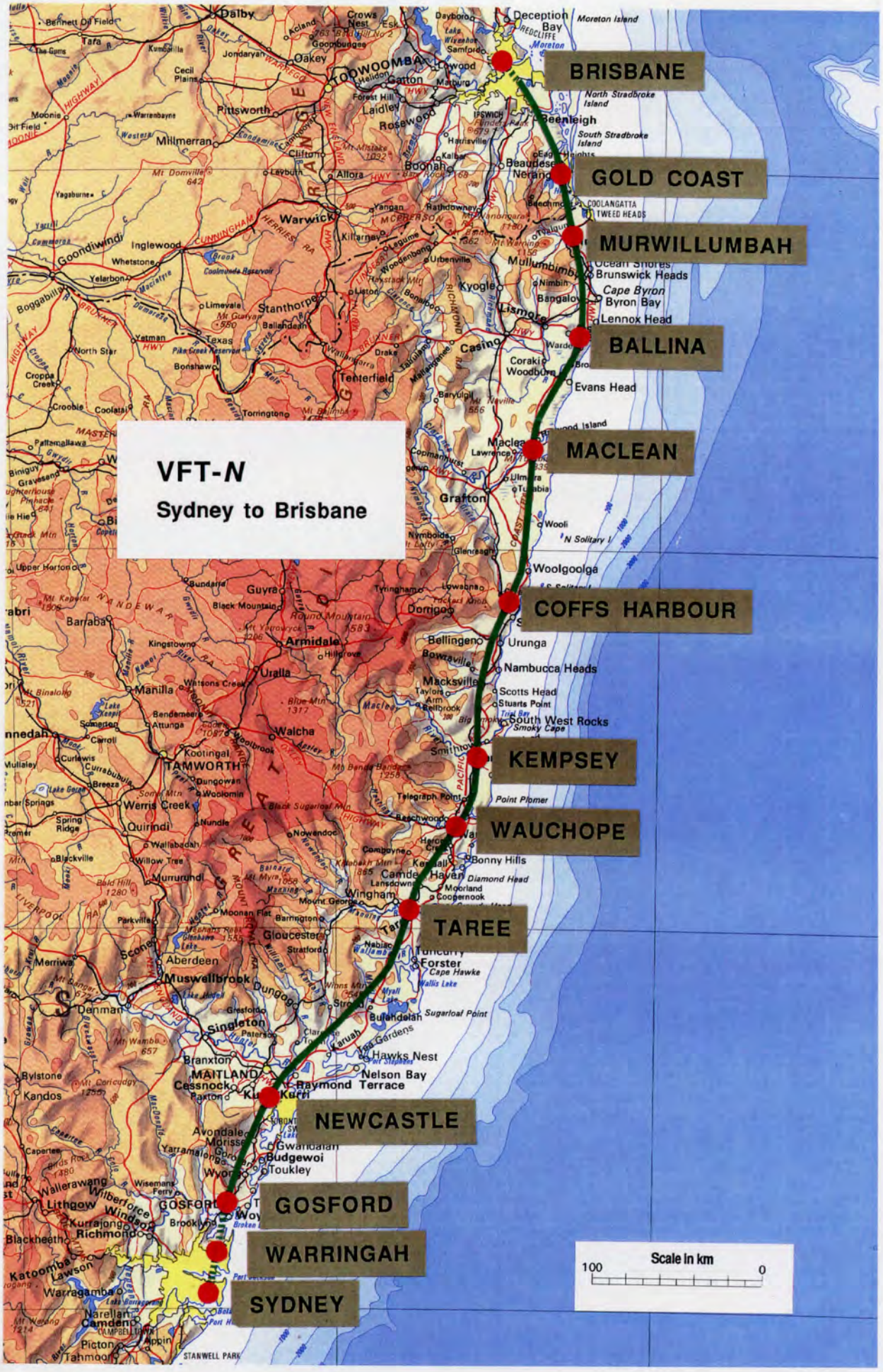
VFT-N
Sydney to Brisbane
BRISBANE
GOLD COAST
MURWILLUMBAH
BALLINA
MACLEAN
COFFS HARBOUR
KEMPSEY
WAUCHOPE
TAREE
NEWCASTLE
GOSFORD
WARRINGAH
SYDNEY
Scale in km
100
0

SUMMARY

- The prospect of a VFT from Sydney to Brisbane ("VFT-*N*") via a coastal route has been examined. It has been found to be technically feasible and, *prima facie,* financially viable. The route would include Newcastle, Coffs Harbour and the Gold Coast.

- In a first scenario, construction is assumed to begin in 1995 following completion of the Melbourne-Sydney link. Operation is assumed to commence in the year 2000.

- In a second scenario, the Sydney-Brisbane VFT would come into operation in 1995, to be followed by the Sydney-Melbourne link.

- A further scenario, not yet evaluated, is to extend the VFT-*N* to Canberra, and possibly to the Snowy Mountains, ahead of the full construction to Melbourne.

- The Sydney-Brisbane route is 797 km long, including 34.5 km of tunnel required for entry into Sydney Central and Brisbane Roma Street terminals. One tunnel runs below Sydney Harbour, another under Ku-Ring-Gai Chase and Broken Bay, and a third under the southern approaches of Brisbane.

- The tunnels facilitate high-speed running, allowing non-stop travel times of 2½ hours from Sydney to Brisbane and 5½ hours from Melbourne to Brisbane.

- The somewhat shorter travel times from Sydney to Brisbane (compared with Sydney-Melbourne) make VFT travel even more competitive against other modes.

- A total of 24 train sets are needed to provide over 30 trips per day in each direction.*

- Passenger demand in the year 2000 for 3 percent per annum growth is 6.5 million one-way Sydney-Brisbane trip equivalents, including an extra 0.7 million on the Sydney-Melbourne link.*

- Passenger revenue in real terms in the year 2000 is similar to that on the Sydney-Melbourne link in 1995.*

- Capital cost is estimated at $4660 million in 1989 dollars, slightly less in real terms than for Melbourne-Sydney. Operating costs are estimated at $185 million per annum in 1989 dollars.

- Financial viability of the Sydney-Brisbane link in 2000 is similar to that of Sydney-Melbourne in 1995.

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* Applies to the first scenario, i.e. construction of the Sydney-Melbourne link first.

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1. INTRODUCTION

The VFT project, now undergoing its feasibility study, links Sydney and Melbourne via Canberra. Should this project prove viable and successful, the question arises as to what other possible routes could be viable for VFT linkages. Two other routes suggest themselves. Based on population figures, they are, in order of viability:

1: Sydney to Brisbane via the Gold Coast

2: Melbourne to Adelaide

If the term "VFT" be reserved for the Sydney-Melbourne route, we may refer to the northern route (1) as VFT-*N* and the southern route (2) as VFT-*S*. This report explores the route and viability of the VFT-*N* system.

The report considers the VFT-*N* system in two possible scenarios. The first assumes the more likely case that if the VFT-*N* were to be constructed it would follow chronologically the start of operation of the VFT between Sydney and Melbourne. Thus, its financial viability would benefit from through traffic from Brisbane to Canberra and Melbourne. The second scenario envisages the less likely case that some fundamental difficulty (e.g. environmental or legal) might be encountered that would delay the Melbourne-Sydney system and cause the Sydney-Brisbane system to be constructed first. This would lead to a slight reduction in the level of financial viability, at least in the short term, although development opportunities yet to be examined could change the relative attractiveness of these proposals.

A third scenario, not evaluated in this report , is to extend the VFT-*N* to Canberra and possibly the Snowy Mountains ahead of the full construction to Melbourne.

It will be assumed that the technology and alignment parameters are to be the same as for the VFT. They are: at least outside terminal city environs, a working maximum speed of 350 km/h, horizontal curvature of 7 km and vertical curvature of 22 km.

2. THE ROUTE

2.1 General

The proposed general route of the VFT-*N*, charted with the aid of 1:100,000 maps, is shown in the frontispiece figure. The route follows the coast and lies mainly in the range 5 to 25 km from the coast-line. Such a route minimizes terrain problems associated with the Great Dividing Range to the west and environmental problems associated with the seaboard to the east. Unlike the present Sydney-Brisbane line, the new route serves the Gold Coast.

2.2 Sydney entry

Possibly the most difficult part of the VFT-*N* route lies between Sydney (Central) and the northern bank of the Hawkesbury River. One possibility is to use all or part of the present SRA alignment to Brooklyn (via either Chatswood or Strathfield). However, this option would add as much as one hour to travel time and would put severe demands on common working arrangements with the SRA, both as regards system control and industrial relations. It is not considered in this proposal.

The preferred route tunnels northward out of Central Station under Port Jackson, Mosman, Middle Harbour and Seaforth, surfacing at North Seaforth. The tunnel is about 12 km long. The route proceeds northwards through thinly populated territory to the southern boundary of Ku-Ring-Gai Chase National Park. The line then tunnels for 12.5 km under Ku-Ring-Gai Chase (for environmental reasons) and Broken Bay.

2.3 Brisbane entry

The proposal envisages a Brisbane underground terminal at Roma Street, which is an excellent inter-transport exchange station recently re-designed to high market standards. The route tunnels out in a direction south of east, surfacing after 10 km in the suburb of Carindale. It proceeds thenceforth through relatively sparsely populated territory.

It should be remarked that the proposed alignment between Brisbane and the Gold Coast parallels a new Queensland Railways (narrow gauge) line under construction — the "Gold Coast Railway." QR plans to use their existing track between Brisbane and Beenleigh and then to use newly-constructed track, built to 160 km/h standards, to Robina, overlooking Surfer's Paradise. QR's transit time between Brisbane and Robina, including five stops, would be 65 minutes. The proposed VFT-*N* covers the Brisbane-Gold Coast section in 16 minutes. There is clearly an opportunity here for collaborative planning towards a common alignment.

3. STATIONS AND TRANSIT TIMES

Assumed stations and transit times are given in Table 1.

The location of Sydney's northern suburbs station requires careful evaluation. Here we assume a station called "Warringah," located at French's Forest. It is centrally placed to serve both the Pacific Highway suburbs and the northern beach suburbs, yet is suitable for new building complexes and car parking.

The existence of such a northern Sydney station is of significant benefit to the Sydney-Melbourne VFT. Besides increasing the competitiveness of the VFT system for north-side dwellers, it provides important operational advantages. Melbourne-Sydney trains would terminate at Warringah, where there would be ample space for turn-around and servicing facilities. (In the same way, Brisbane-Sydney trains would terminate at Sydney Airport). Thus congestion at the Sydney Central underground station — planned to have only two platforms — would be greatly reduced and potential traffic flow would be greatly increased. The northern station would also provide a terminal for commuter trains running to Bowral etc, and would make such a service much more feasible.

TABLE 1
STATIONS AND TRANSIT TIMES

STATION	DIST	TRANSIT TIME (HOURS, MINUTES)		
	(km)	Non-stop	Semi-fast	Stopping
Sydney (Central)	0	0.00	0.00	0.00
Warringah	15.7		0.08	0.08
Gosford	52.1			0.20
Newcastle	131.8		0.35	0.40
Taree	263.2			1.09
Wauchope	323.0			1.25
Kempsey	371.5			1.39
Coffs Harbour	459.4		1.40	2.00
Maclean	555.6			2.22
Ballina	627.0			2.40
Murwillumbah	689.5			2.57
Gold Coast	727.0		2.34	3.09
Brisbane	797.4	2.30	2.50	3.25

The non-stop transit time of 2 hours 30 minutes between the centre of Sydney and the centre of Brisbane is clearly competitive with air travel. Similarly, semi-fast trains connecting Sydney, Warringah, Newcastle, Coffs Harbour, Gold Coast and Brisbane with a total time of 2 hours 50 minutes would provide a convenient service for both business and non-business passengers.

4. COSTS

4.1 Capital costs

The cost of the route for the VFT-*N* is based on the same real costs per unit of construction as for VFT, but is expressed in 1989 dollars. The high-cost items include 12 km of tunnel from Sydney Central under the Harbour and continuing to the north for the Sydney exit; 12.5 km under Ku-Ring-Gai Chase National Park and Broken Bay at the mouth of the Hawkesbury; and 10 km of tunnel for the Brisbane entry (to Roma Street Terminal). However, surface entry through the developed metropolitan areas of Sydney and Brisbane would only be possible at considerable cost.

Costs are based on terrain data taken off 1:100,000 topographic maps. Data are fed into an automated design program which:

- designs the finished surface profile and cross sections
- estimates cut-and-fill volumes
- estimates earthworks costs
- substitutes viaducts or tunnels where they are more economic than fills or cuts respectively, and
- estimates total construction costs.

Software to optimize the earthwork design and costs has been included to minimise earthwork costs.

The automated design process eliminates bias or human error and provides a rational basis for comparing alternative routes. Costs of other elements such as site clearing, drainage, diversion of roads and services, provision of crossings, fences, ballast, track, stations, power systems, control system and rolling stock are based on VFT pre-feasibility study costs.

Unit costs from the 1987 pre-feasibility report, expressed in 1989 dollars, include

Clearing	$12,000 per hectare
Earthworks	$3.50 to $10 per cubic metre
Tunnels — cut and cover, bored	$24 million to $40M per km
Bridges, viaducts	$13 million to $18M per km
Over-crossings, single spans	$0.30 million each
Fencing	$17,100 per km

The cost of tunnels makes allowance for higher costs (up to $40 million per kilometre) which may be incurred due to underwater tunnelling below Port Jackson and Broken Bay and tunnelling under northern suburbs ($30 million per kilometre).

The total cost, including design, supervision and contingency allowances, is $4660 million, broken down as follows:

Land for track and stations		$120 million
Civil engineering works and structures (approximately the same as VFT) including:		$2700 million
	tunnels (34.5 km)	$964 million
	site clearing	$ 36 million
	fences	$ 24 million
	stations	$48 million
	bridges	$156 million
	earthworks	$560 million
	drainage	$144 million
	miscellaneous works	$48 million
	establishment	$60 million
	design and supervision	$230 million
	contingency	$430 million
Ballast and track		$640 million
Electrification		$390 million
Communication and control		$240 million
Rolling stock for 24 train sets		$570 million
Total capital cost for VFT-*N*:		**$4660 million**

4.2 Operating costs

Operating costs are also based on the same unit costs in real terms as for VFT. The total operating costs are determined partly from the simulation model, which calculates energy expended based on terrain and speed, and partly from the financial model, which calculates total operating costs based on the Sofrérail analysis of operating costs for VFT.

5. THE MARKET

5.1 Introduction

The market analysis is based on ABS 1986 (census) and 1987* data for cities and local government areas along the route, and on the VFT market study. Although based primarily on the Sydney-Melbourne corridor, this study included intercept and face-to-face surveys in the Sydney-Brisbane corridor.

The face-to-face survey included Brisbane, Newcastle, Sydney, and coastal resorts on the NSW South Coast. Individual travel behaviour and values of time are assumed to be the same throughout the Melbourne-Sydney-Brisbane corridor.

Two scenarios are considered for staging construction: either VFT followed by VFT-*N*, or vice versa. The sequence may depend on the staging of approvals from the governments involved. The projected dates are:

Scenario	Start Construction	Start Operation
1. VFT	1990	1995
followed by		
VFT-*N*	1995	2000
2. VFT-*N*	1990	1995 or earlier
followed by		
VFT	1995	2000 or earlier

Two sets of trips are included in the VFT-*N* market:

- trips that make use of the VFT-*N* alone, and
- trips that make use of both VFT (after completion) and VFT-*N*.

In the latter case, all of the revenue is attributed to VFT-*N* if the trip would not have been made without VFT-*N*. Otherwise, only the VFT-*N* leg is attributed to VFT-*N*.

Trip generation rates per capita are also assumed to be the same in each region. It is noted, however, that destinations in the north are more attractive to overseas visitors and domestic tourists than those in the south, and higher proportions of overseas visitors and Sydney-siders are assumed to travel north than south. Billions of dollars are already being spent on coastal development projects along the route to cater for this demand.

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* *Australia's Population Trends and Prospects*, Department of Immigration, Local Government and Ethnic Affairs, Canberra, 1988.

5.2 Population in the corridor

The population in the northern corridor is currently 6 million. Its assumed growth rate is approximately 1.5 percent per annum, compared with 1 percent per annum in the Sydney-Melbourne corridor. Projected populations for 1995 are: northern corridor, almost 7 million; Sydney-Melbourne corridor, 7.8 million. By the year 2000, the population of the northern corridor will be nearly 7.5 million and that of the Sydney-Melbourne corridor, 8.2 million.

The current population along the route (data: 1986 census) is as follows:

Sydney	3.43 million
Newcastle-Maitland	0.48 million
Coffs Harbour	0.36 million
Moreton	0.41 million
Brisbane	1.17 million
Total population:	
1986 census	5.85 million in 1986
(1987 ABS data, extrapolated	6.03 million in 1988)

Recent urban growth rates (1981-86) on the Gold Coast and on the newly-defined Central Coast (ABS, 1988) were each 3.7 percent per annum. Total population growth rates per annum in 1987 were:

Queensland	1.99 percent
New South Wales	1.46 percent
ACT	2.77 percent
Victoria	1.16 percent
Australia	1.53 percent

The average national growth rate is expected to rise to above 1.6 percent per annum over the next five years with about half the increase deriving from net international migration.

The population of the northern corridor is not as evenly balanced between the two terminating cities as the Sydney-Melbourne corridor, but the Queensland end of the northern corridor is a more attractive destination.

In addition to the existing population in the northern corridor, the market also comprises overseas visitors, many of whom enter Australia at Sydney and turn north. Over 5 million overseas visitors are expected in the year 2000. The growth rate in overseas visitors is currently 25 percent per annum (1986, 1987, 1988) and is expected to be between 10 percent per annum and 13 percent per annum to the end of the century. This compares with 7 percent per annum assumed for the Sydney-Melbourne corridor in the VFT market study.

Growth in air travel in the north is also much higher than in the south, particularly that to coastal resorts and off-shore islands, where current growth rates are generally above 10 percent per annum.

5.3 Travel time

Because of high-speed running in the tunnels at each metropolitan entry as well as along the greenfield section, the travel time between Sydney and Brisbane non stop by VFT-*N* is only 2½ hours. Consequently, the trip is even more competitive with air than the Sydney-Melbourne VFT. The Melbourne-Brisbane non-stop time is only 5½ hours.

5.4 Passenger market

The expected passenger demand in the year 2000 is 6.5 to 7.9 million Sydney-Brisbane one-way trip equivalents, including the additional trips induced on the Sydney-Melbourne link. The existing travel base in the corridor by mode and city zone pair is given in Table 2 (overleaf).

TABLE 2:
EXISTING TRAVEL & PROJECTIONS TO 2000

CITY PAIR	EXISTING TRIPS		PROJECTIONS TO 2000			
			LOW GROWTH* 3% pa		HIGH GROWTH 5% pa	
	Actual trips**	Syd-Bn Equivs	Travel in 2000	Diverted to VFT#	Travel in 2000	Diverted to VFT#
		«««««« Sydney-Brisbane Trip Equivalents »»»»»»				
	millions	millions	millions	millions	millions	millions
Air travel [1987/88 data]						
Brisbane-Sydney	1.60	1.60	2.29	1.10	2.88	1.40
Coffs Harbour-Sydney	0.08	0.05	0.07	0.04	0.09	0.05
Coolangatta-Sydney	0.66	0.60	0.86	0.50	1.08	0.60
Brisb/Cool-Newcastle	0.02	0.02	0.03	0.01	0.04	0.02
Brisbane-Melbourne	0.49	0.49	0.70	0.25	0.88	0.30
Coolangatta-Melbourne	0.29	0.27	0.39	0.15	0.49	0.17
Total:	3.14	3.03	4.34	2.00	5.46	2.50
Coach travel [1987 data]						
(from the 1987 VFT market study and 1985 BTE *Occasional Paper 74* on long distance coach travel).						
Brisbane via Gold Coast to Sydney	0.6	0.6	1.0	0.5	1.3	0.7
Brisbane via Gold Coast to Melbourne	0.3	0.3	0.5	0.3	0.7	0.4
Total:	0.9	0.9	1.5	0.8	2.0	1.1
Car travel [1987 data]						
(based on trip generation, Sydney-Melbourne corridor — VFT Market Study)						
		>3.0	>4.0	1.0	>5.0	1.2
Induced from population in corridor and visitors				1.5		1.5
Additional Sydney-Melbourne (e.g. Brisbane-Melbourne) passengers diverted to VFT because of VFT-*N*				0.7		0.8
Tourism						
(international visitors additional to those above, ie the additional 7% to 10% growth rate)						
	0.0		>1.5	0.5	2.0	0.8
Total one-way Syd-Bris trip equivalents, year 2000 (millions)					6.5	7.9

Notes:

* *Travel growth to 1988 in the corridor has been substantially higher than 3 percent per annum.*

** *Includes passengers travelling beyond corridor with this sector as part of their trip (normally 15 percent of total).*

\# *Diversions above are based on values in the Sydney-Melbourne corridor. Higher diversions may be expected in this corridor because of lower VFT travel times.*

The results above for the year 2000 are common for both construction scenarios shown in section 5.1.

A growth rate in travel of 5 percent is included in this corridor to allow for the higher growth rates in northward travel that are currently being experienced. The growth rate of 3 percent used for VFT is considered as the base case.

If VFT-*N* were to be constructed first, trips involving both VFT-*N* and VFT will not occur until completion of VFT, between 1996 and 2000. The absence of these trips and of growth factors between 1995 and 2000 will reduce demand accordingly (see Table 3, on page 12).

5.5 Passenger revenue

The shorter travel times on this route, eg Sydney-Brisbane in 2½hours, make VFT-*N* relatively more competitive with other modes, allowing higher fare prices per kilometre. The result is that, when trips which utilize both VFT and VFT-*N* are included, revenues in 2000 are comparable with those of the VFT in 1995.

These revenues apply strictly to the transport system by itself. They take no account of possible benefits that may be derived from ancillary businesses or the offset of capital costs through value capture. Even so, they provide a *prima facie* case that VFT-*N* is commercially attractive in the year 2000 and could even precede VFT if this sequence of construction were appropriate for other reasons.

6. CONCLUSION

- The somewhat shorter travel time for Sydney-Brisbane journeys (compared with Sydney-Melbourne) make VFT relatively more competitive with other modes, particularly air, allowing higher fare levels and increased revenues.

- The completion of both VFT and VFT-*N* further increases demand and revenue by catering for trips which utilize both links (e.g. Melbourne-Brisbane). It also provides economies of scale of facilities and operation.

- Financial viability of VFT-*N* in 2000 is similar to that of VFT in 1995 after revenues resulting from the linking of VFT and VFT-*N* are taken into account.

- Reversal of the sequence of construction, e.g. VFT-*N* followed by VFT, results in a reduced revenue in 1995, catching up at the completion of VFT.

- Viability may be further increased by development of further business opportunities created by VFT-*N* along the route, including land and resort development.

- Completion of VFT-*N* before VFT would accelerate growth of tourism and land development. The development would further increase passenger demands and revenues, at the expense of growth in the Sydney-Melbourne corridor. This would further enhance the financial returns from VFT-*N* and reduce the need for early completion of VFT.

TABLE 3:

COMPARISON OF VFT AND VFT-*N* LINES

	VFT	VFT-*N*
Route length:	876 km	797 km
Tunnel length:	10 to 20 km	34.5 km
Cost:		
1986 dollars	$4114 million	$3910 million
1989 dollars	$4900 million	$4660 million
Non-stop travel time (terminal to terminal):	3 hours	2.5 hours
Passenger demand per annum (full trip equivalents for low growth figures):		
1995	6.6 million	4.7 million
2000	7.4 million	6.5 million
Freight per annum:	400,000 tonnes	265,000 tonnes
Assumed* fares, terminal to terminal:		
1986 dollars	$105	$105
1989 dollars	$125	$125

* Actual fares will be determined by market conditions at the time of operation. Fares given here are those assumed for financial analysis. For a complete trip between terminals they correspond, in 1989 dollars, to rates of 14.5 cents per kilometre for VFT and 15.8 cents per kilometre for VFT-N.