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Multi Modal Corridor Planning In The Hutt Valley Of The Wellington Region

The Wellington Regional Council adopted its current Regional Land Transport Strategy in September 1999. This was the culmination of many years work and provided the strategic framework for land transport infrastructure investment in the region for the short and medium term future.

The Hutt valley is a significant sub region of the Wellington Region. Wellington's topography enables sub regions such as the Hutt Valley to have its own distinctive identity and their own peculiar growth and travel problems.

This paper examines the development of a corridor plan within the Regional Land Transport Strategy for the Hutt valley. The corridor plan needs to simultaneously satisfy regional travel requirements but also address the Hutt Valley's particular needs. This requires a detailed consideration of how the region's highway network and regional passenger transport system can be best configured in the Hutt Valley and integrated with local roads and local travel needs.

Thinking outside the square is required. Some of the issues are difficult and the constraints of topography and money are tight. The Hutt corridor plan provides a challenge but a real opportunity for innovative transport planning including co-ordinated highway, passenger transport and road pricing schemes.

Introduction

The Hutt Valley is an important sub-region within the Wellington region. In recent years the Hutt Valley has experienced decline both in terms of population and as a place of employment.

The Hutt Valley is defined by the harbour edge and a difficult topography. The topography surrounding the Hutt Valley places real constraints on the development of the transport network in the Valley. It is believed that the performance of the transport network is a factor contributing to the decline of the Hutt Valley.

This paper describes a process used to plan the development of the Hutt Valley's transport network and its links to the rest of the region. The process used recognises the constraints on options imposed by topography and funding. The objectives of this study include arresting the environment of decline in the Valley but still ensuring that the proposals are integrated with the region wide strategy for the development of transport infrastructure.

Geographical background

The Wellington region is located on the southern tip of the North Island of New Zealand (see figure 1). At the southern end of the region is Wellington City which is the nation's capital, the dominant employment centre and largest population centre in the region (see figure 1).

The urban parts of the Hutt Valley are made up of two local government units. These are Hutt City and Upper Hutt City. The Hutt Valley is tightly constrained by topography. At the southern end of is Wellington harbour. There is a narrow strip of land that links the Hutt Valley to Wellington City which is wedged between the harbour and very steep rugged country. This gives room for a double track railway and the highway.

This same steep country continues northwards to provide the western wall of the Valley. This, with the assistance of equally imposing steep country on the eastern side of the Valley, constrains development in the Valley into a narrow area where no points are a great distance from the national highway, State Highway 2 (SH2) and the passenger rail services (see figure 2).

The western hills provide an effective barrier to connecting the Valley to those districts to the west except for the highway SH58 which is located north of the main activity centre of Hutt City and south of the main activity centre in Upper Hutt. Consequently, trip making patterns in the Wellington region are normally focused in the linear north-south direction with travel from outlying areas to the Wellington Central Business District. There are only modest flows from east to west. For instance SH58 carries about 11,000 vehicles per day whereas SH2 carries about 68,000 vehicles per day between Petone and Ngauranga. This

pattern is reflected in car, freight and passenger transport travel and is typical of the Hutt Valley.

At the northern end of the Valley, a mountainous range known as the Rimutakas, limits the northern extent of the Valley and defines the end of the urban part of the region and the commencement of the rural hinterland known as the Wairarapa. SH2 continues over the Rimutakas but over this range of hills the road is narrow and difficult with frequent tight corners and steep grades. Only 4,000 vehicles per day travel over this road. The Rimutakas are perforated by a railway tunnel which provides for a single track for both freight and passenger flows.

Demographics and employment

Usually resident population data from census is shown in table 1.

As can be seen from the data presented in table 1, the Hutt Valley's, in usually resident population is in decline. Census 2001 data also indicates that the average age of the usually resident population in the Hutt Valley is slowly increasing. The medium term demographic prospects for the Hutt Valley under current trends is for an ageing smaller population.

The full time equivalent labour force from census is shown in table 2.

Table 2 shows that employment in the Hutt Valley is static or declining.

A report produced by Opus (2000) identifies that transportation issues are acting as constraints on the development of the Hutt Valley. The Hutt Valley has direct links to Wellington City but at peak times road links are congested and public transport services and facilities are at capacity. Connections to the western corridor are not efficient both for road traffic and public transport. In summary, lack of efficient access is limiting the prospects of the Hutt Valley as a place to live or to operate a business.

This is an important issue as Wellington City, being the centre of Government, has been the dominant employment centre in the region. Government's role in New Zealand society has and continues to reduce as a provider of employment. This means that unless Wellington City can develop new employment activities other districts such as the Hutt Valley will need to provide a greater share of employment to prevent the region going into decline. The Hutt Valley has traditionally been the region's centre of manufacturing particularly in the Petone, Seaview, and Gracefield areas. A region wide decline in manufacturing has seen these areas decline as employment centres.

Process

A corridor plan is an element within a Regional Land Transport Strategy. The Regional Land Transport Strategy is developed under New Zealand's Land Transport Act. The process for developing the Regional Land Transport Strategy is outlined in a paper by Ashley, Brennand and Houghton (1999).

The Regional Land Transport Strategy provides the overall strategic framework for land transport in a region and ensures consistency at the interface for the respective corridor plans. The process for developing corridor plans is presented in a paper by Brennand (2001). The development of the Hutt corridor plan follows the development of the Western corridor plan, the corridor running from the intersection of the two state highways at Ngauranga, to the Kapiti Coast. The corridor plan approach is unique in New Zealand and is particularly suited to Wellington's difficult topography which assists in clearly defining discrete corridors.

A summary of the process is shown in figure 3.

Scope

The scope of this investigation includes travel from the northern end of the Hutt Valley through to Ngauranga which is the merge point of the highway and rail systems with their counterparts on the western corridor. Connections from the Seaview and Gracefield areas to SH2 and then across to SH1 are also part of this scope. The investigations are primarily concerned with road and passenger transport but also give consideration to walking and cycling. This study is conducted at the strategic level and is not concerned with local network improvements.

Objectives

The objectives for the corridor plan are derived from the Regional Land Transport Strategy. The objectives are:

- To promote accessibility and economic development
- To ensure proposals are economically efficient
- To ensure proposals are affordable
- To promote safety
- To ensure proposals contribute to a sustainable network

The Regional Land Transport Strategy requires the recognition of a concept known as network balance. The linear nature of the strategic road and public transport networks means there is a propensity for road improvements to merely shift bottlenecks and undermine public transport patronage unless a comprehensive system wide analysis is undertaken.

Economic development issues have been given a particular emphasis in the Hutt Valley. This reflects the real concern at the district level for the future prospects of the Hutt Valley.

Identified needs and issues

The following needs and issues were identified through a stakeholder consultation process.

- Low population growth in the Hutt Valley
- Continued employment in Wellington CBD for people living outside of Wellington City
- Slow down in manufacturing regionally
- Peak period road congestion
- Inadequate peak frequency levels of passenger rail in the Hutt
- Increase in freight movements across the Hutt Valley, particularly near or in residential areas
- Increase in journeys for recreation and shopping
- Poor local access in and out of the Hutt Valley
- Lack of direct passenger rail across to the Lower Hutt Central area
- Growing need for improved roads to meet increases in tourism

It is interesting to note that a number of these needs and issues refer to economic issues. It is generally recognised that transport is not the only factor that influences economic development but in this case it would appear significant.

First stage analysis

A 20 year horizon has been used to look at options in terms of how they perform against the objectives. Sets of performance indicators have been assigned to each objective so changes in these indicators when an option is compared with a Do Minimum base case can be assessed. For example, changes in peak period journey time in a Do Something option compared with the base case in an indicator for accessibility and may give some insights into economic development potential. An illustration of the indicators is provided in table 3.

The analysis of options has been split into three dimensions. The first dimension is concerned with improvements to SH2 from Ngauranga to the northern end of the Hutt Valley. The second dimension is concerned with public transport improvements. The third dimension deals with road connections across the Valley floor from the Seaview-Gracefield industrial area to SH2 then connecting from SH2 to either SH1 or Porirua.

There were several stages of technical analysis used in the Hutt Valley corridor plan work. In the first round options were examined as independent packages. That is three levels of SH2 packages were investigated with no public transport proposals or cross valley–western link road options. Three levels of public transport investment with no state highway or link road options were also investigated. Finally six cross valley–western link road options were examined with no SH2 or public transport improvements were investigated. Details of the options are provided in table 4 but in broad terms the three levels of state highway and public transport represent low, medium and high levels of investment. In this way the impacts of more expensive infrastructure such as LRT, in the case of public transport, could be contrasted with conventional rail improvements supported by a system of enhanced bus feeder services and park and ride.

This exercise involved the use of a conventional four stage strategic transport model in conjunction with a local network motor vehicle assignment model. The strategic model was based on an EMME/2 software platform and a SATURN model was used for the local network assignment model. The strategic model provided trip generation, distribution, mode split and provided motor vehicle matrices that could be exported to the more detailed local network vehicle assignment model which then could be assigned so that critical screenlines, junctions and car travel statistics could be reported on.

The analysis of options has been done using a 20 year horizon. A two hour morning peak and a seven hour interpeak period have been used as the subject of analysis in each case. The analysis of options has used a conventional four stage strategic model in tandem with a detailed local area car assignment model.

The trip generation phase of the strategic model is a function of accessibility. The car ownership model is a function of accessibility at peak times and other variables. Growing congestion leads to lower levels of car ownership in an area. The number of trips produced in an area is a function of car ownership levels.

The strategic model is also capable of redistributing some peak period trips into the interpeak period in response to significant congestion. This enables the simulation of peak spreading.

If the use of the two models is to produce meaningful results this means a reasonable level of consistency is required between the traffic volumes and travel times of the strategic and the more detailed car assignment model. This necessitates a careful formulation of the volume-delay function on key routes in the strategic model and careful checking within an iterative loop of the outputs and inputs related to traffic volumes and travel times in the two models.

The above approach enables the key characteristics of singular initiatives to be identified in terms of their performance against objectives as shown by the performance indicators. In addition, those singular initiatives can be refined by

removing poor performing elements or by optimising the extent of an element as discussed later.

Outputs from this first stage analysis can be directly used in evaluating an option in the five point scale planning balance sheet as described by Ashley et all (1999, p 343) or passed to specialist advisors who would evaluate the performance of an option against specific objectives. In this case an economist and an environmental scientist were used to assist in evaluating performance against economic development and sustainability respectively.

It should be noted that this evaluation is not completely model based and does require some "off model" analysis. For example, safety benefits are only crudely estimated by this tandem use of models and so information, which may be site specific, is needed to enrich the analysis. Similarly, the accessibility and safety benefits of an ATMS project can only be crudely estimated by these transport models and so model outputs are supplemented by other analyses in the evaluation of this project's performance.

The distribution stage of the strategic model uses accessibility parameters to link trip productions from the various origins and destinations from the trip generation phase. Increased trip making in and out of the Hutt Valley due to trip distribution effects is therefore an indicator of improved accessibility and can also be understood as an indicator of potential increased residential and economic activity.

It is acknowledged that this approach is only dealing with the first order and more immediate responses to enhanced accessibility. There will be second order and slower responses to enhanced accessibility such as internal population migration and relocation of business. A model has been developed for the Wellington region by Vincent (2000) which relates land use redistribution to accessibility. As this corridor plan is designed to look at what initiatives might contribute to objectives such as accessibility and economic development rather than determine precise quantitative responses a first order analysis was deemed to be sufficient.

Conclusions from the first stage analysis

State Highway 2 improvements

The analysis of improvements to SH2 as a singular initiative provided the following insights. Improved highway efficiency led to

- Increased activity in the Hutt Valley reflected in increased use of the highway
- Increased vehicle travel distances reflected in increased numbers of trips into Wellington City from more northern areas of the Hutt Valley

- A reduced level of public transport use.

Closure of side roads at priority or even signal controlled intersections on the highway (often for safety reasons) increased the efficiency of the highway but increased the demands on the local street network.

The section of the highway at the southern end of the Hutt Valley known as Petone, refer figure 2, through to Ngauranga generates some interesting issues. Currently this is a four lane (two lanes in each direction divided by a solid median barrier) which operates at 100 kph. At peak times the highway is congested.

This highway is sandwiched between the railway and steep mountainous country. Currently there exists a substandard cycleway between the railway and the highway which is used by a small number of cyclists. This cycleway provides enough room to enable one extra lane to be built for the highway but the needs of the cyclists would have to be addressed in some other way. The use of a moveable median barrier would enable this lane to be used more productively by allowing a reversible 3-2 lane configuration.

The use of this extra lane for road traffic could allow for significant efficiency improvements in this section of the highway which again increases the attractiveness of the Hutt Valley as a place to do business or live. However, in the morning peak if this extra lane is a general purpose lane there is a major risk that the highway south of Ngauranga will become overloaded.

Another way of using this lane is to allow only high occupancy vehicles to use it and/or those vehicles whose driver is prepared to pay a toll for a higher level of service and the ability to avoid the other two congested lanes. This kind of approach enables efficiency and accessibility improvements to occur and gives the ability to manage the volumes of traffic that reaches the highway south of Ngauranga. In addition, this approach generates a revenue stream that could be used to fund other projects in the corridor.

There are a number of ways that such a toll lane could be operated. These include:

- Setting the toll that maximises revenue

- Setting the toll to guarantee a minimum level of service

- Setting the toll to ensure that the volume of traffic delivered south of Ngauranga can be managed by the road network there

Analysis of these various options showed a revenue maximising toll ensured that traffic speeds on the HOT lane were sufficiently high to be perceived as almost free flowing and the volume to capacity ratio for the lane was about 0.6. This level of lane use coincidentally also ensured that the road network south of

Ngauranga was not over capacity. It is envisaged that such a tolling system would be electronically based.

Public transport Improvements

Currently a single ferry service operates between Eastbourne at the south eastern limit of the Hutt Valley and central Wellington. Other options with different origins and destinations were examined. These were not found to be promising as these origins and destinations are currently well served by rail and bus services. A refinement of the low level public transport strategy is to remove new ferry services.

Within the Hutt Valley there is currently a well established operation of bus services. There are only a small number of services that run from the Hutt Valley into Wellington. These services run from locations that are not well served by rail which provides the primary passenger transport connections between the Hutt Valley and Wellington.

The provision of a more comprehensive set of direct bus services between the Hutt Valley and Wellington complemented by reserving the extra lane between Petone and Ngauranga for buses has been examined. This proposal leads to a significant improvement in public transport accessibility and hence increased Hutt Valley trip activity. This operation increases overall public transport use but does lead to some abstraction of former train users. This indicates that some care is necessary in selecting which bus services would complement the rail operation if the overall public transport operation is to be optimised.

Improvements to the rail service such as increasing service frequency and speed and extending regular commuter services beyond the current terminal point of Upper Hutt Central showed good responses in terms of increased ridership. This leads to improved accessibility in the Hutt Valley and increased trip making reflecting enhanced Hutt Valley activity.

Two Light Rapid Transit (LRT) options were considered. These both required a high level of service to be effective. What proved to be interesting was that extending the Melling line into the Hutt Central Business District appears to be attractive in ridership and hence accessibility terms. Extensions further eastwards towards the eastern rail line become increasingly less attractive as the eastern rail line already provides an attractive passenger rail service. Optimisation of this option would lead to limiting the rail extension as far as the Hutt CBD.

East-West connection roads

Six east-west connection options were examined. The two most northern options have limited impact on generating new activity and simply provide a more efficient means of providing for a small or modest volume of traffic.

The southern most option provides a much more efficient means of travel for trips between the Hutt Valley and north Wellington or south Porirua. Consequently this option provides relief for both SH2 south of Petone and SH1 south of Porirua, particularly at peak times. This option improves accessibility in and out of Wellington and the Hutt Valley.

The remaining options provide a direct link between Hutt City and Porirua City and significantly reduces current travel distance between the two cities. These options have little impact on the southern sections of SH1 and SH2. The direct link between Porirua and Hutt City adds a major new dimension to accessibility for the Hutt Valley and is the source of a significant level of new trip making.

Planning balance sheet

A planning sheet is used to score these options. The planning balance sheet was a five point scale of = to ++ where = means performs very poorly against the objective, 0 is neutral performance and ++ is performs very well against the objective. The resulting scores are shown in table 5.

Composite packages – Second stage analysis

The examination of these options in isolation can provide useful information on how these options perform and how they might be optimised. These options can be refined, as discussed earlier in this paper, by removing poor performing elements and by including the optimal length, for example, of LRT extension. When refined options are combined then the elements within the package may either reinforce or oppose or have no impact on each other. In the linear Wellington network with parallel road and rail networks there is a high degree of interdependency between elements in a package.

Six composite packages were formed. They are:

S1 which is made up of H1 + H2 + P2 + P3 (refined)

S2 which is made up of H1 + P2 + P3 (refined)

S3 which is S2 + tidal flow between Petone and Ngauranga – bus lane between Petone and Ngauranga

S4 which is made up of H2 + P2 + rail services extended beyond Upper Hutt + X1

S5 which is made up of H2 + P2 + rail services extended beyond Upper Hutt + X2

S6 which is made up of H2 + P2 + rail services extended beyond Upper Hutt + Melling line extended to Hutt CBD + X1 (SH2 to SH1) + X2 (SH2 to Seaview)

These six composite strategies were analysed using the four stage strategic model in tandem with a more detailed road assignment model. This was important as it achieved several functions.

Firstly it provided a more reliable estimate of highway traffic flows between the Hutt Valley and Wellington city so that there was greater confidence in the ability of the highway proposals to cope with the demands placed on them.

These same highway flows supplemented by the passenger transport flows were also used to test the consistency of the Hutt corridor plan with the wider Regional Land Transport Strategy as required in Figure 3. For example, the provision of a general purpose tidal flow lane between Petone and Ngauranga delivers morning peak highway traffic volumes that are too large for the Wellington city road network south of Ngauranga to manage even with the proposals anticipated by the Regional Land Transport Strategy. This kind of analysis shows that proposals such as the general purpose tidal flow lane is inconsistent with the proposals of the Regional Land Transport Strategy and in particular violates the principle of network balance. There is a mismatch between upstream and downstream road network capacity and that such a proposal would significantly impact on the balance between road and passenger transport use.

The more detailed assignment model was important in examining the cross valley link roads internal to the local network linking the Seaview-Gracefield area to State Highway 2. There are two issues here. There is a need, in broad terms, to identify the optimum cross valley link road that might be considered as a representative of the local Hutt City component for each of the six east-west connection roads so that the merits of such proposals can be fairly represented in the analysis. Unlike many of the other road improvements considered in the corridor plan, the cross valley component travels through an urban area. To get a reasonable understanding of the effectiveness of such roads and their ability to attract traffic it is important that intersection delay is modelled well. Examination of table 6, which is the stage 2 planning balance sheet, includes a row “V/C ratios”. This identifies the performance of each composite package against the actual demand volume to capacity ratio for the key internal Hutt City road network junctions as well as the volume to capacity ratio for the Petone to Ngauranga section of the highway.

A number of the key indicators in the planning balance sheet such as the motor vehicle statistics and vehicle travel time require a reasonable estimate of delay

including junction delay if the evaluation of alternative composite packages is to be robust.

It was also found in the analysis of option S6 that the combination of the HOT lane from Petone to Ngauranga, the X1 option (SH2 to SH1) and X2 (SH2 to Seaview) placed a large demand on the highway (SH2) between Petone and where the X2 (SH2 to Seaview) intercepted the highway. To provide for this demand at peak times would require the highway to be widened to six lanes. Unfortunately there is physically insufficient room to provide for six lanes in this part of the highway.

The detailed assignment model was useful in providing a more reliable assessment of demands compared to capacity of this section of the highway and therefore the extent of which this was a major issue. It was found that the enhancement of an existing spur rail service to Melling, which runs parallel to the highway, by improving service frequency and extension into the Hutt Central business district did enough to ensure highway demand did not greatly exceed four lane capacity at peak times.

Package Performance

The performance of each of the composite packages during the morning peak period compared to the Do Minimum terms of percentage change is presented in table 6.

It can be seen that various composite packages could make significant reductions in travel time from the upper valley (Upper Hutt) to south of the Wellington central business district (Airport). This could significantly reduce the economic cost of congestion in the region.

The various composite packages to varying degrees could significantly enhance the level of travel in and out of the Hutt Valley at peak times without necessarily leading to big increases in motor vehicle trips. This analysis proved to be useful in examining the likely resulting distribution of trips between car driver, car passenger, rail and bus. It should be appreciated that in the Do Minimum base case the number of bus trips in and out of the Hutt Valley is small.

As in the stage 1 analysis, the composite packages were evaluated against the objectives of the Regional Land Transport Strategy using a Planning Balance Sheet. This is shown in table 7.

S1, S2, S4 and S6 emerged as promising packages from this analysis. The major disadvantage of options S4 and S6 is the capital cost. However, this could possibly be offset by a useful revenue stream provided by the HOT lane (table 7).

No weighting was proposed to suggest that one objective in the Planning Balance Sheet was more important than another. It was however, recognised that accessibility and economic development was an important issue to many of the stakeholders. Instead the intent behind the construction of the packages S1 to S6 was to ensure that they had as few negatives as possible.

As can be seen by the planning balance sheet all these options significantly enhance accessibility with generally both motor vehicle and public transport accessibility improved. This is a reflection of significant gains in people flows in and out of the Hutt Valley and is indicative of a number of road improvements (SH2 and east-west connections) and some public transport elements reinforcing one another. For example option S3 will deliver 17.5% more people than the base case at morning peak periods.

It is clear that those packages that attempt to enhance connections between SH1 and SH2 will have to the most significant cost and environmental impacts but the economic efficiency of these options is not prohibitive.

What Next?

It is intended that the robustness of these six packages will be tested by subjecting them to a series of sensitivity tests. The analysis so far has extrapolated current demographic and employment trends into the future but have been adjusted so that they are not inconsistent with national forecasts.

The sensitivity tests will treat the work to date as the base case. There will be two further “growth” scenarios. One of these will be at a greater rate of decline than anticipated and the second one will examine a positive growth rate. Essentially these two scenarios assume the current underlying patterns but provide a range of “growths” around the base case.

Three other scenarios will be used as sensitivity tests on the composite strategies. These reflect three possible economic outlooks as specified by the study team’s economist. They are:

- a focus on the Seaview industrial area – this assumes a significant increase in light industry, distribution and research activities in the Seaview area
- a focus on retail – this scenario assumes a significant increase in retail activities in the Hutt City central area and Petone
- a focus on IT, communications and media – this scenario capitalises on Hutt City being well positioned computer communications and extensive internet use.

The results of these analyses and the sensitivity testing outlined above will be reported to the political decision makers. It is expected that two or three of the composite strategies will be selected for the purposes of a formal public

consultation exercise. It is anticipated that this will lead to the selection of a preferred package for adoption.

Conclusions

Corridor plans provide a useful means of multi modal transport planning to achieve desired objectives. In particular conventional four stage strategic transport models linked to more detailed vehicle assignment models can be very helpful in determining which measures may assist in promoting enhanced accessibility and economic development potential in an area.

Decisions between options that compete for road space and sub modal public transport competition can be better informed by using these corridor plan techniques. Information concerning potential flow and impacts on the immediate network and downstream network can be provided using these methods.

Examination of the usefulness of high occupancy vehicle lanes, toll lanes, bus lanes and tidal flow lanes in the context of a composite package of measures can be undertaken. It has been found that packages of measures may have elements that either reinforce or oppose other elements in the package.

The methodology used to undertake this work proved to be helpful with few problems. However, it is conceded that this approach does involve a significant volume of work.

APPENDIX A

Table 1 **Usually resident population (source: Census)**

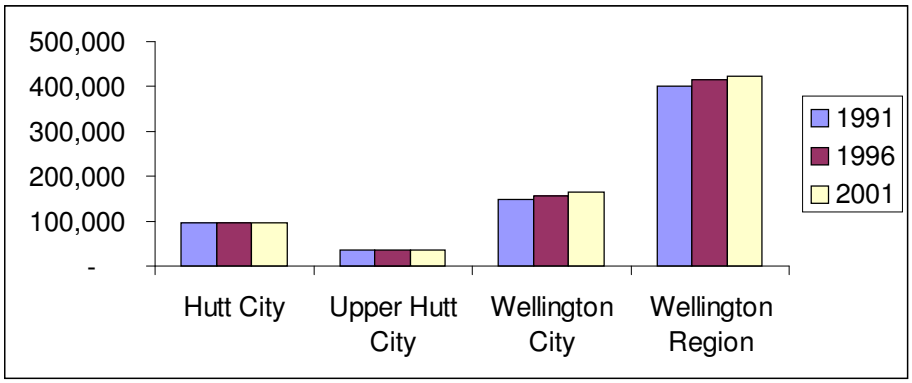


Table 2 **Full time equivalent labour force (source: Census)**

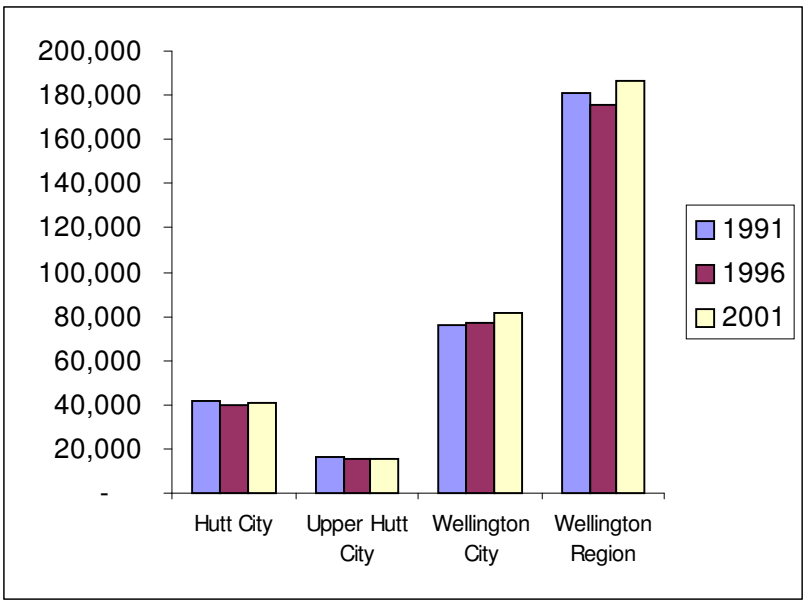


Table 3 Performance Indicators

1	**Accessibility**
	Motor vehicle statistics (trips, vehicle hours, average network speed, vehicle travel distance …) Public transport statistics (trips, passenger hours, passenger distance …) Vehicle time to Wellington
2	Safety (accident cost)
3	Affordability (total cost)
4	Economic Efficiency (benefit cost ratio)
5	Sustainability Environment (tonnes CO_2, CO, impacts on community) Fuel (litres of fuel consumed)

Table 4 Options (source: From Hutt Corridor Plan presentation renumbered X1 to X6)

H1	Advanced Traffic Management System Petone-Ngauranga Closure of minor roads at intersections
	Melling intersection grade separated
H2	Tidal flow toll lane Petone to Ngauranga Melling intersection grade separated
H3	Tidal flow general purpose lane Petone-Ngauranga Grade separation of several SH2 junctions
P1	Bus/HOV lane Petone-Ngauranga New bus and ferry services
P2	Increased rail frequency and speed supported by enhanced bus feeder services and improved park and ride
P3	Melling loop LRT to Waterloo Stokes Valley LRT Extension of rail services beyond Upper Hutt CBD
X1 to X6	Link options as shown in figure 4

Table 5 Stage 1 Analysis Planning Balance Sheet

Indicators	Options											
	H1	**H2**	**H3**	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**P1**	**P2**	**P3**
1 Accessibility												
Motor vehicle statistics	0	+	+	+	+	+	+	0	0	0	+	0
Public transport statistics	0	0	0	0	0	0	0	0	0	0	+	0
Vehicle times to Wellington	-	+	++	+	0	0	0	0	0	0	0	0
2 Safety	0	-	+	-	-	-	-	-	-	0	0	0
3 Affordability	+	++	=	+	=	=	=	-	0	++	++	++
4 Economic efficiency	=	-	-	+	0	-	-	0	0	0	++	-
5 Sustainability												
Environment	0	0	-	-	=	=	=	-	-	0	0	0
Fuel	0	0	=	0	0	0	0	0	0	0	0	0
V/C ratio	0	+	++	+	+	+	+	0	0	0	0	0

Table 6 Stage 2 Analysis – AM Peak Package Performance Compared with the Do Minimum: Percentage Charge

	S1	**S2**	**S3**	**S4**	**S5**	**S6**
Motor vehicle travel time	-2.8	-2.7	-1.5	-2.5	-2.8	-2.9
Time Upper Hutt to Airport	-14.9	-5.6	-18.9	-12.7	-13.8	-11.7
Total vehicle trips	-0.4	-0.9	-0.1	0.0	0.2	-0.1
Total passenger transport trips	2.7	4.3	0.8	2.0	1.4	2.4
Cost of congestion	-11.1	-7.7	-8.5	-12.2	-13.5	-13.2
SH2 vehicles Pet-Nga	13.0	-1.8	29.5	0.0	9.4	0.2
(HOT lane vehicles)	18.6			8.0	16.0	8.3
Veh passengers Pet-Nga	-9.5	-2.6	22.0	3.3	11.3	3.4
Bus passengers Pet-Nga	921	1300	170	285	410	304
Train passengers Pet-Nga	-7.8	-3.7	-5.1	-8.8	-11.4	-5.9
Total people Pet-Nga	12.8	7.9	17.5	5.4	11.3	6.7
Petone-Grenada/Pet-Nga(%)				32.8		33.0
Melling-Porirua/Pet-Nga (%)					35.0	

Table 7 Planning Balance Sheet Scores for Stage 2 Options

Indicators	Options						
	Base	S1	S2	S3	S4	S5	S6
1. Accessibility							
Motor vehicle statistics	0	+	+	+	+	+	+
Public transport statistics	0	++	++	0	++	+	++
Vehicle travel times from Upper Hutt to Airport	0	++	+	++	++	++	++
Vehicle travel times from Hutt to Porirua	0	++	0	+	++	++	++
2. Affordability							
5 year cost	0	+	++	+	-	--	--
3. Economic Efficiency							
Benefit Cost Ratio (BCR)	0	+	+	0	0	0	0
4. Sustainability							
Environment	0	+	+	0	0	-	0
Fuel	0	0	+	-	0	0	0
Safety	0	0	+	0	0	-	0
V/C ratios	0	+	0	+	+	+	+

++ excellent 0 neutral == very poor

Promising options S1 S2 S4 S5

APPENDIX B

Figure 1 **A map of Wellington region showing main highways, railways and cities/districts**

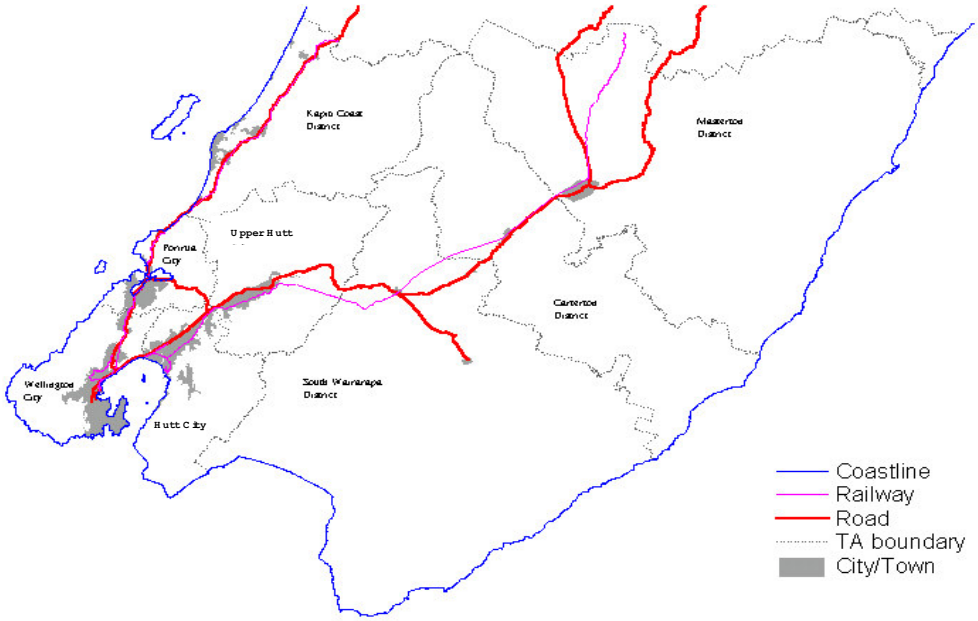


Figure 2 **A map of Hutt Valley (Upper Hutt to Ngauranga) showing main highways, main roads, railways, and cities and districts**

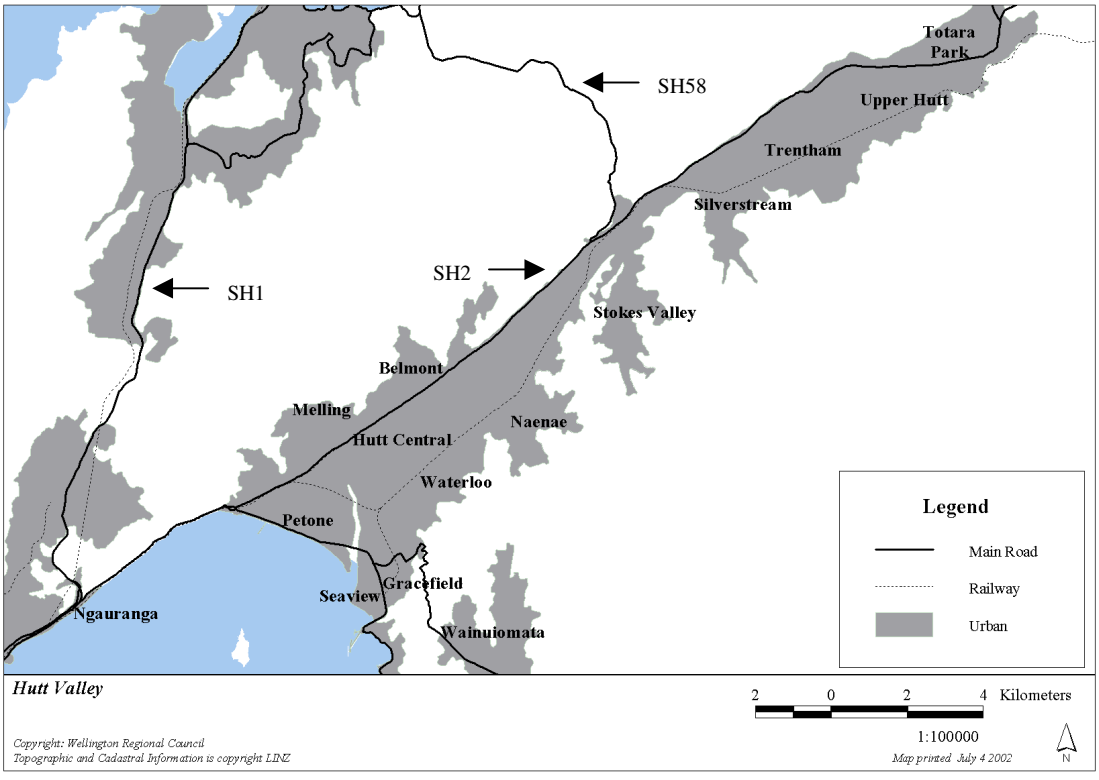
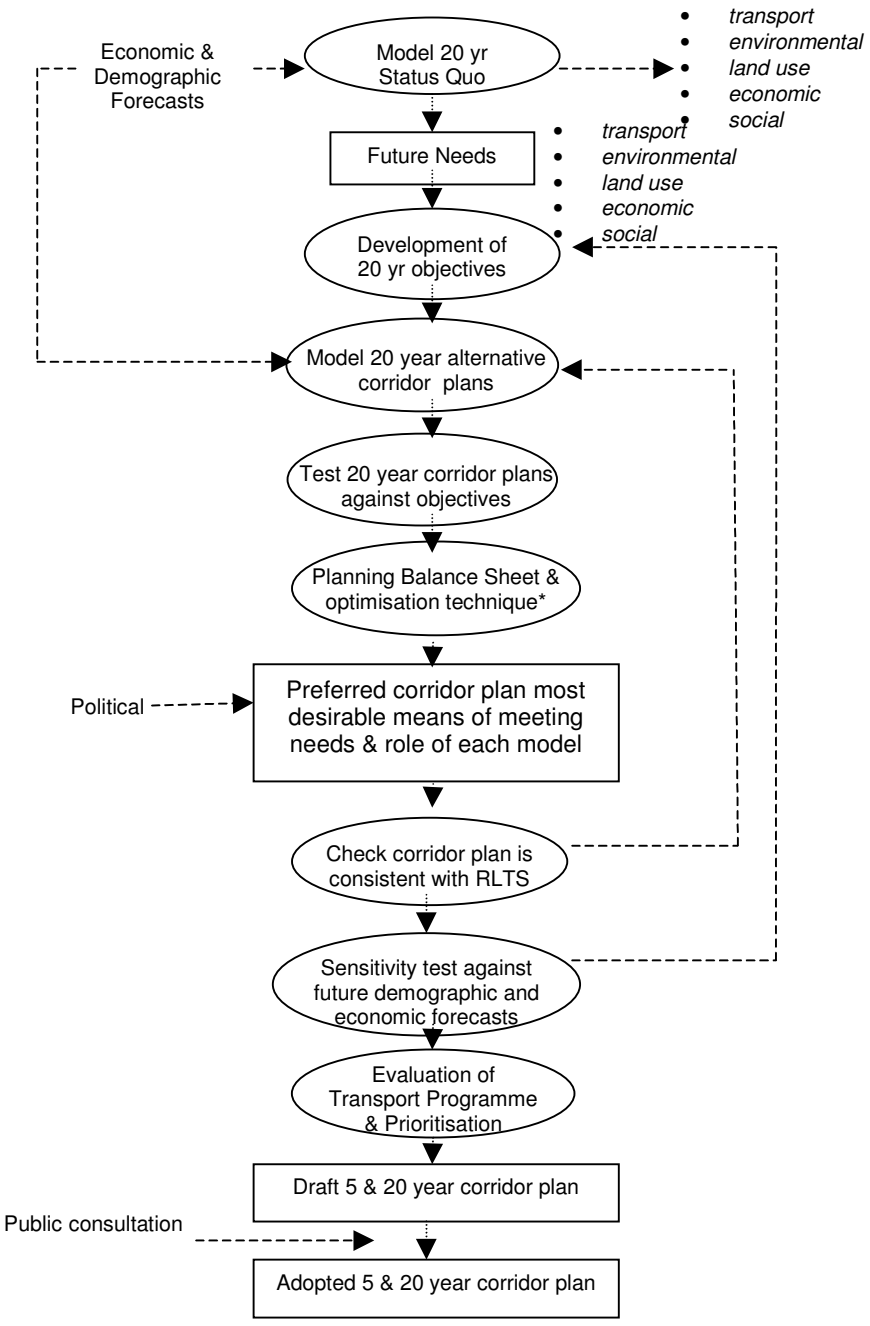
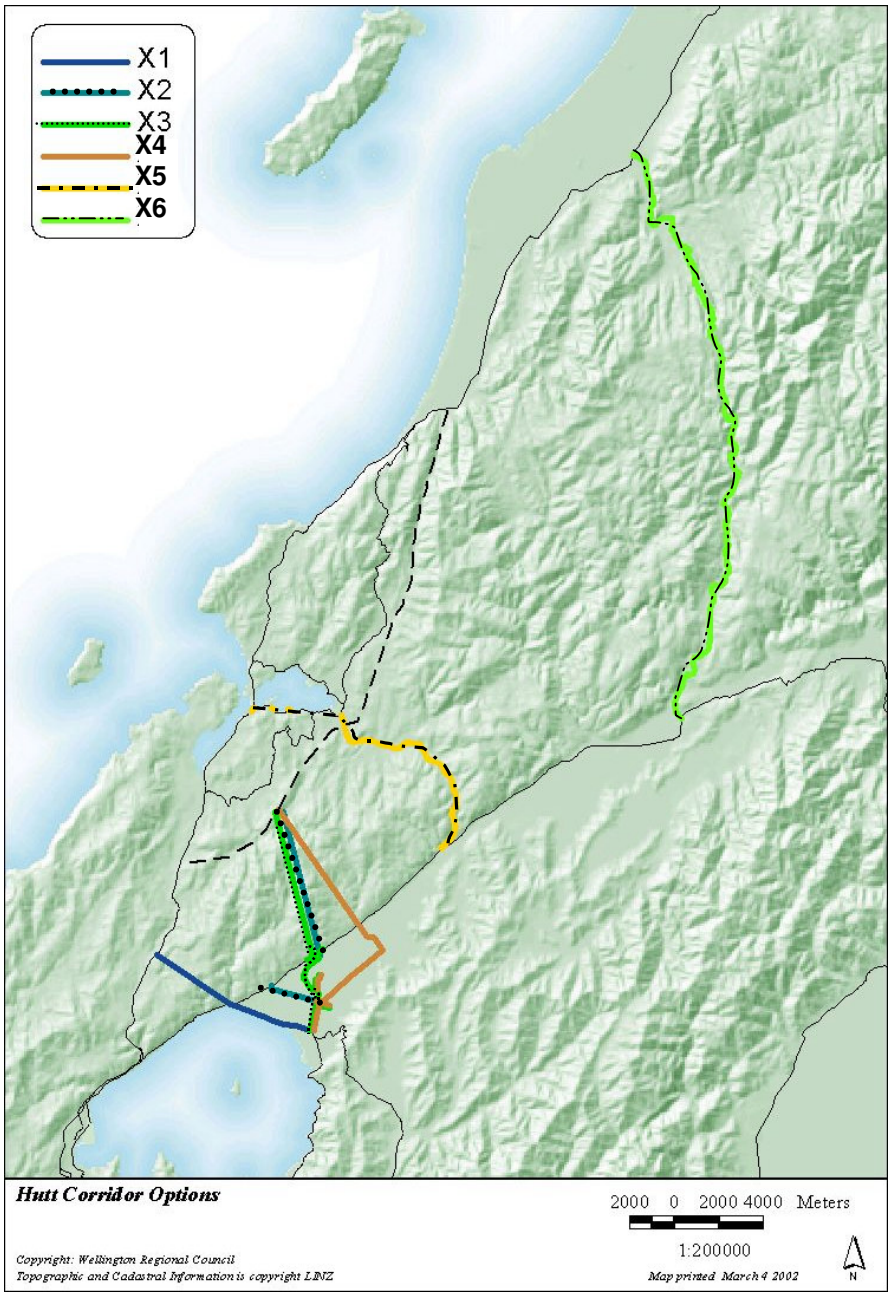


Figure 3 Corridor plan process



* refer Ashley, Brennand and Houghton (1999)

Figure 4 **Hutt Corridor Options – Links across the valley floor and between the Hutt Valley and SH1**



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