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Wellington Regional Council
Hutt Valley - Porirua Road Link Study
Feasibility Investigation Report

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Wellington Regional Council
Hutt Valley - Porirua Road Link Study
Feasibility Investigation Report

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HUTT VALLEY - PORIRUA ROAD LINK STUDY

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* Not included. Refer to Working paper for Steering committe Consideration - October 1996

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Status: Final

Date: 21 April 1997

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EXECUTIVE SUMMARY

The Hutt Valley to Porirua Link Study has been undertaken to investigate the feasibility of a more direct road link between the Hutt Valley and eastern Porirua, to supplement the two circuitous routes presently available using State Highway 1, State Highway 2 and State Highway 58.

The report is in two main parts, describing essentially the second and third phases of the study. Phase 1 identified several concepts routes, Phase 2 assessed these routes on a subjective basis, and Phase 3 developed the preferred options in more detail, to the level of Preliminary Feasibility.

The location of the routes investigated are shown in the figure following. It has been found that the most feasible routes commence at the Hutt Valley end at the intersection of State Highway 2 and the Kennedy Good Bridge, being specifically route D to the ridge line of the Belmont Hills.

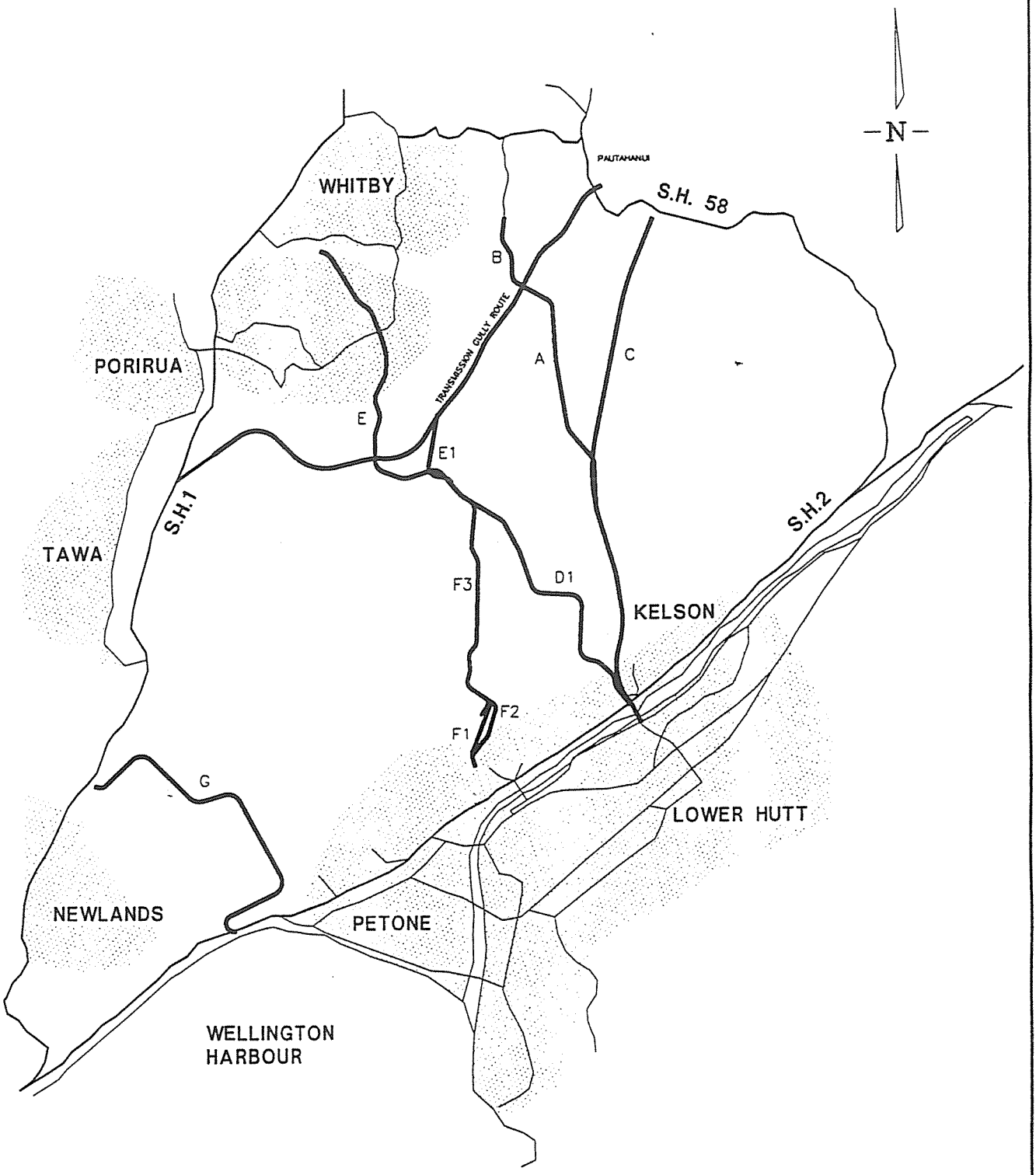
At the Porirua end, several alternatives are available, and their relative economic effectiveness depends also on whether or not the Transmission Gulley project is constructed ahead of the Link. North/west of the ridge line, routes E2-TG(S), E, E1-TG(N)-B have been found to be feasible.

Environmental issues are discussed, relevant documents referred to and the main issues requiring further consideration at a subsequent level of study are defined.

Project costs are sensitive to earthworks quantities and the scope of the work included in the scheme. For the scheme options investigated the construction costs ranged from $58 million to $79 million. These estimates , depend not only on the options but on the precision of the unit rates chosen and quantities.

Two components of project benefits have been considered, namely travel time savings and vehicle operating costs. The Wellington Regional Council's TRACKS model has been used to project vehicle volumes. Accident savings are likely to be a positive benefit of lesser economic value and have not been included at the present level of investigation. Intangible benefits/disbenefits have also not been included. The economic benefits have been calculated to range between $61 million and $358 million depending on assumptions about traffic growth and precision of calculated traffic volumes.

The report discusses several approaches to calculating the traffic benefits, and the lower bound benefit-cost ratios are recommended as a cautious approach which recognises the coarseness of the calculations. The ratios are given in the following table.



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Title: POSSIBLE ROUTES WITH TRANSMISSION GULLY		
Location: HUTT VALLEY – PORIRUA ROAD LINK STUDY		Job No.: 5C8709.00
Client: WELLINGTON REGIONAL COUNCIL		Figure:

Option (See figure above)	B/C
Without Transmission Gully	
1: Route D1 & E (SH2 Belmont to Warspite Ave only)	2.8
2: Route D1 & E (SH2 Belmont to Warspite and Whitford Brown Ave	2.6
3: Route D1 & E (SH2 Belmont to Whitford Brown Ave only, ie, no connection to Warspite Avenue)	2.2
4: Route D1, E1, TG(N) &B (SH2 Belmont to James Cook Drive)	1.3
5: Route D1, E2, & TG(S) (SH2 Belmont to Kenepuru Drive)	3.7
6: Route D5 & E (SH2 Belmont to Warspite Ave only)	2.3
With Transmission Gully	
7: Route D1 (SH2 Belmont to join TG route with Link to Warspite/Whitford Brown already in place)	4.3
8: Route D5 (SH2 Belmont to join TG route with Link to Warspite/Whitford Brown already in place)	4.0

Several of the options examined merit further study to improve the assessment of engineering details and environmental effects, and to refine the precision of economic considerations.

Overall, without Transmission Gully in place Option 5 is recommended from the transportation benefit point of view.

With Transmission Gully in place prior to the Hutt Valley-Porirua Link, Option 7 is recommended from the transportation benefit point of view.

In terms of a road corridor between the Hutt Valley and Porirua, a route which follows D1, E2 and TG(S) through to Kenepuru Drive is recommended for further study.

1 INTRODUCTION

1.1 Purpose of the Study

Road links between the Hutt Valley and the Tawa-Porirua Basins are at present restricted to two, ie State Highways 1/2 (via Ngauranga Gorge and the Hutt Road) and 58 (via Judgeford/Pauatahanui). Both of these routes are off set from the geographic centres of the urban areas and utilise State Highway 2 to connect to the local road network at the Hutt Valley end.

This study has been commissioned to investigate the feasibility of an intermediate link, and define a corridor which is technically feasible, meets the travel demand efficiently and relieves congestion on the present roading network, in particular State Highways 1 and 2.

1.2 Objectives of this Report

The study has been undertaken in three phases.

- **Phase 1** identified a number of concept routes as being worthy of further investigation.
- **Phase 2** involved a broad brush assessment of these routes.
- **Phase 3** developed the preferred option in more detail.

At the completion of Phase 2 a working paper giving the results and recommendations of the initial appraisal of the options was prepared for the Steering Committee's consideration. The contents of this paper have been absorbed into the current report with editorial changes made to suit the new format. Only the key appendices have been brought forward and included in the final report.

This report presents the outcomes of the above phases and includes:

- the background relevant to the traffic analysis, engineering and environmental/planning aspects investigated,
- a comparative evaluation of the options, and
- a recommendation as to which scheme should be investigated in more detail.

The report is in two parts. Part A covers Phases 1 and 2 while Part B gives the results of Phase 3.

1.3 General Approach to the Study

The general approach adopted for the study has proceeded essentially as given in our

Proposal. Comment will be made where necessary in the following sections on specific features and issues.

1.4 Study Area

The study area is principally bounded by State Highway 1 (on the west), SH 58 (on the north), SH 2 (on the east) and the northern boundary of Paparangi Newlands. Refer to Figure 1. Some traffic effects occur outside the above boundaries and have been noted where significant.

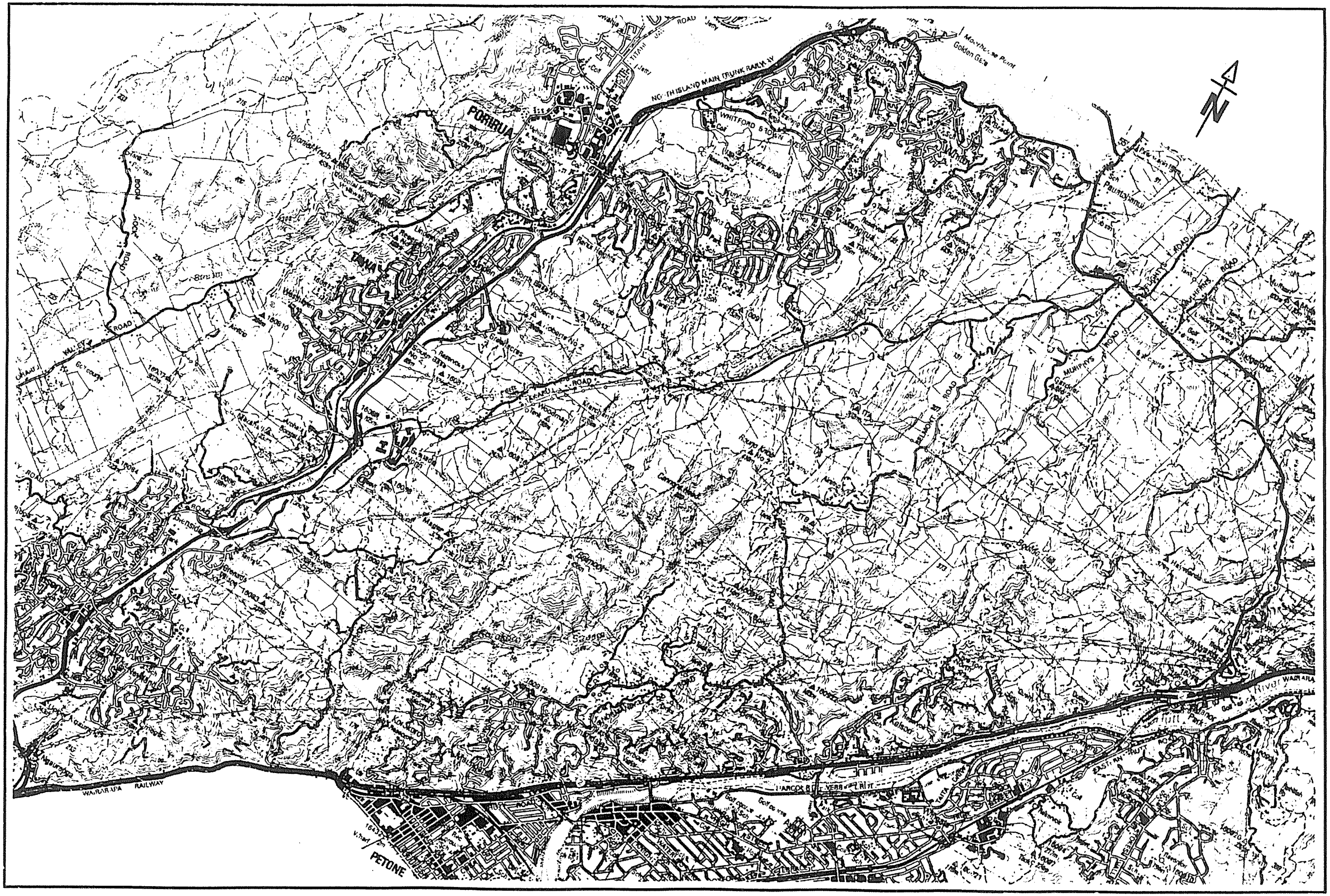


Figure 1 Study Area and General Location

PART A : PRELIMINARY APPRAISAL OF OPTIONS

1 BACKGROUND

1.1 General

Both a possible road link between SH 58 and SH 2 via (Belmont - Kennedy Good Bridge) and the Transmission Gully alternative to State Highway 1 were studied as part of the Regional Council's GATS work in 1989 - 90. The latter was refined by further work undertaken for Transit NZ and Porirua City Council in subsequent years.

A possible road link between Petone and Grenada was also studied as part of the GATS work undertaken for the Regional Council in 1989, and again in a report for Transit NZ in 1995.

The alignment of the above routes have been adopted without change for this study. However, the impacts identified as occurring with these routes have not been included.

1.2 Topography

The nature of the topography plays an important part in determining realistic road link corridors within the study area. The key features of the area are:

- The escarpment of the Wellington Fault (alignment direction 55°).
- The ridgeline of the Belmont Hills. The direction of this is erratic but there are two general segments meeting at Round Knob. The direction of the trend of the southern segment is approximately 45° and at the northern segment 70 °. This ridge separates the two major stream catchments which discharge into different sections of the coastline.
- Duck Creek (alignment direction 35°).
- Porirua East ridge, ie, that which lies immediately east of the urban areas of Waitangarua and Cannons Creek (alignment direction 35°).

The overall elevation of the top of the Belmont Hills was originally generally uniform. However, the differential erosion of the materials which make up the land have produced a highly dissected and variable landscape. There are a number of saddles between the two major stream catchments which are lower and thus form potential route options.

The general trend of the drainage pattern and secondary ridges is noticeably north-south (alignment direction 0°) but there are numerous exceptions.

The steep and relatively high scarp of the Wellington fault line, which is parallel and

adjacent to SH2, has only a limited number of "breaks" in it. These breaks were formed by streams. The most favourable have now been developed as roading access points from SH2 to the residential developments on the hillsides above because of the relatively easier grades they provide. Two of these access points coincide with Hutt river crossing locations. The development of any new sites for access from State Highway 2 to the Belmont Hills would involve considerable reshaping of the steep and high scarp.

The slopes of the hill sides in the stream valleys vary but are predominantly steep.

In general terms, any connection between the Hutt City and Porirua City principal urban areas will inevitably have to cross the natural "grain" of the country which will result in significant earthworks particularly if a reasonable standard of highway is to be attained. The cost of construction is therefore expected to be a very significant engineering factor in determining the feasibility of the route.

1.3 Corridors and Routes

The principal access points to the Hutt Valley western hill suburbs from State Highway 2 are given in Table 1.

After examining the topography and destinations, and utilising the above access points, a number of potential (concept) routes were identified. These routes included combinations of new routes and options examined in the earlier investigations such as constructing sections of Transmission Gully highway and its connection to James Cook Drive.

Throughout this report, the term "route" is used to describe a component of a corridor, but may be common to more than one corridor.

For the traffic analysis, the range of networks examined included options with and without the full Transmission Gully in place. These were considered to evaluate whether a link between Hutt Valley and Porirua integrated well with the proposed inland alternative to SH 1. The principal corridors examined were:

(a) SH 2, Belmont (Kennedy Good Bridge) to :

- SH 58 (Belmont Rd) via Speedys Stream Valley
- SH 58 (Golf Course) via Speedys Stream Valley and unnamed stream valley on the north side of the dividing ridge
- Whitby (James Cook Drive)
- Porirua East (Whitford Brown Ave)

TABLE 1 : SH2 TO WESTERN SUBURBS - EXISTING CONNECTIONS

Location	Width	Alignment	Grade	Intersection with SH2	Access to City Centre	Comments
Horokiwi Road	Narrow	Winding	Steep in places	Uncontrolled T	via SH2	Alternative route to north linking into Petone I/c may be possible
Cornish Street	Adequate	Straight	Flat	Uncontrolled T	via SH2	Route via Korokoro Valley Not recommended
Korokoro Road	Narrow	Winding	Steep in places	Signalised staggered T (Grade Separation proposed)	via SH2 or Direct (Korokoro Cres)	Not recommended
London Road	Narrow	Winding	Steep in places	Signalised staggered T (Grade Separation proposed)	via SH2 or Direct (Korokoro Cres)	Not recommended
Dowse Drive	Adequate	Winding	Steep in places	Signalised T	via SH2	
Normandale Road (Normandale Road)	Narrow	Winding	Steep in places	Nil	Direct	
Normandale Road (Miro Miro Road)	Narrow	Winding	Steep in places	Nil	Direct	Not recommended
Harbour View Road (Melling)	Narrow	Winding	Steep in places	Signalised (Grade Separation proposed)	via Melling Bridge Intersection	
Tirohanga Road (Melling)	Narrow	Winding	Steep in places	Signalised (Grade Separation proposed)	via Melling Bridge Intersection	Not recommended
Pomare Road	Narrow	Winding	Steep in places	Uncontrolled T	via SH2	Not recommended
Wairere Road	Narrow	Winding	Steep in places	Uncontrolled T	via SH2	Not recommended
Grounsell Crescent (Park Road)	Narrow	Winding	Steep in places	Uncontrolled T	via SH2	Not recommended
Grounsell Crescent (Hill Road)	Narrow	Winding	Steep in places	Signalised T	via SH2	Not recommended
Major Drive (Belmont)	Adequate	Winding	Steep in places	Signalised staggered T	via Kennedy Good Bridge	Not recommended (See alternative route A, C & D)
Hebden (Liverton)	Narrow	Winding	Steep in places	Uncontrolled T	via SH2	Not recommended

(b) SH 2, Melling to :

- Porirua East (Whitford Brown Ave)
- Whitby (James Cook Drive) via Transmission Gully Highway

(c) SH 2 (Horokiwi Rd) to:

- Grenada
- Whitfield Brown Ave via Horokiwi Rd (Magee ridge) and Takapu Rd substation.

Each of the routes was appraised in subjective terms as to it's practicality in terms of its connection to the urban areas, route alignment, satisfying the traffic demand and construction.

The routes considered to be not practical were:

- SH 2 (Horokiwi Rd) to Whitfield Brown Ave via Horokiwi Rd (Magee ridge) and Takapu Rd substation.

  The length of this route, if it follows the ridge top, is approximately 14 km which is longer than any of the other routes considered. The route would be exposed both in visual and meteorological terms.

- SH 2 (Korokoro) to Round Knob Saddle/Airstrip via Korokoro Stream Valley.

  The Korokoro valley is steep sided and bush clad with high visual and ecological values. The valley is a popular public recreational area.

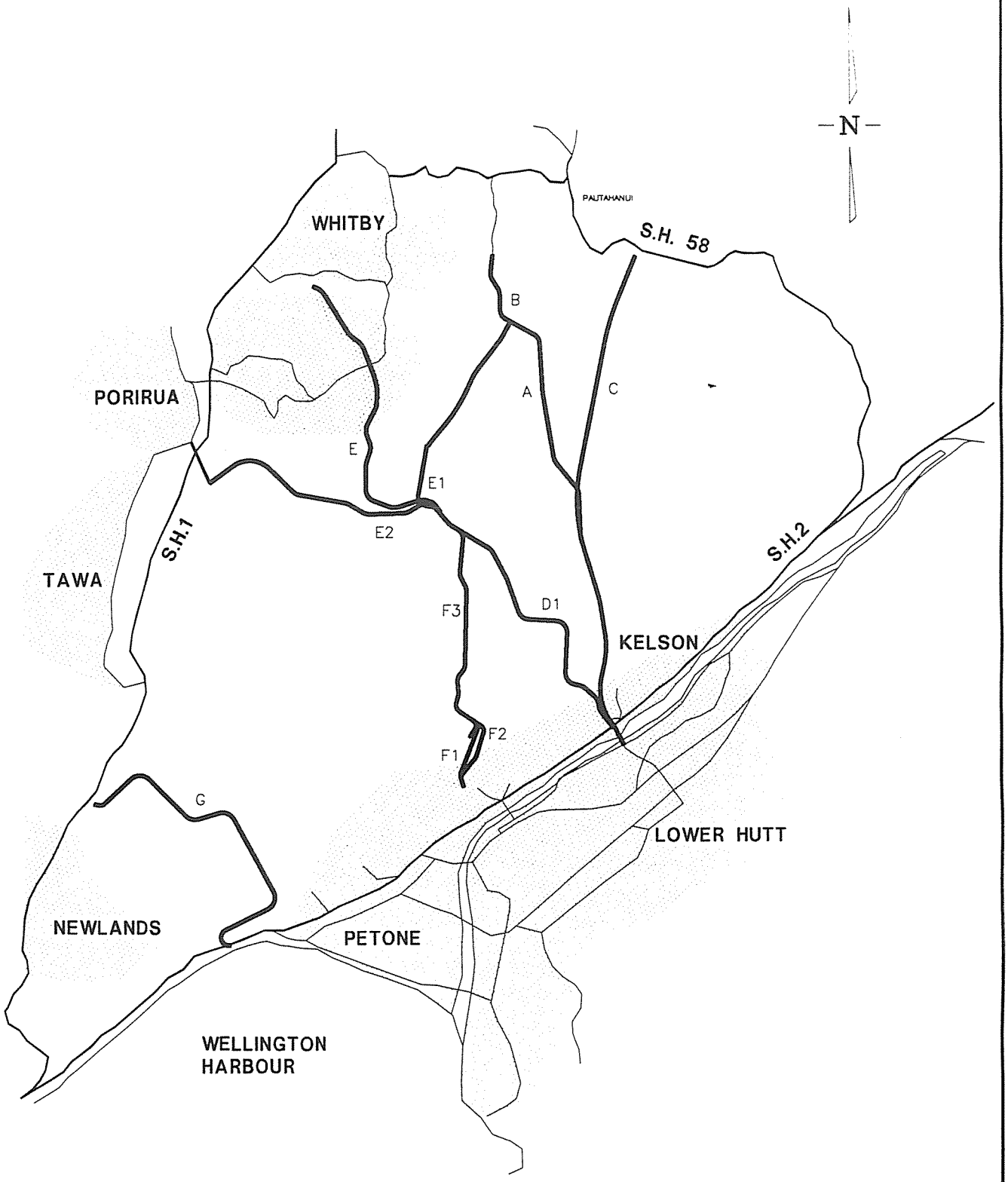
- SH 2 (Kennedy Good Bridge) to SH 58 (Golf Course) via Speedys Stream Valley and unnamed stream valley on the north side of the dividing ridge.

  The connection to SH 58 is 1 km approximately east of the other schemes considered, and further away from the area it will service. Also the route passes through the grounds of the Judgeford golf course.

1.4 Description of Routes Examined in the Initial Appraisal

The routes examined in the initial appraisal were subdivided into sections for the purposes of road design and defining alternative combinations. These sections are given below and shown on Figures 2 and 3, and in more detail in the figure which accompanies the table in Appendix A2.

The principal features are summarised in Table 2.



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Title	POSSIBLE ROUTES WITHOUT TRANSMISSION GULLY	
Location	HUTT VALLEY – PORIRUA ROAD LINK STUDY	Job No. 5C8709.00
Client	WELLINGTON REGIONAL COUNCIL	Figure 2

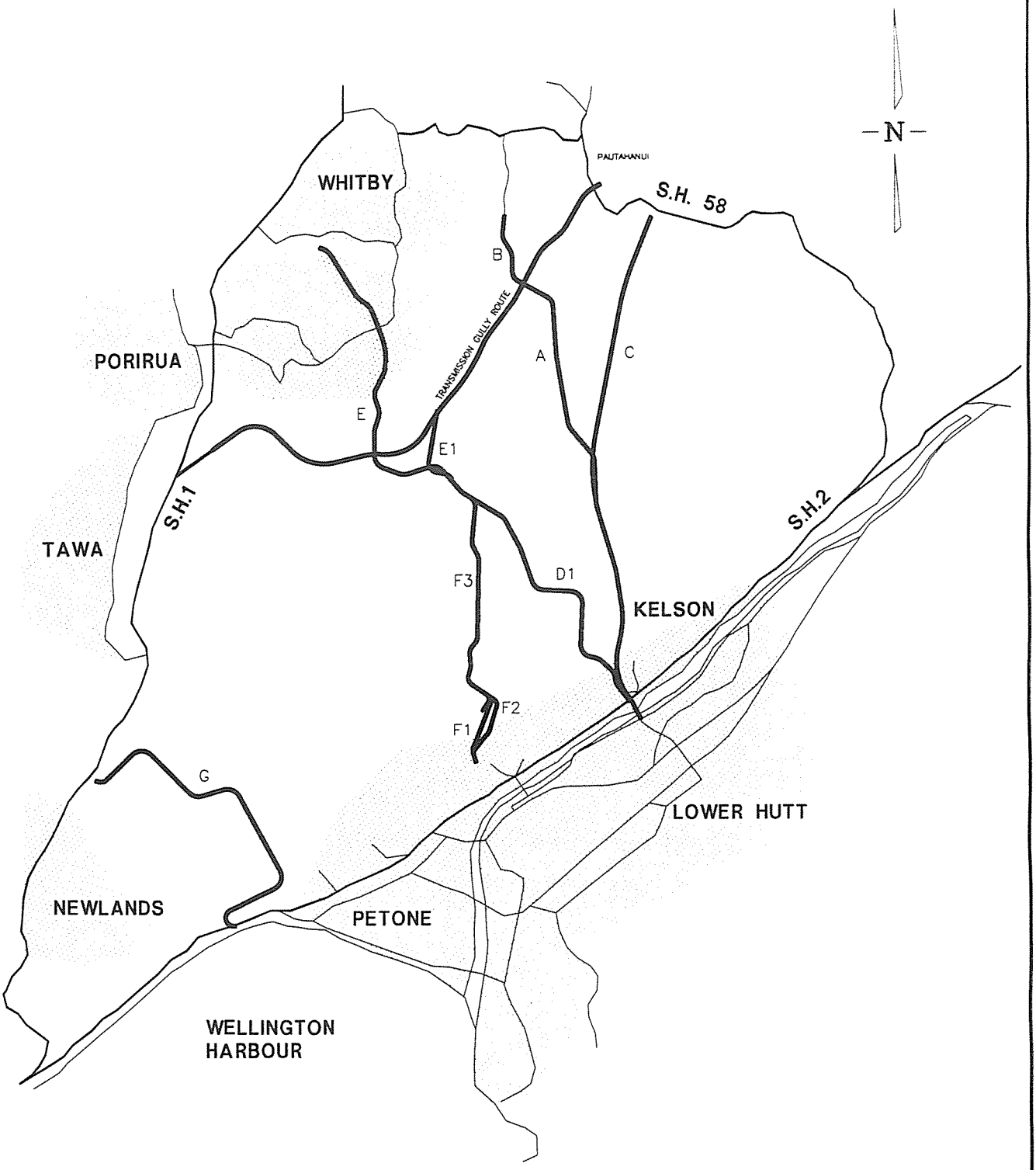

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Figure	3

TABLE 2 : HUTT VALLEY - PORIRUA ROAD LINK STUDY
ROUTE SECTION FEATURES/CHARACTER

Route No	Description	Length	Altitude at Hutt Valley End(1)	Altitude at Key Point(1)	Altitude at Key Point (2)	Altitude at Key Point (3)	Altitude at Porirua End	Grade/ Length (1) (Refer Note 2)	Grade/ Length (2) (Refer Note 2)	Grade/ Length (3) (Refer Note 2)	Grade/ Length (4) (Refer Note 2)	General Location in Topography (Refer Note 3)	Alignment (curvature)	Predominant Type of Construction Earthworks (Refer Note 3)	Comment
A	SH2 Belmont (KGB) to Transmission Gully	7.7 km	30	220	90		105	8.0 % 1.0 km	8.0 % 0.5 km	5.3 % 1.3 km		Valley/ Ridge	70 km/h	Block cuts/fills	
B	Transmission Gully to James Cook Drive	1.2 km	105	110			40	7.5 % 0.6 km				Ridge	70 km/h		
C	SH2 Belmont (KGB) to SH58	8.4 km	30	225	300		20	8.0 % 1.0 km	8.0 %	8.0 % 1.1 km		Valley/ Ridge	100 km/h		
D	SH2 Belmont (KGB) to Airstrip Junction	6.5 km	20	335			290	7.0 % 3.4 km	8.2 % 0.4 km			Valley/ Ridge	70 km/h	Sidling cut	
E	Airstrip Junction to Warspite Ave	4.0 km	290				80	8.2 % 1.6 km	5.5 % 1.4 km			Valley/ Ridge	70 km/h	Sidling cut	
Ea.	Airstrip Junction to TG North	1.4 km	290				145	10 % 1.2 km				Valley	70 km/h	Sidling cut and block fill	
E2	Airstrip Junction to TG South (Takapu Rd)	3.0 km	290				130	8.2 % 1.4 km				Valley/ Ridge	70 km/h	Sidling and block cut/fill	
F1	SH2 (Melling) to Normandale Rd - alternative alignments	1.4 km	20	160				12 % 1.1 km				Ridge	70 km/h	Sidling and block cut	
F2		1.3 km	20	160				11.2 % 1.1 km							
F3	Normandale Rd to Airstrip Junction	4.5 km	160	335			290	8.2 % 0.4 km				Ridge	70 km/h	Sidling cut	
G	SH2 (Horokiwi Rd) to Grenada/(Tawa I/c)	6.6 km (Gren)	2	265			115	10 % 0.6 km	6.0 % 1.0 km	8.0 % 1.2 km	5.0-6.6 % 1.5 km	Ridge	70 km/h R_{min} 120m	Sidling cut and block cut/fill	Reduction to 8 % grades will increase cut batter heights by up to 10m

Notes: 1 All distances, levels (altitude), and grades are approximate.
2 Grades/lengths given are only those which exceed 5%
3 The evaluation given is subjective
4 Altitude is given in MSL terms
5 Key points are significant crests and sags in the proposed highway profile

Section A *SH 2 (Kennedy Good Bridge) to Transmission Gully Highway*
via a new route along the western tributary of Speedy's Stream and "Belmont Road Saddle".

Section B *Transmission Gully to James Cook Drive.*

Section C *SH 2 (Kennedy Good Bridge) to SH 58* (connecting between Murphys/Belmont Rds)
via a new route along the western tributary to Speedy's Stream, and then "Belmont Road Saddle".

Section D *SH 2 (Kennedy Good Bridge) to Round Knob Saddle/Airstrip*
via new route roughly parallel to Hill Road and on the northern side of the stream.

Section E *Round Knob Saddle/Airstrip to Whitford Brown Avenue or Mungavin Avenue*
via Waihora Park.

Section F *SH 2 (Melling) to Round Knob Saddle/Airstrip*
via Harbour View Rd, Normandale Rd, and then on the eastern side of the Korokoro Stream Valley to Round Knob Saddle/Airstrip.

Section E1 *Round Knob Saddle/Airstrip connecting to Transmission Gully (TG (N)) Highway* in a northerly direction.

Section E2 *Round Knob Saddle/Airstrip connecting to Transmission Gully* (TGS)in a southerly direction (joins near Takapu Rd substation).

Section TG(N) *End of Ea. to where B crosses the Transmission Gully Highway.*

Section TG(S) *End of E2 to SH1 and Kenepuru Drive*

Additional variations to the above routes exist, which may be feasible - they are mainly related to the possible connections on the Hutt Valley side. For example, Route F, which links into the Melling Interchange, could possibly swing south and link into the Normandale Bridge or into Dowse Drive and the proposed interchange linking across to Hutt City. These variations were not included in Phase 2 but would have been examined if the overall appraisal had concluded that the main Route F corridor was one of the favoured options.

Intersections with State Highway 2 were assumed for the initial traffic modelling purposes to be two-directional and grade separated. A closer examination of these intersections was left to Phase 3.

2 TRAFFIC

2.1 Introduction

The alternative route options for the Hutt Valley - Porirua Link road cover a wide geographic area and vary in terms of both the length of connection and geometric characteristics. As a result, it is reasonable to assume that the alternative alignments will vary in terms of traffic attraction and the redistribution of traffic from existing routes.

An initial assessment was undertaken in order to quantify the traffic effects of each alignment option. The objective was to generate results which were sufficiently robust to allow the alternatives to be compared and hence ranked in terms of traffic impact. More refined work to assess the selected options in more detail is reported in part B.

2.2 WRC Traffic Model

The basis for the traffic assessments was the Greater Wellington Area Land Use and Transport Strategic Review (GATS) traffic model, maintained by Wellington Regional Council (WRC). This is a gravity-based model, using the TRACKS suite of traffic modelling software.

In the GATS model, the Wellington area is covered by a system of 130 zones.

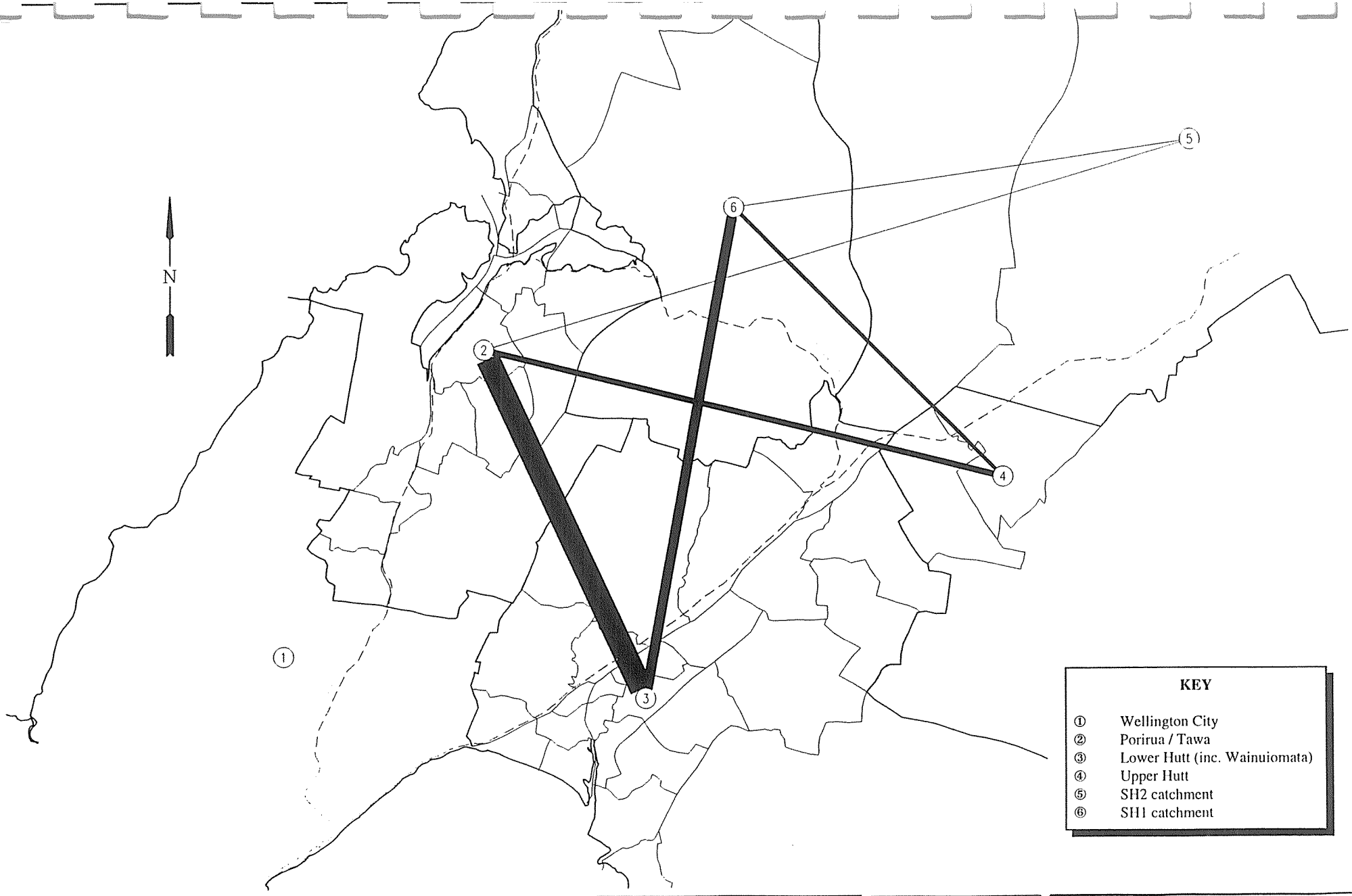
For the initial assessments, only data for 1991 was available, and hence this formed the basis of the analysis. Though actual volumes will have changed in the period since 1991, it is considered unlikely that differential growth in the Wellington area would have been sufficient to affect any conclusions reached relating to the *relative* performance of the route options.

2.3 Desire Lines Analysis

The objective of the 'Desire Lines' analysis was to obtain an indication of the demand for travel between the principal origins and destinations.

The large number of zones in the model was rationalised to a system of 47 sectors. This rationalisation was greatest in the areas more remote from the study area, for example the central city and eastern suburbs, where trip characteristics could be considered to be similar. All trip movements except those which potentially travel between the Hutt Valley and Porirua areas were then deleted from the matrix, as these are of no relevance to the analysis.

Trip matrices for AM, PM and Inter-Peak periods were added to produce an 11-hour "all day" weekday matrix. The all-day matrix was then used to generate a desire line diagram as shown in Figure 4 where the "crow lines" are diagrammatic representations in which the line thickness is proportional to the volume of travel.



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DESIRE LINE ANALYSIS FIGURE 4

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Whilst the trip volumes implied by the diagram are of limited use, the diagram produced clearly shows the relative importance of trips between the various origins and destinations on each side of the dividing hills, which were aggregated to a system of 6 sectors;

Sector Number	Area
1	Wellington City
2	Porirua / Tawa
3	Lower Hutt (including Wainuiomata)
4	Upper Hutt
5	State Highway 2 catchment (ie. Waiarapa and beyond)
6	State Highway 1 catchment (ie. Kapiti Coast and beyond)

There are zero trips between Wellington City and the other sectors which cross the hills, as these trips would use either the State Highway 1 or State Highway 2 corridor.

Figure 4 shows a strong line of travel demand between the Porirua/Tawa area and Lower Hutt, representing over half of the travel between the two sides of the hill. At present, most of this movement is serviced by State Highways 1 and 2 as this offers the most convenient route. Travel by State Highway 58 would, for most trips, necessitate a detour to the north. The next largest movement (just under a quarter of the total) is between the northern catchment of State Highway 1 and Lower Hutt. For these trips, the use of State Highway 58 is a more likely possibility, and this would be especially the case if Transmission Gully was in place. The remaining movements would be primarily serviced by State Highway 58, although the Akatarawa Road between Upper Hutt and Waikanae caters for some of these trips.

Although Figure 4 gives an indication of the relative importance of movement between areas in the region, the detail of the information is insufficient to enable the assessment of individual route options. The GATS model was used to provide more detailed information relating to each route option, as discussed below.

2.4 Traffic Modelling

The alternative route alignment options shown in Figures 1 and 2 were compared using the GATS traffic model. A "Do Nothing" option was included to provide a basis for the comparison.

The basis of the comparison was a traffic assignment using the 1991 "all day" trip matrix. For each of the options, the total network travel time and travel distance values were compared as were the modelled traffic flows at a number of key locations.

Comparisons were made both with and without the Transmission Gully route in place. This route, which would provide an alternative to the existing State Highway 1 route between

Tawa and McKays Crossing, will clearly have an impact upon the volume and distribution of traffic along routes which join the Hutt Valley and the Tawa-Porirua Basins. The "Base" Transmission Gully route which is incorporated within the GATS model includes connections into the existing road network at Kenepuru Drive, Warspite/ Whitford Brown Avenue and James Cook Drive in Whitby.

2.4.1 Assumed Route Speeds

The travel speeds of vehicles along any new route, and therefore the ability of that route to attract traffic from existing routes, is largely determined by the quality of the route alignment. It was assumed for the initial traffic modelling that the alignment of any new route would be of a sufficient standard to allow a free vehicle speed of 80 km/hr along the route. This assumption has been used throughout the traffic modelling in Part A of the investigation and speeds are reassessed in Phase B, when the modelled routes are more accurately defined.

The sensitivity of the traffic flow predictions to different route speeds was checked for the Routes D & E, both with and without the Transmission Gully Route in place.

Without Transmission Gully, the modelled flow on Route D increased by 7% or decreased by 5% if the route speeds were raised or lowered by 20 km/hr respectively. With Transmission Gully, the flow increased by 3% or decreased by 7% if the same changes were made. These differences are considered small, and indicate that the volume of traffic which would be diverted to any of the new routes is not greatly affected by the exact route alignment and speed.

2.5 Comparative Evaluation

Table 3 shows the traffic flow forecasts for the scheme options tested. All flow information relates to the 1991 11-hour weekday base of the traffic model used for assessment purposes, and the emphasis is therefore upon the *relative*, rather than *actual*, traffic volumes. Actual flows in 1996 will be significantly higher than flow levels indicated by this analysis. For example, the 1991 11 hour Do-Nothing flow on State Highway 58 of 6,800 vehicles compares with recent count information which indicates Annual Average Daily Traffic (AADT) flow levels of approximately 10,000 vehicles on this section of road.

The presence of the Transmission Gully scheme results in an increase in traffic on State Highway 58 (of approximately 20%) and corresponding decreases on State Highways 1 and 2 to the south. This results from the Transmission Gully alignment, which intersects with State Highway 58 to the east of Porirua Harbour, making travel via State Highway 58 more attractive. For similar reasons, alternative alignments tested with Transmission Gully in place generally carry more traffic than those without.

2.5.1 Without Transmission Gully

Without Transmission Gully, Routes D and F attract the greatest volumes of traffic regardless of which connections are made to the existing road network at the Porirua end. These routes provide the greatest economic benefits and provide the greatest flow relief to the existing State Highway 1 and 2 routes. Routes D and F provide the most direct travel routes between the Porirua/Tawa and Lower Hutt areas, which was shown by the desire line analysis to have the greatest demand for travel.

The option which provides a direct link from Route D to Kenepuru Drive (via a partial section of the Transmission Gully route) attracts the greatest traffic flows and also provides the greatest economic benefits. In the phase 3 investigations it may be desirable to investigate a similar option utilising Route F.

Route C would attract traffic flows and economic benefits which are higher than for Route A, but lower than for Routes D or F. Routes A and C would attract significant traffic flows from the existing State Highway 58, but would attract little from State Highways 1 and 2.

The proximity of Route G to the southern end of the study area means that it would provide the greatest flow relief to existing State Highway 1 and 2 routes, but the lowest to State Highway 58. Route G provides a shorter travel route between Porirua/Tawa and Lower Hutt than the existing State Highway 1 / 2 route via Ngauranga Gorge, but a longer route, and therefore much smaller economic benefits than either Route D or F.

A new road link across the Hutt River from State Highway 58 at Manor Park to the Eastern Hutt Road / High Street intersection would attract a significant volume of traffic and provide reasonable economic benefits. Such a new link would not provide flow relief on State Highway 1 or 58, but would reduce flows on State Highway 2, north of Melling. This proposal will need to be verified as to its relation and effect on the Hutt City's strategic network, in particular on the Eastern Hutt Road and High St.

The realignment of State Highway 58 over Haywards Hill may provide slight flow relief to the existing State Highway 1 and 2 routes and would provide a modest economic benefit.

2.5.2 With Transmission Gully

The relative performances of the alternative route options are similar with the Transmission Gully route, as they were without.

Route G would attract the highest traffic flows, but would provide the lowest economic benefits, because it provides the least lateral displacement from an existing route. Routes D and F provide the best combinations of flow attraction from the existing State Highway 1, 2 and 58 routes and economic benefits.

3 ROADING

3.1 Highway Geometry

For the "broad brush" or coarse assessment, preliminary trial geometric centre lines were established for all routes to enable both indicative longitudinal grades and typical cross sections to be produced. The location of these alignments was related to obvious features but no refinements to reduce the highway longitudinal grades, impacts on property and achieve an earthworks balance were attempted for this phase.

The technical features of the routes are summarised in Table 2.

A longitudinal section for Route D between SH2 and Warspite Avenue via the Airstrip is shown in Figure 5.

The earthwork volumes extracted from the computer model indicate that a considerable surplus occurs for all of the schemes assessed. The topographic base data used for the preliminary design has a contour interval of 20 m which limits the accuracy of the outputs. Therefore, fine tuning of the alignments and minimising impacts can only be successfully achieved to a very limited extent without more detailed topographic data.

It has been assumed that adequate connections of all proposed routes to existing highways and streets can be achieved.

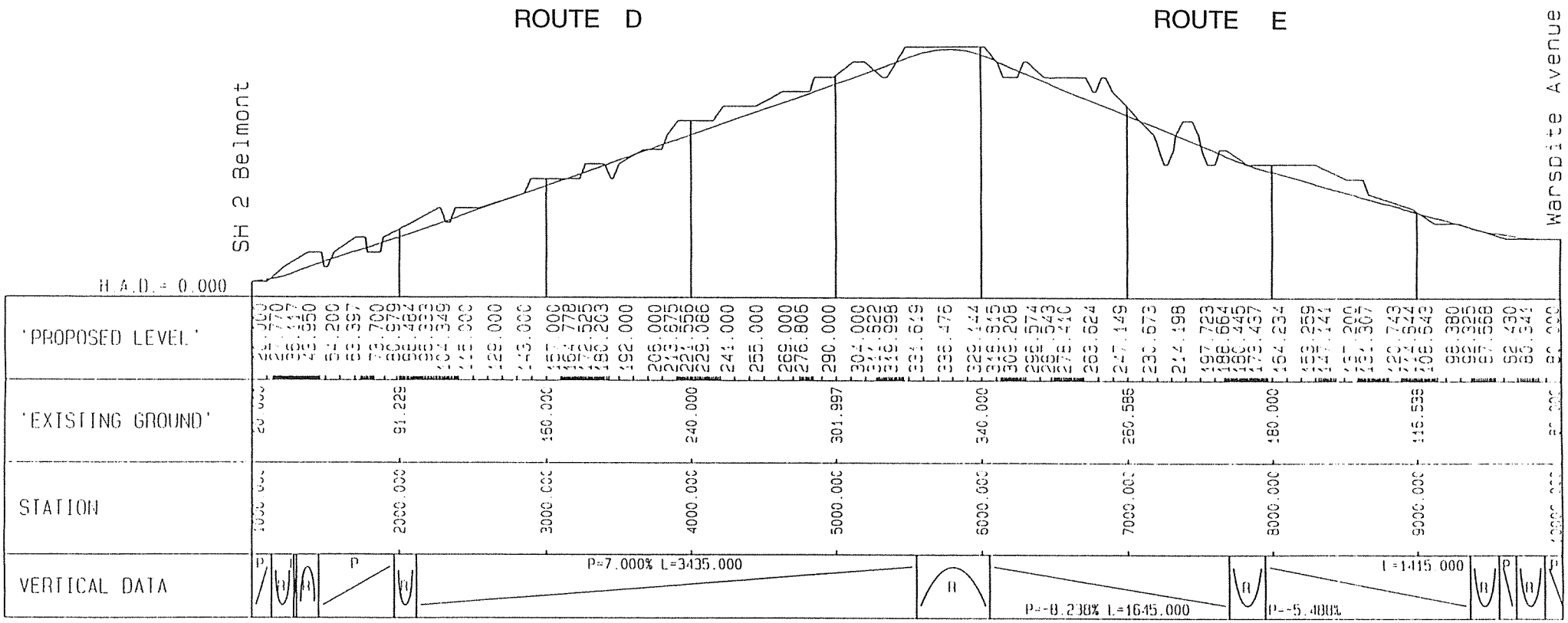
The connections on the Porirua side assume the connections previously developed for the Transmission Gully route will be used. If the Porirua to Hutt Valley route is constructed before Transmission Gully, these links into the Porirua street network should not change. However, provision should still be made in any Porirua-Hutt Valley route for future connections with the Transmission Gully.

Route G

The connections on the Hutt Valley side are likely to require major work on SH 2. Route G connection to SH 2 is likely to only be feasible with a new grade separated Petone interchange as it is unlikely that a feasible at grade intersection can be developed on this busy section of SH 2.

Route F

Route F, which connects to with Harbour View Road, is likely to require a major upgrade of the existing Melling signalised intersection. It is unlikely that the existing signal layout could be modified to provide for the volume of turning traffic at the existing intersection. A grade separated Melling interchange being examined as part of the current SH 2 Petone to Melling Upgrading Study.



HUTT VALLEY TO PORIRUA ROAD LINK STUDY

OPTION D/E SH 2 Belmont to Warspite Avenue

LONGITUDINAL SECTION

FIGURE 5

Route D

A reduction in those grades which exceed 8% would generally require lowering the summit levels and introducing deep cuttings. Replacement of these cuttings with tunnels is only feasible at the summit ridges and then only if adequate cover can be provided. Using route D/E1 as an example, if a 700 m long tunnel is constructed at the summit to lower the highway level by say 25 m, the maximum grade on the Porirua side (E1) can be reduced from 10% to 7.5%. The cost of a 2 lane tunnel for the above is likely to be of the order of $50-100 million.

Route D connects with SH 2 in the vicinity of the Kelson (Major Drive) signalised intersection and Kennedy Good/SH 2 signalised intersection. Various options for this connection are possible, including a grade separated interchange.

The general geometric standards adopted for the preliminary design work are to a design speed of 70 km/hr allowing an operating speed of around 80 kph, although the Transmission Gully route and Belmont connector to SH58, designed in 1989, used 100 km/hr. The lower speed is considered to be more consistent with the topography than adopting 100 km/hr design. Limitations on operating speed will be largely set by the grades, in particular the uphill values. If the operating speed is increased to attract higher traffic volumes, it is likely that the principal modification required will be to ease grades rather than the horizontal alignment. This will substantially increase the cost of construction. Designing for a lower design speed will reduce the construction cost but this will be offset in the economics by increased road user costs.

As there will be significantly long lengths of grades exceeding 5% (see Table 2), additional uphill lanes may be necessary over a high proportion of all routes examined to ensure reasonable traffic flows. For the estimates of cost it has been assumed that the grades are steep enough to warrant four lanes throughout (ie, crawler lanes for both up and down hill heavy vehicles). This is the worst case scenario.

3.2 Engineering

It has been assumed that construction of the primary length of all schemes involves principally earthworks and roading, with no significant structures. Earth retaining walls and other forms of embankment support could well be necessary in areas where batter/stream interference occurs. If detailed design and operational analysis indicates that grade separation is necessary at the State Highway 2 junctions then bridges and walls will be necessary.

The effects of any of the proposed routes on the major utilities within the area were not assessed in detail. All of the routes cross the path of Transpower high voltage lines, the WRC Kaitoke watermain and laterals, and the Natural Gas and TransAlta pipelines.

The routes and the utilities affected are given in Appendix A3.

3.3 Geotechnical

For the Part A exercise the geotechnical implications of the routes were not examined in detail. Indications were that ground conditions are not a determining factor which could preclude any of the options at this stage, and that ground conditions have a similar influence on all schemes. The geotechnical aspects are considered in more detail in Part B for the favoured corridor.

In calculating earthwork volumes cut batter slopes of 1 to 1, and fill batter slopes of 1.5 to 1 were adopted. As the heights of the cuts and fills could be up to 80 m (cut) and 50 m (fill) these slopes will have to be formed as a series of benches. The above heights apply to the airfield to Duck Creek section.

3.4 Natural Drainage

The heavily indented topography has produced an extensive dendritic drainage pattern. The watercourses range from seepage paths to streams with significant (though generally not large) dry weather flows.

All of the routes have considerable impact on the natural drainage, some more than others, particularly those which follow the valleys of the larger streams. Despite alignment refinements, it will probably be necessary in some instances to either support the toe of the earthwork batters with retaining structures or realign streams.

It has been assumed for this broad brush approach that all watercourses and stream flows crossed by the routes can be adequately accommodated by culverts.

3.5 Summary

Key features of the routes are summarised in Tables 4 and 5.

TABLE 4 : SUMMARY OF ENGINEERING FEATURES OPTIONS WITHOUT TRANSMISSION GULLY HIGHWAY

Route	Traffic flow attracted to new route. (refer note 1 at bottom of table)	Level of relief for SH 1 and SH 2 routes. (refer note 1 at bottom of table)	Does it utilise existing streets/roads? (excluding those used for TG and links)	Does existing street need to be upgraded?	Can it be built in stages?	Degree of traffic disruption during construction.	Indicative cost. (refer note 2 at bottom of table)	Indicative Annual Benefits. (refer note 3 at bottom of table)	Comments.
1: Routes A & B	5,600 vpd Moderate	2,400 vpd Low	Yes (Links into James Cook Dr)	No	No	High at SH 2 Interchange. Low elsewhere.	$47 m	$9 m	Concentrates traffic on SH 58 at inlet. Cost includes interchange at SH 2.
2: Routes D & E (to Warspite)	8,200 vpd Moderate-High	3,800 vpd Moderate	No		No	High at SH 2 Interchange. Low elsewhere.	$52 m	$14 m	Cost includes interchange at SH 2.
3: Routes D & E (to Whitford Brown)	8,200 vpd Moderate-High	3,800 vpd Moderate	Yes (Part of Whitford Brown Ave)	No	Yes (Whitford Brown Link)	High at SH 2 Interchange. Moderate at Warspite Ave.	$58 m	$15 m	Cost includes interchange at SH 2.
4: Routes F & E (to Warspite)	7,700 vpd Moderate-High	4,100 vpd Moderate	Yes (Harbour View Rd)	Likely	No	High at Harbour View Rd. Low elsewhere.	$55 m	$12 m	Interchange at SH 2 not included in cost. Substantial property cost. Difficult to upgrade Harbour View Rd without major cost and impact.
5: Route F & E (to Whitford Brown)	7,700 vpd Moderate-High	4,100 vpd Moderate	Yes (Part of Whitford Brown Ave)	No	Yes (Whitford Brown Link)	High at Harbour View Rd. Moderate at Warspite Ave.	$61 m	$13 m	Interchange at SH 2 not included in cost. Substantial property cost. Effect on Harbour View Rd as for #4.
6: Routes D, part TG & B	9,100 vpd High	4,000/2,500 vpd Low-Moderate	Yes (Links into James Cook Dr)	No	No	As for #1	$57 m	$15 m	Concentrates traffic on SH 58 at inlet. Cost includes interchange at SH 2.
7: Routes F, part TG & B	6,400 vpd Moderate	3,400/1,900 vpd Low-Moderate	Yes (Links into James Cook Dr & Harbour View Rd)	Likely Harbour View Rd	No	High at Harbour View Rd. Low elsewhere.	$60 m	$8 m	Interchange at SH 2 not included in cost. Substantial property cost. Impacts on Harbour View Rd and SH 58 at inlet.

Route	Traffic flow attracted to new route. (refer note 1 at bottom of table)	Level of relief for SH 1 and SH 2 routes. (refer note 1 at bottom of table)	Does it utilise existing streets/roads? (excluding those used for TG and links)	Does existing street need to be upgraded?	Can it be built in stages?	Degree of traffic disruption during construction.	Indicative cost. (refer note 2 at bottom of table)	Indicative Annual Benefits. (refer note 3 at bottom of table)	Comments.
8: Route C	6,100 vpd Moderate	2,200 vpd Low	No	No	No	As for #1	$45 m	$10 m	Cost includes interchange at SH 2.
9: Route D, part TG & Kenepuru Dr Link	10,100 vpd High	5,700 vpd Moderate-High	Yes (Kenepuru Dr)	Possibly	No	High at SH 2 Interchange and SH 1 crossing.	$64 m	$23 m	Cost includes interchange at SH 2.
10: Route G	8,800 vpd Moderate-High	6,700 vpd Moderate-High	Yes (Part of SH 2)	Requires upgraded Petone I/C	No	High at SH 2 Interchange.	$36 m	$2 m	Likely to require major new interchange at Petone with possible intrusion into harbour.
11: Upgrade SH58	300 Low	300 Low		Yes	Yes	Moderate.		$1 m	Traffic volume is extra over existing volume on SH 58.
12: Eastern Hutt Rd Link	5,900 vpd Moderate	2000 Low	Yes (Part of Eastern Hutt Rd)	Possibly	No	High at SH 2 crossing and Eastern Hutt Rd.	$11 m	$3 m	Increase in traffic on SH 58 is minor.

Notes:

1. Traffic volumes indicated are from assignment of the 1991 "All Day" 11-hour trip matrix.
2. The estimates for the construction cost are primarily parameter based using 1996 rates.
   Probable accuracy : - 30% to + 50%. (Refer also to text.)
3. Annual benefits are for road user costs (travel time and distance) only. (Refer also to text.)

TABLE 5 : ENGINEERING FEATURES
OPTIONS WITH TRANSMISSION GULLY HIGHWAY

Route	Traffic flow attracted to new route. (refer note 1 at bottom of Table 4)	Level of relief for SH 1 and SH 2 routes. (refer note 1 at bottom of Table 4)	Does it utilise existing streets/roads? (excluding those used for TG and links)	Does existing street need to be upgraded?	Can it be built in stages?	Degree of traffic disruption during construction.	Indicative cost. (refer note 2 at bottom of Table 4)	Indicative Annual Benefits. (refer note 3 at bottom of Table 4)	Comments.
13: Routes A & E (to Warspite)			No	No	No	High at SH 2 Interchange. Low elsewhere.	$43 m		Network similar to #15. Cost for A only, ie assumes E (to Warspite) built as part of TG. Cost includes Interchange at SH 2.
14: Routes A & E (to Whitford Brown)			No	No	No	High at SH 2 Interchange. Moderate at TG crossing.	$43 m		Network similar to #15. Cost for A only, ie assumes E (to Whitford Brown) built as part of TG. Cost includes Interchange at SH 2.
15: Routes A, E (to Whitford Brown) & B	6,500 vpd Moderate	2,100 vpd Low	No	No	No	As for #14	$43 m	$11 m	Cost for A only, ie assumes E (to Whitford Brown) and B built as part of TG. Cost includes Interchange at SH 2.
16: Routes D & E (to Warspite)			No	No	No	As for #13	$46 m		Network similar to #18. Cost for E (to Warspite) not included. Cost includes Interchange at SH 2.
17: Routes D & E (to Whitford Brown)			No	No	No	As for #14	$46 m		Network similar to #18. Cost as for #16, ie Cost for E (to Whitford Brown) not included. Cost includes Interchange at SH 2.
18: Routes D, E (to Whitford Brown) & B	9,300 vpd High	3,900 vpd Moderate	No	No	No	As for #14	$46 m	$14 m	Cost as for #16, ie Cost for E (to Whitford Brown) and B not included. Cost includes Interchange at SH 2.

Route	Traffic flow attracted to new route. (refer note 1 at bottom of Table 4)	Level of relief for SH 1 and SH 2 routes. (refer note 1 at bottom of Table 4)	Does it utilise existing streets/roads? (excluding those used for TG and links)	Does existing street need to be upgraded?	Can it be built in stages?	Degree of traffic disruption during construction.	Indicative cost. (refer note 2 at bottom of Table 4)	Indicative Annual Benefits. (refer note 3 at bottom of Table 4)	Comments.
19: Routes F & E (to Warspite)			Yes (Harbour View Rd)	Likely	No	High at SH 2 Interchange. Low elsewhere.	$48 m		Network similar to #21. Cost for E (to Warspite) not included. Cost includes overpass at TG but excludes interchange at SH 2. Substantial property cost. Difficult to upgrade Harbour View Rd without major cost and impact.
20: Routes F & E (to Whitford Brown)			Yes (Harbour View Rd)	Likely		High at SH 2 Interchange. Moderate at TG crossing.	$48 m		Network similar to #21. Cost as for #19, ie Cost for E (to Whitford Brown) not included. Effect on Harbour View Rd as for #19.
21: Routes F, E (to Whitford Brown) & B	8,500 vpd Moderate-High	4,000 vpd Moderate	Yes (Harbour View Rd)	Likely	No	As for #20	$48 m	$12 m	Cost as for #19, ie Cost for E (to Whitford Brown) and B not included. Effect on Harbour View Rd as for #19.
22: Route C & E (to Warspite)			No			As for #13	$45 m		Network similar to #23 Cost for E (to Warspite) not included. Cost includes Interchange at SH 2.
23: Route C, E (TG to Whitford Brown) & B	6,600 vpd Moderate	1,700 vpd Low	No		No	As for #14	$45 m	$11 m	Cost as for # 22, ie Cost for E (to Whitford Brown) and B not included. Cost includes Interchange at SH 2.
24: Route G, E (to Whitford Brown) & B	10,200 vpd High	7,600 vpd High	Yes (part of SH 2)	Link to SH 2 requires upgraded Petone Interchange	No	High at SH 2 Interchange. Moderate at TG crossing.	$36 m	$3 m	Cost for G only, ie Cost for E (to Whitford Brown) and B not included. Likely to require major new interchange at Petone with possible intrusion into harbour.

4 ENVIRONMENTAL/PLANNING ISSUES

The routes have been assessed in terms of the issues documented in the regional and district plans. A broad brush process has been used for this initial appraisal. A summary of the likely social and environmental effects is given in Table 6. A more detailed description of the overall features and the general effect which each route could have on the social and environmental qualities is given in Appendix A4.

TABLE 6 : SYNTHESIS OF 'LIKELY' SOCIAL/ ENVIRONMENTAL IMPACTS

	Routes									
	SH58	A	B	C	D	E	Ei	Eii	F	G
Assessment Criteria										
(i) Landscape or Visual Impact	high (inlet)	high in part, o/w low	low	high in part, o/w low	high in part o/w mod	high in part o/w mod	low	low	high in part o/w mod	low
(ii) Impact on Significant 'Identified' Sites:										
(a) Heritage	pot. high	nil	nil	nil	nil	nil	nil	nil	high	nil
(b) Archaeological/ Cultural/ Spiritual	-	mod	-	-	high	-	-	-	mod-high	mod
(c) Ecological	high	high	mod-high	high	high	mod	mod	low-mod	high	low-mod
(iii) Noise Impact	low	mod in part o/w low	mod	mod in part o/w low	mod	high	low	low	high in part o/w mod	low
(iv) Impact on Regional Park Recreation Activities	n/a	low-mod	nil	low-mod	mod-high	mod	low	mod	mod-high	n/a
(v) Impact on Significant Fresh Watercourses	low	mod	nil	mod	mod	low-mod	nil	low	low	low
(vi) Relationship with Road Hierarchy and Resulting Community Impact	n/a	low	mod-high	low	low	low	low	low	high	low
Overall Impact Evaluation	high in part o/w low	mod/high in part o/w low	mod	mod/high in part o/w low	mod-high	mod	low	low	high	low

5 ECONOMICS

5.1 Construction Costs

From the limited amount of base data and detail available for all schemes it has been possible to provide only indicative estimates of the construction costs. The costs given in Tables 4 and 5 are derived from principally parameter methods which are based on a limited selection of historic data. It is recognised that the method has severe limitations and is very crude, and that within the range of likely accuracy the ranking of the options could change.

The estimates include arbitrary sums to represent the cost of property, intersections, and professional services.

5.2 Traffic Benefits

A comparison was made between the total vehicle travel time and travel distance values for each option. These values were derived from the assignment of the 1991 11-hour "all day" trip matrix. Link delays and intersection delays were included in the total travel time values. For each option, the travel time and distance values were combined to produce an estimate of the total annual network operating costs. Economic benefits for each option were then formulated relative to the "Do Nothing" option.

The analysis did not include any assessment of vehicle accident costs.

The traffic benefits produced are indicative only, and emphasis should therefore be placed on the *relative* rather than the *absolute* values of the benefits.

The traffic benefits for the schemes investigated are included in Table 4.

6 EVALUATIONS

All of the schemes have been evaluated against the key features given below:

- Meeting the traffic objectives
- Highway geometry standards
- Construction aspects
- Overall environmental and social effect
- Temporary construction impacts
- Construction cost
- Traffic benefits (economics)

Each scheme has been assessed and ranked as to the degree the objectives are achieved and the magnitude of the impacts eg high, moderate low. The assessment is necessarily broad brush as the objectives considered are an amalgamation of a number of aspects which have been discussed and evaluated in the preceding sections of this report. Therefore the results are subjective.

The results are given in Tables 8 and 9. In Table 9, ranking was carried out only for those options for which traffic benefits were calculated.

TABLE 8 : SUMMARY OF OVERALL FEATURES and EVALUATION SCHEMES WITHOUT TRANSMISSION GULLY

Scheme	Ability of the scheme to meet the traffic objectives?	What is the overall road geometry standard achieved?	What is the relative degree of difficulty of construction?	What is the degree of temporary construction impacts?	What is the degree of overall environmental and social effect?	Relative Cost.	Relative level of Road User Benefits.	Overall Ranking	Comments.
1: Routes A & B	Moderate	Moderate	Moderate	Moderate	Moderate-High	Moderate	Low-Moderate	2	Environmental impact assessment includes SH 58 (inlet) effects. Ranking subject to resolving SH 58 (inlet) issues.
2: Routes D & E (to Warspite)	High	Moderate	High	Moderate	Moderate-High	High	Moderate	1	
3: Routes D & E (to Whitford Brown)	High	Moderate	High	Moderate	Moderate-High	High	Moderate	1	
4: Routes F & E (to Warspite)	Moderate	Low	High	High	High	High	Moderate	5	
5: Routes F & E (to Whitford Brown)	Moderate	Low	High	High	High	High	Moderate	5	
6: Routes D, part TG(N) & B	Moderate	Moderate	Moderate	High	High	High	Moderate	1	TG section - 100 km/hr. Environmental impact assessment includes SH 58 (inlet) effects. Ranking subject to resolving SH 58 (inlet) issues.

Scheme	Ability of the scheme to meet the traffic objectives?	What is the overall road geometry standard achieved?	What is the relative degree of difficulty of construction?	What is the degree of temporary construction impacts?	What is the degree of overall environmental and social effect?	Relative Cost.	Relative level of Road User Benefits.	Overall Ranking	Comments.
7: Routes F, part TG(N) & B	Moderate	Low	High	High	High	High	Low-Moderate	5	TG section - 100 km/hr. Environmental impact assessment includes SH 58 (inlet) effects.
8: Route C	Moderate	Moderate-High	Moderate	Moderate	Moderate-High	Low	Low-Moderate	3	
9: Route D, part TG(S) & Kenepuru Dr Link	High	Moderate	Moderate	High	Moderate	High	High	1	TG section 100 km/hr. Highest cost scheme. Highest road user benefits.
10: Route G	Low	Low	High	High	Low	Low	Low	4	
11: Upgrade SH 58	Low	Moderate-High	Low	Moderate	Moderate-High	Low	Low	6	Environmental impact assessment includes SH 58 (inlet) effects.
12: Eastern Hutt Rd Link	Low	Moderate	Moderate	Moderate-High		Low	Low		

TABLE 9 : SUMMARY OF OVERALL FEATURES and EVALUATION SCHEMES WITH TRANSMISSION GULLY

Scheme	Ability of the scheme to meet the traffic objectives?	What is the overall road geometry standard achieved?	What is the degree of difficulty of construction?	What is the degree of temporary construction impacts?	What is the degree of overall environmental and social effect?	Relative Cost.	Relative level of Road User Benefits.	Overall Ranking	Comments.
13: Routes A & E (to Warspite)	Moderate	Moderate	Moderate-High	Moderate	Moderate	Moderate			Environmental impact assessment includes SH 58 (inlet) effects
14: Routes A & E (to Whitford Brown)	Moderate	Moderate	Moderate-High	High	Moderate	Moderate			EIA as for #13
15: Routes A, E (to Whitford Brown) & B	Moderate	Moderate	Moderate-High	High	Moderate	Moderate	Moderate	2	EIA as for #13
16: Routes D & E (to Warspite)	High	Moderate	High	Moderate	Moderate	Moderate			
17: Routes D & E (to Whitford Brown)	High	Moderate	High	High	Moderate	Moderate			
18: Routes D, E (to Whitford Brown) & B	High	Moderate	High	High	Moderate	Moderate	Moderate	1	Highest road user benefits.
19: Routes F & E (to Warspite)	Moderate	Low	High	High	Moderate-High	Moderate			
20: Routes F & E (to Whitford Brown)	Moderate	Low	High	High	Moderate-High	Moderate			

Scheme	Ability of the scheme to meet the traffic objectives?	What is the overall road geometry standard achieved?	What is the degree of difficulty of construction?	What is the degree of temporary construction impacts?	What is the degree of overall environmental and social effect?	Relative Cost.	Relative level of Road User Benefits.	Overall Ranking	Comments.
21: Routes F, E (to Whitford Brown) & B	Moderate	Low	High	High	Moderate-High	High	Moderate	5	Highest cost scheme.
22: Route C & E (to Warspite)	Moderate	Moderate-High	Moderate-High	Moderate	Moderate	Moderate			
23: Route C, E (to Whitford Brown) & B	Moderate	Moderate-High	Moderate-High	Moderate	Moderate	Moderate	Moderate	3	
24: Route G, E (to Whitford Brown) & B	Low	Low	High	High	Low-Moderate	Low	Low	4	

7 SUMMARY AND CONCLUSIONS OF INITIAL APPRAISAL

From Table 8, the evaluation of the five broad corridors can be summarised as follows:

	Ability to meet traffic objectives	Alignment Standard	Relative Cost	Level of Road User Benefits	Environmental Impact
SH 58	Low	Moderate	Low	Low	Moderate-High
Route A/B	Moderate	Moderate	Moderate	Low	Moderate-High
Route C	Moderate	Moderate-High	Low	Low-Moderate	Moderate-High
Route D	High	High	High	High	Moderate-High
Route F	Moderate	High	High	Low	High
Route G	Low	High	Low	Low	Low

Route D attracts most inter-urban traffic and has the highest level of road user benefits. It has a high standard of alignment, environmental impacts are mid-range but the cost is relatively high due to the topography.

Route A/B attracts less traffic than D and has a low level of road user benefits. The environmental impact at Paremata Inlet would need to be resolved. However it is less expensive than Route D as the topography is less severe.

Routes SH 58 and G are not favoured as they do not meet the traffic objectives and have a low level of road user benefits. In addition SH 58 has a high environmental impact at Paremata Inlet.

Route F is not favoured primarily because of the high environmental impact at Harbour View Road and the complexity of the intersection with SH 2.

Route C is not favoured because of the high environmental impact on the south side of Paremata Inlet after joining SH 58 at Pauatahanui.

Route D with sub options is the preferred route at this stage and Route A is also worthy of further study. Both are compatible with Transmission Gully.

It was recommended, and agreed to by the Steering Committee, that investigation of Route D/E through to Warspite/Whitford Brown Avenue be developed, including further consideration to the impacts such a link would have on the immediate local streets.

The investigation includes examining alternatives which reduce the impact of Route D on Speedys Reserve, and comparing the benefits of Route D/E to Warspite/Whitford Brown

Avenue with alternative link connections to Porirua.

The results are reported in Part B.

PART B : DEVELOPMENT OF RECOMMENDED OPTIONS

1 INTRODUCTION

This section of the Report gives the results of the further investigation into Route D/E including suboptions which minimise the impact on Speedys Reserve.

Route D and two suboptions utilising Major Drive to bring the route around the northern end of Speedys Reserve were investigated and then discussed with Hutt City Council roading and planning staff. For a number of reasons, use of the local streets as an arterial highway was not favoured. In addition, the winding alignment and steep grade at the SH2 end makes the two suboptions unattractive from the operational point of view. Further. a number of planning/environmental issues were also raised regarding the impact the route would have on Speedys Reserve. As a consequence the above two suboptions were excluded from the evaluation.

Following further consideration of alternatives a third suboption (D5) on an alignment at the Hutt Valley end similar to Route A. was examined. Although this route passes through the Reserve and has a similar effect on the land, part of the initial section is in block cutting, which has visual and noise advantages.

The location of the D1, D5 and E routes, and the alternative connections into Porirua East considered in the economic analysis are shown in Figure 6.

In this section of the report only the additional information relating directly to Route D and the suboptions, and the more detailed analysis is given. Comment is made where it differs from what has already been given in Part A Sections 3, 4, 5 and 6.

2 TRAFFIC

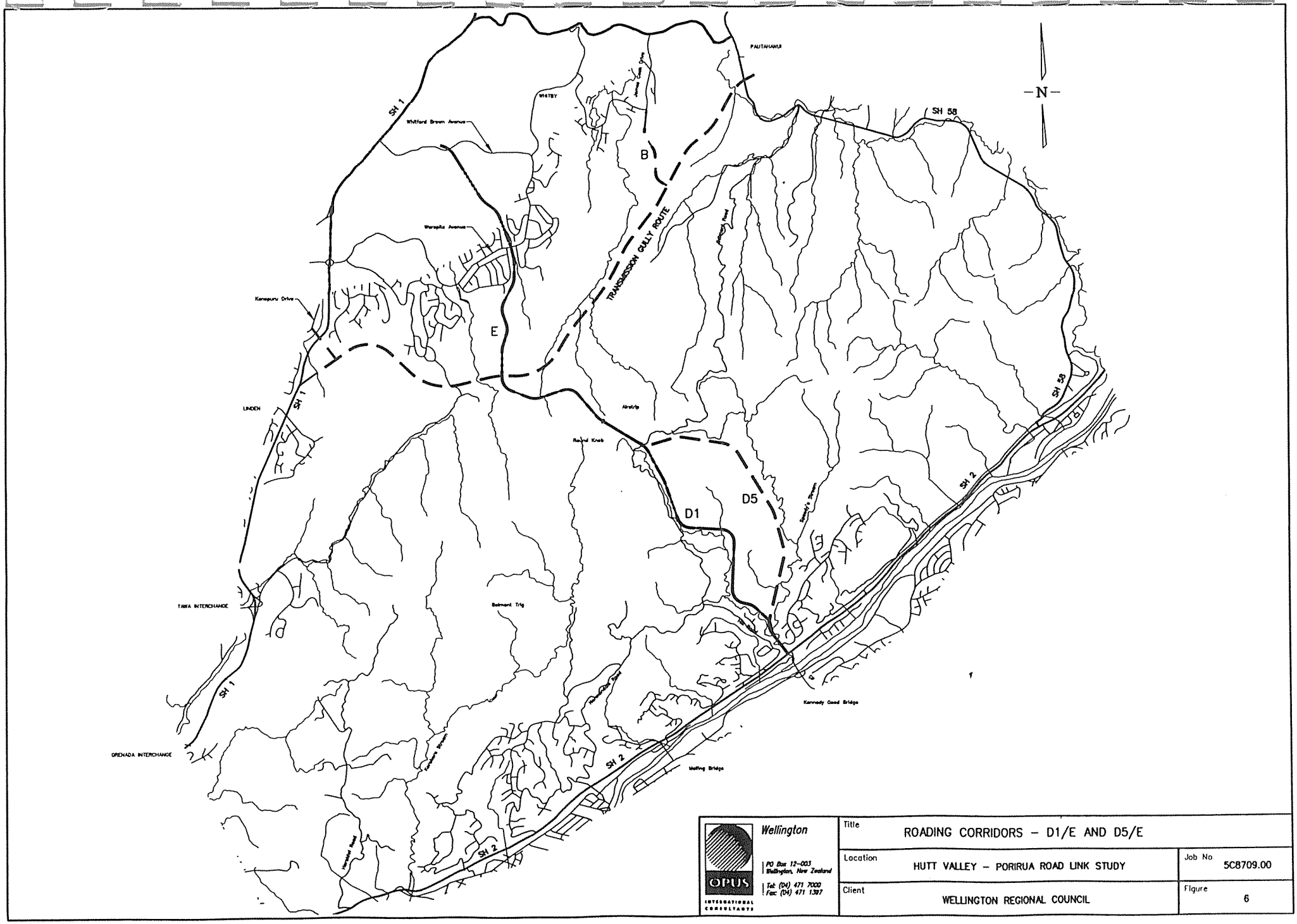
2.1 General

The existing TRACKS traffic model was altered to model the revised Route D alignments.

The route options have been modelled for the 1996 base year of the analysis, and for the future year 2011. The WRC 2011 all day trip matrix has been utilised, while a 1996 all day matrix was formulated by interpolating linearly between the 1991 and 2011 WRC matrices. All of the matrices are based on 1991 census data. This approach was discussed and agreed with the Regional Council.

2.1.1 Connections to Existing Road Network

A number of alternative connections to the existing road network were tested at the Porirua end of the link road. This allowed the magnitude of changes in the traffic flows on existing streets to be assessed, depending on whether connections from the new route are made to



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Title	ROADING CORRIDORS – D1/E AND D5/E	
Location	HUTT VALLEY – PORIRUA ROAD LINK STUDY	Job No 5C8709.00
Client	WELLINGTON REGIONAL COUNCIL	Figure 6

Warspite Ave and/or Whitford Brown Ave.

2.1.2 Modelled Traffic Flows

The modelled flows indicate that all of the alternative Route D alignment options would attract 8,000 to 10,000 vehicles during the 1996 daytime 11 hour period. Option D11 (which connects only to Warspite Ave at the Porirua end) and Option D13 (which connects only to Whitford Brown Ave) would provide similar levels of benefits, but Option D13 would place little additional traffic on existing roads. Option D12 (which connects to both Warspite and Whitford Brown Ave) would provide the greatest economic benefits, but would still place a significant amount of additional traffic on existing routes.

The Route D Suboptions D1 and D5 would attract similar numbers of vehicles from the existing network routes, but suboption D1 would provide a slightly higher level of benefits because of its shorter overall length.

The predicted traffic volumes for the Link and the existing major arterial highways and streets are given in Table 10 for both years 1996 and 2011.

2.1.3 Screenline Counts

The relevant screenline counts from the 1996 Census day have been compared with the modelled 1996 "Do Minimum Option" flows from the TRACKS model.

The census counts were not taken over the full daytime period modelled in TRACKS, so in order to provide suitable comparison values, scaling factors were calculated from the ratios of the total number of hours during which vehicles were counted crossing each screenline to the total number of hours in the modelled time period (11 hours). The census and modelled flows are shown in Table 11.

Table 10 shows that all but one of the modelled directional screenline flows fell within 10% or 2,000 vehicles per day of the counted values. The northbound Census Day count for the W6 screenline (SH2 north of Ngauranga) was 17% or 4,200 vpd lower than the modelled value, but the counted value was also 5,500 vpd lower than the corresponding southbound total. The modelled screenline counts therefore show a reasonably good level of agreement with the counted Census Day values and provides a robust basis for the estimation of economic benefits.

TABLE 11 : COMPARISON OF CENSUS AND MODELLED TRAFFIC FLOWS (VEHICLES PER DAY)

Screenline		Census Flows	Modelled Flows	Absolute Difference	Percentage Difference
W5	Southbound	22,940	22,690	-250	-1.1%
	Northbound	19,660	19,970	310	1.6%
	Two Way	42,600	42,660	60	0.1%
W6	Southbound	30,840	32,770	1,930	6.3%
	Northbound	25,310	29,550	4,240	16.8%
	Two Way	56,150	62,320	6,170	11.0%
LH2	Southbound	22,930	20,980	-1,950	-8.5%
	Northbound	19,400	18,300	-1,100	-5.7%
	Two Way	42,330	39,280	-3,050	-7.2%
P2	Eastbound	3,720	4,080	360	9.7%
	Westbound	3,140	3,930	790	25.2%
	Two Way	6,860	8,010	1,150	16.8%
P3	Southbound	20,530	22,300	1,770	8.6%
	Northbound	18,760	20,200	1,440	7.7%
	Two Way	39,290	42,500	3,210	8.2%
TOTAL		187,230	194,770	7,540	4.0%

Note: Traffic flows are: a. for Year 1996.
b. for a 11 hour period which includes the AM and PM peaks and the working day period between (Interpeak).

3 ROADING

3.1 Highway Geometry

The alignments of the Route D/E highway and Suboptions D1 and D5 investigated are shown on Figure 6 and the larger scale drawing in Appendix B2. As part of the option development exercise, a minor amount of fine tuning of the Route D/E alignment, has been undertaken to improve some aspects of the geometry.

The overall horizontal geometry generally equates to a design speed of 70 km/h, with a minimum curve radius of 200m. The location of the alignment has been chosen to:

- cross Duck Creek close to the top of the catchment so as to reduce the drop in elevation into the bed of the stream and thus avoid a deep fill/long viaduct. A crossing of Cannons Creek was also avoided for similar reasons. In this location the route lies approximately ½ km northeast of the Takapu Road Substation.

- avoid the TransAlta Gas Station. In this location the route is approximately 150m to the south of the Gas Station.

Route D1 (starting at the SH2 end) generally follows the stream which is a tributary of Speedys Stream and initially parallels Hill Road. The route joins up with the existing Landcorp access road in the vicinity of the Regional Council Belmont Park carpark. From this point it follows the stream, on the opposite of the valley to the existing access road track, through to the Airstrip.

Route D5 generally follows the main branch of Speedys Stream for approximately 1 to 1½ Kilometres before looping around to the West, crossing a number of stream tributaries, to join up with Route E in the vicinity of the Airstrip.

A comparison of key highway features between Route D1 and Suboption D5 is given in Table 12. Overall, the alignment of Suboption D5 has a slightly higher geometric standard than Route D1, but is approximately 500 m longer.

Routes E, and both the D suboptions have a common point in the vicinity of the airstrip.

Section E of the overall route passes between the Landcorp farm house and the TransAlta gas station, and to the south of the airstrip on generally a northwest heading before swinging west. A large arc then brings the alignment onto a northly heading which follows a ridge leading to the gap in the urban development that borders Warspite Avenue. The key geometric data for the length from the Airstrip through to Warspite Avenue is also included in Table 12. An at-grade crossing of the proposed Transmission Gully highway has been assumed at this stage.

TABLE 12 : FEATURES OF ROUTE D1, SUBOPTION D5 AND ROUTE E

Feature	Route D1 (SH2 to Airstrip)	Suboption D5 (SH2 to Airstrip)	Route Section E (Airstrip to Warspite Ave)	Comments
Design Speed	70 km/h	70 km/h	70 km/h	
Minimum Curve radius	200 m	200 m	200 m	
Number of Curves	8 total 5 @ 200 m	6 total 3 @ 200 m	9 total 2 @ 200 m	
Route Length (Approximate)	4.5 km	5 km	4.5 km	
Average Grade (Overall)	7.6 %	6.8 %	5.8 %	Elevation difference at ends/section length
Maximum Grade	8 % over 0.5 km	7.7 % over 2.5 km	8 % over 1.7 km	
Maximum Sustained Grade	7 % over 3.5 km	7.7 % over 2.5 km	8 % over 1.7 km	
Maximum Cut Height (Approximate)	30 m on centre-line 55 m on edge-line	35 m on centre-line 50 m on edge-line	30 m on centre-line 55 m on edge-line	With refined topographic base, these figures are likely to increase
Maximum Fill Depth	25 m on centre-line 35 m on edgeline	30 m on centre-line 40 m on edge-line	35 m on centre-line 55 m on edge-line	With refined topographic base, these figures are likely to increase
Surplus Earthworks	1.2 million m^3	0.6 million m^3		The volumes are for total length, SH 2 to Warspite Ave

A longitudinal profile showing the elevation changes and likely highway grades for Routes D1 and D5 are shown in Figure7 and 8. A larger scale version is contained in Appendix B3.

A typical cross section of the proposed highway is shown in Figure 9.

The alignment passes the airstrip some 50 to 100m on the southern side. The route should have little effect on aircraft operations (which are infrequent) as aeroplanes both land and take-off to the north.

From Warspite Avenue, the alignment of Route E follows generally a northwest heading through to Whitford Brown Avenue. The length of this section is 1.8 km and the levels of the two ends are approximately the same. There are a number of low ridges and gullies to cross in this section. No preliminary design work on the alignment was undertaken for this section of the route but it is not seen as presenting significant obstacles at this stage.

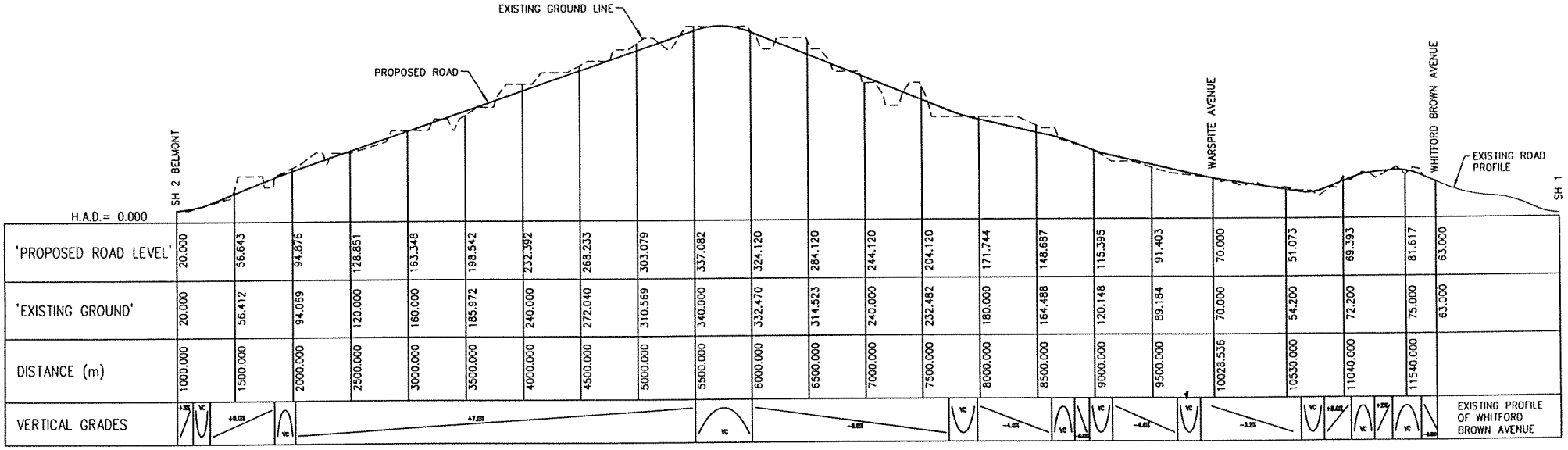
Fine turning of the overall alignment would need to allow for providing a safe highway of consistent geometric standards which, minimises any impacts on ecological and archeological sites, and balances the earthwork cuts and fills.

A minimum number of two lanes is required to cater for the predicted traffic volumes . However, with the steep grades, it will be essential to provide passing lanes. A number of lane combination options are possible. Thus, the highway cross section is likely to vary between two and four lanes. For this present investigation a four lane highway throughout has been adopted for convenience.

The route lengths are given in Table 13.

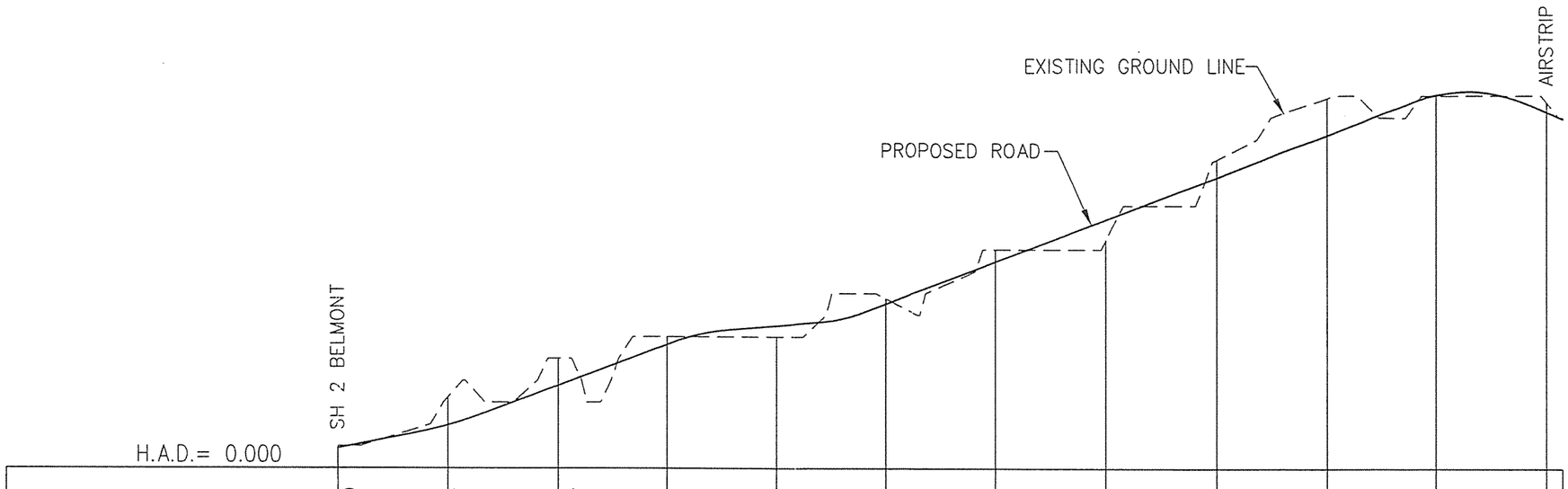
TABLE 13: ROUTE LENGTHS

Route		Length
SH2 to Warspite Avenue	via D1	9.0 km
	via Sub option D5	9.5 km
Warspite Avenue to Whitford Brown Avenue		1.8 km
Whiteford Brown I/S to SH1		1.2 km
SH2 to James Cook Drive via Transmission Gully		10.8 km
SH2 to Kenepuru Drive via Transmission Gully		10.1 km



'PROPOSED ROAD LEVEL'	20.000	56.643	94.876	128.851	163.348	198.542	232.392	268.233	303.079	337.082	324.120	284.120	244.120	204.120	171.744	148.687	115.395	91.403	70.000	51.073	69.393	81.617	63.000	
'EXISTING GROUND'	20.000	56.412	94.069	120.000	160.000	185.972	240.000	272.040	310.569	340.000	332.470	314.523	240.000	232.482	180.000	164.488	120.148	89.184	70.000	54.200	72.200	75.000	63.000	
DISTANCE (m)	1000.000	1500.000	2000.000	2500.000	3000.000	3500.000	4000.000	4500.000	5000.000	5500.000	6000.000	6500.000	7000.000	7500.000	8000.000	8500.000	9000.000	9500.000	10028.536	10530.000	11040.000	11540.000		
VERTICAL GRADES																								EXISTING PROFILE OF WHITFORD BROWN AVENUE

Wellington	Title: OPTION D1/E – SH 2 TO WHITFORD BROWN AVENUE LONGITUDINAL SECTION	
	Location: HUTT VALLEY – PORIRUA ROAD LINK STUDY	Job No: 5C8708.00
	Client: WELLINGTON REGIONAL COUNCIL	Figure: 7



'PROPOSED ROAD LEVEL'	18.000		39.307	75.426	112.852	130.204	150.511	188.899	227.286	265.674	304.061	340.857	325.130
'EXISTING GROUND'	20.000		64.853	100.000	120.000	120.000	155.315	200.000	208.749	281.993	337.866	340.000	333.765
DISTANCE (m)	1000.000		1500.000	2000.000	2500.000	3000.000	3500.000	4000.000	4500.000	5000.000	5500.000	6000.000	6500.000
VERTICAL GRADES	+4%	VC	+7.5%	VC	+2%	VC	+7.7%					VC	

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Title: OPTION D5 – SH 2 TO AIRSTRIP – LONGITUDINAL SECTION

Location: HUTT VALLEY – PORIRUA ROAD LINK STUDY

Job No.: 5C8709.00

Client: WELLINGTON REGIONAL COUNCIL

Figure: 8

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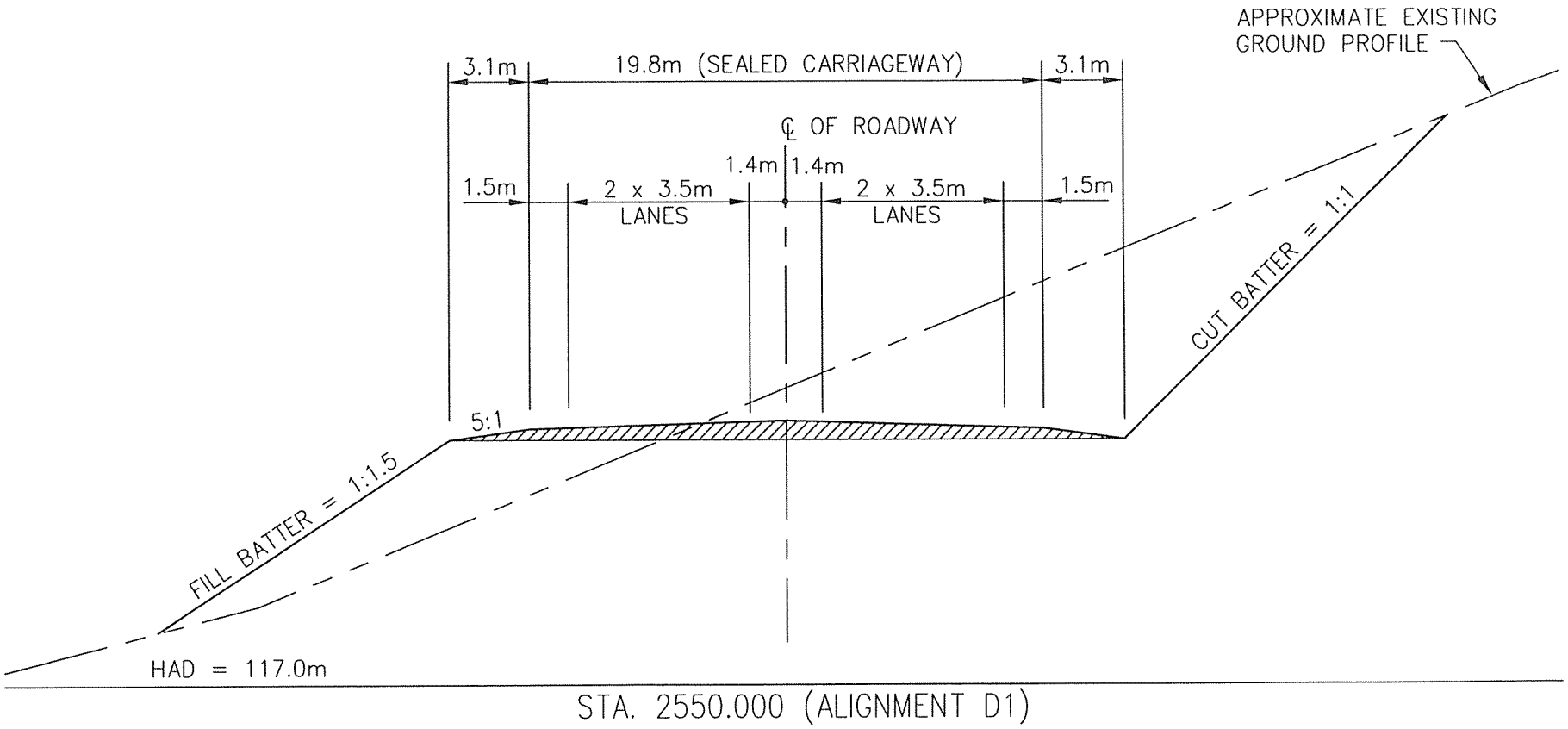
Client: WELLINGTON REGIONAL COUNCIL

Location: HUTT VALLEY - PORIRUA ROAD LINK STUDY

Title: TYPICAL CROSS SECTION THROUGH ROADWAY

Job No. 5C8709.00

Figure 9



TYPICAL CROSS SECTION THROUGH ROADWAY

SCALE 1:250

3.1.1 Engineering

Key features of the project are:

- heavy earthworks form a large component
- catering for natural drainage
- providing a collection and disposal system for the highway stormwater runoff
- road structural and surfacing layers
- structures - these are most likely be bridges associated with the connection of the proposed Link to SH 2 and the existing Hutt City street network, and possible interchanges at SH1-Whitford Brown Ave intersection.

Replacement of batters with retaining walls or fill slopes reinforced with geotextiles could reduce the extent of land taken and be desirable to avoid interfering with streams and watercourses. Initial indications are that with refinements to the alignment some of the fill heights through Speedys Reserve area in particular can be reduced to a height which could be economically retained by a wall or reinforced slope. However, retaining walls for the larger cut heights are unlikely to be technically feasible. If the carriageway is reduced from 4 to 3 lanes the cut height are reduced, but not dramatically.

The earthworks vary from sidling cut/fills to block cut/fills with the average cut height being 18 metres and the average fill depth being 14 metres. The maximum values are given in Table 12.

3.1.2 Construction

Construction is predominantly an earthmoving project, apart from the interchanges at SH 1 and SH2, and any underpasses required at the Porirua end of the link. Features which need to be considered if the project proceeds further, include-

- access to different lengths of the project
- minimising cut/fill imbalance
- sensitivity of the earth materials to moisture
- disposal of unsatisfactory and surplus material
- control of fine material entering the existing watercourses/streams
- providing for natural and carriageway drainage
- the steep highway grades
- environmental concerns
- noise
- contamination of waterways in addition to fine material from the earthworks
- the weather
- supply of roading materials

The proposed highway, apart from where it crosses or connects into existing roads, is entirely new construction and will generally be clear of traffic. Some delays to traffic could

occur at the Porirua end where the link road crosses existing streets. At the sites of SH1 Interchange and SH 2 connections, the impact on traffic flows from the construction could be severe.

3.1.3 Connection to City Street System.

No specific analyses of the requirements has been made nor layouts provided. However, from an initial appraisal it appears that the forms of connections may be as follows:

Hutt Valley End

An all-direction connection with SH2 will need to be considered.
The volumes of traffic crossing the Hutt River may require additional lanes to be provided ie, a second bridge

Porirua End

At Warspite Avenue, either a signalised or roundabout intersection will need to be provided. Alternatively, there may be good reasons to grade separate the crossing and thus avoid increasing the traffic on Warspite Avenue.
At the Whitford Brown Avenue connection, similar forms of intersections are likely to be required.

Possible concept layouts for the Hutt City and Porirua City connections are given in Appendix B4.

Downstream street modifications necessary to cater for increased traffic flows have not been examined in detail. However, possible works are as follows:

Hutt City End

Four laning of Fairway Drive (It appears that the road reserve boundaries of Fairway Drive are generally wide enough to accommodate 4 lanes if required).
Upgrading of the Fairway Drive-High Street intersection may be necessary.

Porirua City End

Four laning of Whitford Brown Avenue (The effect of the Link on both Mungavin and Warspite Avenues will need to be examined further).
Upgrading of SH1-Whitford Brown Ave Intersection (A full at-grade intersection could be necessary)

3.1.4 Property Access Effects

The proposed link will have no direct effect on the existing Landcorp farm access from Hill

Road, but the main internal link through the farm and some side tracks will be affected, both of which are also part of the Regional Park walking track system. It may be necessary to provide some stock overpass/underpasses and a number of accesses directly off the new road, and facilities to cater for users of the Park.

It appears that for all the adjacent urban areas, the present property access points will remain unaffected.

3.1.5 Utilities

The major utilities crossings where conflict may occur are shown in Table 14. For the cost estimates only an indicative cost has been included as the scope of the work has not been defined and it may be possible to modify both the horizontal and vertical alignment of the route to ease the impact.

TABLE 14: NUMBERS OF CONFLICTS BETWEEN UTILITY CROSSINGS AND ROUTE ALTERNATIVES

Crossings	Route		
	D1	D5	E
Transpower Cables/Lines	3	3	2
TransAlta Cables/Lines			
Natural Gas Corporation Pipelines	-	-	1
TransAlta Gaslines	1	2	1
Regional Council Watermain	-	-	1

3.2 Geotechnical

The bed rock consists of Argillite/Greywacke which has been highly fractured through the actions of numerous geological faults and tectonic warping. Most hill slopes are mantled by loess and colluvium, with gullies often partially filled with variable depths of alluvium deposits.

Old remnant landslides/slumps exist within the bedrock, and slips /earthflows have occurred near the surface.

The whole area is in a highly active seismic zone and existing slopes have a low to high susceptability of failure.

Stable cut slopes will be determined by the nature of the rock fracturing, the orientation of the bedding planes and degree of weathering, all of which vary throughout the length of the

route. The slopes recommended for adoption in this study are given in the table below. The slope angles are generalised ones and flatter or steeper slopes may be necessary (or possible) in places to achieve stability. Stabilisation measures such as rock bolting and drainage holes may be appropriate in some locations.

	Cut Faces	**Fill Batter Slopes**
Slope Construction Detail	*Competent bedrock:* 3m wide benches at 8 to 10m intervals *Colluvium,Loess, Alluviums:* 1V:2H	*Fills higher than 10m:* 3m wide berms at 10m height intervals
Overall Slope	1V:1H	1V:2H

The above "overall slope" figure for cut faces was adopted in the estimation of earthwork volumes. However fill slopes were assumed to be 1V:1.5H on the average. No adjustment was made for benching the fill slopes onto a slope. A flatter fill slope could help reduce any earthwork cut surplus.

Soft material can be expected in locations such as the floor of stream valleys. These areas will need to be treated to avoid instablity problems such as settlement and liquefaction/lateral spread.

3.3 Natural Drainage

3.3.1 General

Preliminary appraisals of the water engineering aspects of the D1, D5 and E routes for the proposed Hutt Valley - Porirua link road have been undertaken.

The water courses and streams which could be effected by the route were identified from the topographic plans and a walkover inspection of the site. The effects were assessed in relation to the preliminary design.

The majority of the terrain in the area of the alignment is steep and hilly farmland. Speedys Reserve is steep hilly terrain, covered in dense bush, with the waterways well incised. The terrain near Warspite Ave is significantly flatter and is likely to be more prone to flooding. As the anticipated road surface is to be at the same level, or above the existing level of Warspite Ave, there are unlikely to be any flooding problems for the proposed road. Although the topography is steep there are few obvious signs of major slips.

The proposed route options intersect or pass next to numerous watercourses and drains. By providing sufficient culverts drains of appropriate size, and appropriate diversion of waterways, no problems are foreseen.

3.3.2 Culverts

An assessment of the culvert sizes has been undertaken to assist in working out a scheme cost The sizes and number are only preliminary and will require checking when a more detailed survey of the surrounding land has been undertaken. A minimum culvert size of 450 mm has been assumed for ease of maintenance.

It is expected that additional drainage works will be required to control surface runoff from the road surface or batters in cut.

The changes to the pattern and volumes of flood flows in existing streams due to the modifications to the natural topography brought about by the new highway have not been studied. This includes any effects on existing major culverts such as those under SH2 and at Warspite Avenue.

3.3.3 Major Features

The major features of the work required to cater for existing streams and watercourses are culverts up to 3 m diameter (or 3.5 x 2.2 elliptical), and stream diversions with riprap or gabion protection to the sides and floor of the new channel. In some areas it may be preferable to steepen the slopes using geotextiles, or similar, to avoid having the toe of the batter in the stream.

Major culverts are required where the route crosses Speedys Stream, the unnamed tributory which parallels Hills Road, Duck Creek and the unnamed tributory to Kenepuru Stream which passes under Warspite Avenue.

A summary of the stream/watercourse crossings is given in Appendix B5.

The total length of culverting required is of the order of 1½ km.

4 ENVIRONMENTAL/ PLANNING ISSUES

This section expands on the Environmental and Planning Issues associated with Routes D1, D5 and E given in Section 5.

4.1 Speedy's Reserve

Route D1 will require approximately 13 ha of Speedy's Reserve.

Route D5 will require approximately 14 ha of Speedy's Reserve.

Speedy's Reserve is included in the Hutt City Proposed District Plan as a "significant natural resource". It is also listed in the report "Biological Resources of the Wellington Region" as a protected site. It's protection status is as a reserve in terms of the Reserves Act 1977. Its reserve status needs to be confirmed.

The values of this reserve are as follows:

- Lowland forest on hill country, with diverse canopy species, mahoe/ broadleaved forest.
- Tawa forest with large specimens.
- Large number of bird species.
- Spur/ ridge truncated by movement along a fault. (*Source: Proposed District Plan - City of Lower Hutt*)

Impacts on the Reserve itself include impacts on gazetted reserves (Reserves Act status to be confirmed), loss of indigenous vegetation from significant earthworks, possible downstream impacts on waterways (Belmont Stream/ Speedy's Stream/ Hutt River), impacts on wildlife habitat (Speedy's Stream and bush), noise and visual impacts especially for recreational users of the Reserve, and impacts on Speedy's Stream as a significant geological feature (fault related) (refer Draft Belmont Regional Park Management Plan).

There are provisions within regional and district plans which clearly seek to protect significant natural resources from inappropriate subdivision, use and development. The impact of any development on Speedy's Reserve will be a significant issue. However, there are also likely to be provisions which support this type of development, particularly within transportation and utility provisions.

Hutt City Council have provided information showing that the lower parts of Speedy's Reserve are gazetted as scenic, recreation and esplanade reserve. Some parts are also shown to be in private ownership. The status and ownership of all of Speedy's Reserve needs to be confirmed by way of a title search. Some of the gazetted reserves will be affected by both Routes D1 and D5. There is currently no management plan for Speedy's Reserve.

Section 48 of the Reserves Act sets out the procedure for granting a right of way or easement over a reserve. It sets out strict requirements including:

(i) that consent be obtained from the Minister of Conservation; and
(ii) that any proposal be publicly notified and made open for submissions.

Therefore, it is imperative that further investigation of a route through Speedy's Reserve involve consultation with the Department of Conservation. There will also need to be consultation with the Parks and Recreation Division of the Regional Council, as part of Speedy's Reserve lies within the Belmont Regional Park.

4.2 Impacts on Other Identified Biological/ Ecological Resources

Route D

Route D5 passes around the outside of a remnant of Significant Natural Resource area number 2 (refer Hutt City Council Proposed District Plan). The remnant area is identified as Belmont Road and Saddle Bush. With careful placement, the route should not affect this area.

Route E

Route E crosses the tips of Ecologically Significant Site number 2 (refer Draft Belmont Regional Park Management Plan). This site is listed as Belmont Hills Bush (north of Round Knob) and is valued for its nikau forest which is uncommon in the Region and its maintenance of a bird habitat in an area lacking forest cover. This site is protected by way of a covenant.

Route E also passes close to two Covenant Areas, A and B (refer Draft Belmont Regional Park Management Plan), which are two of eight conservation covenants placed on land owned by Landcorp Farming Limited within the Belmont Regional Park. The conservation covenants have been made pursuant to section 77 of the Reserves Act 1977. Conservation Covenant A is an area of 29.20 hectares at Takapu Road. Conservation Covenant B is an area of 11.30 hectares at Cannons Creek. Again, careful placement of the route during final design should mean that both areas can be avoided.

Route E crosses the main ridgeline in the vicinity of Round Knob. Round Knob is listed as a "significant natural resource" in the Hutt Proposed District Plan. The area is identified as a "flat topped or gently rounded summit on the Western Hills, representing peneplain remnants." Whilst Route E avoids the area shown marked on the Hutt Proposed District Plan planning maps, the route does appear to impact on the peneplain remnants of Round Knob and northeast of Hill road, as shown in the Draft Belmont Regional Park Management Plan. These are identified as regionally/ locally significant geological features in the Management Plan.

4.2.1 Impacts on Significant Waterways

Route D

Routes D1 and D5 both have the potential to have downstream effects on the Hutt River, especially during the construction period when bare earth surfaces are exposed. With the adoption of appropriate mitigation measures, it should be possible to manage and minimise any downstream effects. The impact on water flows should be insignificant.

Wellington Regional Council have recently released a Proposed Regional Freshwater Plan. This document will need to be assessed to determine its implications in terms of regional consents that will be required. It is noted that the Hutt River is listed in the Proposed Regional Freshwater Plan as a "Water Body with Important Trout Habitat" and a "Water Body with Regionally Significant Amenity and Recreation Values". Duck Creek is listed as a "Water Body with Nationally Threatened Indigenous Fish Recorded in the Catchment."

Route E

Route E crosses an upper tributary of Duck Creek. If this is culverted, with substantial filling involved, the impact on indigenous fish will need to be assessed..

4.2.2 Visual/ Noise Impacts

Route D

Route D1 will be visible from residential parts of Hill Road, Belmont, but not Kelson, whereas portions of Route D5 will be visible from Kelson but not from Hill Road. The route, including the earthworks and/or roadway, will also be visible within Belmont Regional Park, especially from the Hill Road entry, west to Round Knob, and from the Cannons Creek entry.

Route D5 will also be visible from the major track through the Landcorp farm which is both a private road and a walking track (to be referred to as "Belmont Road farm track"). Both Routes D1 and D5 will have high noise impacts on Speedy's Reserve. They also have the potential to have relatively high noise impacts for the nearby suburban areas of Belmont and Kelson.

The route will also have noise impacts within the Park, causing disruption to Landcorp's farming operation (within Kilmister, Waitangirua and Takapu Blocks), and Park users such as walkers, horse riders, mountain bikers, orienteering groups, especially from the Hill Road and Cannons Creek entry points.

An indicative view of the general location of the proposed highway in the landscape for the section SH2 Kennedy Good Bridge to the Airstrip is given in Appendix B8.

Route E

Route E crosses the top of the Western Hutt Hills in the vicinity of Round Knob. Round Knob is identified in the Wellington Regional Council Draft Regional Landscape Plan as a prominent ridgeline.

The route will also affect the grassed open hill tops (generally above the 250m contour) which are identified as a regionally significant landscape of the Park in the Draft Belmont Regional Park Management Plan.

The visual impact of the route as viewed from the Hutt Valley or Porirua urban areas is unlikely to be significant.

Route E crosses two Landscape Protection Areas identified within the Proposed Porirua City District Plan. The first is across the Belmont Hills east of Waitangirua and Cannons Creek. The second is in the Aotea Block south of Ascot Park. The rules applying to Landscape Protection Areas make earthworks a discretionary activity.

Route E will have relatively high visual and noise impacts for Waitangirua, Cannons Creek and Ascot Park.

An indicative view of the general location of the proposed highway in the landscape where the route descends from the Airstrip to the headwater of Duck Creek is given in Appendix B3.

4.2.3 Traffic Impacts

Hutt Valley end

Access to Kelson via Major Drive will remain in principle . The form of access between the suburban area, the state highway and Hutt City will depend on the intersection layout details. With a major new road being introduced into the area there is the potential for some inconvenience to occur to motorists such as slightly longer routes.

If the link is continued across to the other side of the Hutt River and four lanes are required, a second bridge will need to be built. Fairway Drive may also need to be widened. It appears that this should be able to be done within the existing road reserve. The main impact for residences along Fairway Drive will be increased noise levels. There could also be increased delays at the Fairway/ High Street intersection.

Porirua end

Whitford Brown Avenue may need to be widened to 4 lanes to handle the traffic volumes. There are also likely to be increased delays at the Whitford Brown/ SH1 intersection. The traffic effects of the route at Warspite Avenue and the downstream effects on the

Waitangirua and Cannons Creek Suburbs have not been assessed. The size of affect and options for addressing these will need to be looked at as part of any further investigation.

4.2.4 Access

A significant positive effect of the proposed link is the potential to provide an improved access to the Regional Park.

The Route crosses the Belmont Road farm track. An underpass/ overpass will need to be provided to maintain uninterrupted access along this farm track.

A number of other existing farm and Park tracks will be affected by the route including Old Coach Road, and the Cannons Creek entry into the Park. Activities/ users likely to be affected by this include the Landcorp farming operation (within the Kilmister, Waitangirua and Takapu Blocks), walkers, horse riders, mountain bikers, orienteering groups, users of Cannons Creek entry. It may be possible to reorganise some of the walkways. There needs to be further investigations of the impacts and options for maintaining existing links through and within the Park.

The location of the former Maori trail, identified in the Draft Belmont Regional Park Management Plan, is unknown. The impact of the Route on this trail will need to be investigated through direct consultation with Iwi.

4.2.5 Landcorp Farm Operation

As discussed above, the route passes through the Kilmister, Waitangirua and Takapu Blocks of the Belmont Regional Park. The Waitangirua Block is privately owned by Landcorp Farming Limited. The Kilmister Block is by Hutt City Council. The Takapu Block is owned Crown owned. Both the Kilmister and Takapu Blocks are leased to Landcorp Farming Limited for farming purposes. The whole area is known as the Waitangirua/ Kilmister Management Zone.

Therefore, the route will have a direct effect on the Landcorp farming operation. As discussed, the route crosses a number of farm tracks including the Belmont Road farm track. It is proposed that the link along this track will be maintained through grade separation. In addition, the impacts on other farm tracks and the options for addressing these will need further investigation.

The route also passes between a farm house, farm workers building, woolshed, stock yards near the Belmont Road farm track, separating the farm house and workers building from the woolshed and stockyards. Provided the access along Belmont farm track is maintained, the impact will be minimised.

In terms of the operation of the farm, there is likely to be some severance of paddock blocks. These will require some reorganisation including possible new fencing.

The route also passes to the south of the farm's top dressing airstrip (at its closest point the route is approximately 50 metres away from the airstrip, but in terms of the flight path, the route is approximately 100 metres away). The impact of the route on the operation of the airstrip needs to be assessed.

4.2.6 Historical and Cultural Impacts

The Route passes to the south of the majority of the Belmont Magazines (identified as an important feature of the Belmont Regional Park in the Draft Belmont Regional Park Management Plan), causing approximately 10 to be isolated from the main block. A further three will be directly impacted by the Route.

A number of "probable house sites" are identified in the Draft Belmont Regional Park Management Plan. The impact of the Route on the probable house sites is unknown at this stage and will require further investigation.

Impact on former Maori trail - refer comments above.

The route joins Whitford Brown Avenue virtually opposite Horouta Marae. Horouta Marae is listed in the Proposed Porirua City District Plan as a Heritage feature with importance to tangata whenua (Ngati Porau). If four lanes are required, Whitford Brown Avenue will have to be widened. The type of impact on Horouta Marae will depend on which side of Whitford Brown Avenue is widened. If the southern side is widened, then the impacts will be indirect, such as noise from increased traffic levels. If the widening occurs on the northern side, then the impacts will be both direct and indirect. The impacts need to be further assessed in consultation with iwi when more details are known.

4.2.7 Relevant Documents

The following is a list of the statutory documents relevant to this study:

- Operative Wellington Regional Policy Statement
- Proposed Regional Freshwater Plan
- Draft Regional Landscape Plan
- Proposed Regional Discharge to Land Plan
- Proposed Regional Air Quality Management Plan
- Draft Regional Soil Plan
- Draft Belmont Regional Park Management Plan
- Proposed Hutt District Plan
- Proposed Porirua City District Plan

Most are still either at a proposed or draft stage. The implications of these will need to be reviewed as they become operative.

The Operative Wellington Regional Land Transport Strategy is also relevant to this study. It is understood to be currently under review.

4.2.8 Further Investigations

If the proposal is advanced to the next level of commitment, a number of specific investigations will need to be made in relation to the actual and potential effects associated with the construction of the arterial. They include the following:

- Ecological
- Landscape
- Visual
- Noise
- Archaeological
- Cultural
- Geotechnical/ Geology
- Traffic
- Landcorp Farm Operation
- Community Impacts

It is important that these are preceded by consultation with the Department of Conservation over Speedy's Reserve, consultation with Parks and Recreation Division of WRC and any other relevant Regional Park land owners over the impacts on Belmont Regional Park and consultation with Iwi.

5 ECONOMICS

5.1 Construction Costs

The costs given in Section 5 of Part A for the D1 and E options have been reappraised from a further examination of the scope and extent of the work involved. The estimates, which assume a four lane highway, are based on the scheme plans prepared and further investigation undertaken. No specific design has been undertaken and as a result some of the quantities adopted are largely based on experience and are subjective. The schedule has been as made as comprehensive as possible within the degree of refinement of the investigation. The items included are summarised in Table 15 and given in more detail in the Cost Estimate Schedule which is included in Appendix B6.

Refinements to the earthwork quantities have been discussed earlier. From inspection it is apparent that not all of the peaks and hollows in the ground surface are being picked up in the topographic modelling, and a more accurate topographic base is needed to improve the estimates. An arbitrary increase of 15 % has been made to the earthwork volumes to compensate for this. In addition, a cut to fill volume factor of 90 % has been adopted.

The costs of the property required for the scheme are based on data supplied by Valuation NZ, and includes estimates of the likely legal, valuation and purchase fees. No allowance has been made for severance or betterment costs.

Between Warspite Avenue and Whitford Brown Avenue, no earthworks quantities were obtained as the topographic model did not extend that far. The estimated cost of this section has been based on the "per kilometer" cost of the remainder of the project. This also applies to the alternative schemes evaluated in the economics to link Route D to Porirua East.

Professional services relating to planning, investigation, design and construction supervision have been included as a percentage fee.

A summary of the construction cost estimates for Routes D1/E and D5/E, over the length of SH2 to Whitford Brown Avenue, is given in Table 15.

The accuracy of the estimate is assessed as -30% to +50%.

It is noted that earthworks accounts for approximately 40% of the total estimated cost of the road construction component of the project. Any changes to the quantities and rates for this item will have a significant impact on the total cost.

For a three lane highway the estimate is roughly of the order of $10 million less.

It has been assumed that the annual maintenance which includes repairs will be of the order of $2,000 per kilometer. Reseals which will occur at 10 year intervals have been assumed to be $70,000 per kilometer.

The costs of the principal components which made up each option analysed in the economic evaluation are given in Tables 16 and 17. Descriptions of the options analysed for traffic flows and economic benefits are given in Table 17.

TABLE 15 : SUMMARY OF CONSTRUCTION COST ESTIMATES

	Route D1/E ($million)	**Route D5/E** ($million)
SH2 Belmont to Warspite Ave (Construction)	27.9	34.6
Warspite to Whitford Brown Av (Construction)	5.2	5.2
Contingency	8.5	10.6
Professional Services	6.1	7.2
Property (SH2 to Whitford Brown Ave)	1.0	1.1
Grade Separated Interchanges (total) • SH 2 Belmont including Hutt River crossing • SH 1/Whitford Brown Avenue • Transmission Gully	34.8	34.8
Local Street Upgrading (HCC & PCC)	1.0	1.0
Total	84.5	94.5

TABLE 16 : SUMMARY OF CAPITAL COSTS ADOPTED FOR ECONOMIC EVALUATION

	Route D1/E ($million)	Route D5/E ($million)
SH2 Belmont to Warspite Ave	41.0	50.0
Warspite to Whitford Brown Ave	8.0	8.0
Warspite Underpass	0.5	0.5
Whitford Brown widening	1.0	1.0
Fairway Drive upgrading	0.5	0.5
SH 1 - Whitford Brown Ave interchange	12.0	12.0
SH 2 Belmont Interchange	12.0	12.0
Duplicate K G Bridge across Hutt River	4.0	4.0
Transmission Gully Interchange	7.0	7.0
Total	84.5	94.5
The following were derived from the above costs on a length basis		
SH2 Belmont to James Cook Drive via Transmission Gully	49.0	59.0
SH2 Belmont to Kenepuru Drive via Transmission Gully	59.0	59.0
SH2 Belmont to Transmission Gully	32.0	39.0

TABLE 17 : TRAFFIC MODELLING OPTIONS, SCOPE OF PROJECT AND ESTIMATED COST

Options		Scope of Project	Total Cost
1	1.1	Route D1/E to Warspite Ave	
	1.2	SH 2 Interchange	
	1.3	Duplicate K G Bridge + Fairway Dr improvements	$57.5m
2	2.1	Route D1/E to Warspite Ave	
	2.2	Warspite Ave to Whitford Brown Ave	
	2.3	SH 2 Interchange	
	2.4	Duplicate K G Bridge + Fairway Dr improvements	
	2.5	Whitford Brown Ave improvements	
	2.6	SH 1/Whitford Brown Interchange	$78.5m
3	3.1	Route D1/E to Warspite Ave	
	3.2	Warspite Ave to Whitford Brown Ave	
	3.3	Warspite Ave underpass	
	3.4	SH 2 Interchange	
	3.5	Duplicate K G Bridge + Fairway Dr. improvements	
	3.7	SH 1/Whitford Brown Interchange	$78.5m
4	4.1	Route D1 + Modified E	
	4.2	Transmission Gully (TG) highway	
	4.3	TG to James Cook Drive	
	4.4	SH 2 Interchange	
	4.5	Duplicate K G Bridge + Fairway Drive improvements	$65.5m
5	5.1	Route D1 + Modified E	
	5.2	Transmission Gully (TG) highway	
	5.3	Link to Kenepuru Drive	
	5.4	SH 2 Interchange	
	5.5	Duplicate K G Bridge + Fairway Drive improvements	$65.5m
6	6.1	Route D5/E to Warspite	
	6.2	SH 2 Interchange	
	6.3	Duplicate K G Bridge + Fairway Drive improvements	$66.6m
7	7.1	Route D1/E to Transmission Gully highway	
	7.2	SH 2 Interchange	
	7.3	Duplicate K G Bridge + Fairway Drive improvements	
	7.4	Transmission Gully/HVP Link interchange	$55.5m
8	8.1	Route D5/E to Transmission Gully Highway	
	8.2	SH 2 Interchange	
	8.3	Duplicate K G Bridge + Fairway Drive improvements	
	8.4	Transmission Gully/HVP Link interchange	$62.5m

5.2 Traffic Benefits

The time streams for all of the routes and schemes analysed assumed that design and construction would take 2 years. A base date of July 1996 was adopted with the first benefits occurring in year 4. Variations which delayed the construction of the more "distant" components of the overall scheme (such as SH1 - Whitford Brown Avenue interchange) by 5 years were also examined for some of the options. The results are given in Table 16.

The traffic benefits for the two schemes have been calculated using four approaches in an attempt to gain a realistic range of the project benefits and to reflect the uncertainities involved. The appraoches were:

A. Utilising the calculated benefit growth rate for the period from 1996 to 2011, extended over the full analysis period;
B. Utilising the calculated benefit growth rate for the period from 1996 to 2011, but with benefits capped at the 2011 year values;
C. Using only the calculated 1996 benefits, with benefit growth matching the suggested traffic growth rate of 2.5%.
D. Assuming that the 2011 benefits would not occur until 2026 (i.e. assuming that the Year 15 benefits would occur in Year 30 instead) which therefore halves the assumed benefit growth rate over the analysis period.

The results are presented in Table 18. The data shows that the project benefits come almost exclusively from travel time costs. For some options the vehicle operating costs may actually lead to disbenefits.

Using the definitions contained with the Transit NZ Project Evaluation Manual, this road would be categoried as 'Rural Strategic', as an 'arterial or collector road connecting main cetnres of population and carrying over 2,500 vehicles per day'. As a result, a base travel time cost of $22.20 (1994) per hour was applied for calculation of travel time benefits, and updated to 1996 values.

However, it is likely that a significant proportion of the traffic which would benefit either directly from the use of this road or from the decongestion benefits elsewhere in the network would be commuter traffic with a lower unit travel time cost. Taking an average unit value of time for the 'Rural Strategic' and 'Urban Arterial' road type would give a value of $18.65 per hour. The application of this value would result in a reduction of approximately 16% in the estimated travel time benefits for the project.

This indicates that information is required with respect to the trip purposes of the traffic movements which would be likely to use this road. It would be appropriate to collect such information as part of the subsequent stages of the analysis of the project.

The calculations for the benefits are given in Appendix B7.

TABLE 18 : SUMMARY OF BENEFITS FOR OPTIONS

Options		Total PV Benefits ($ Million)			
		Method A	Method B	Method C	Method D
Without Transmission Gully					
1 (D11)	Route D1 & E (to Warspite Ave Only)	372.6	337.3	78.4	216.7
2 (D12)	Route D1 & E (to Warsp. & Whit. Br. Ave)	480.3	433.4	85.0	273.1
3 (D13)	Route D1 & E (to Whitford Brown Ave only)	403.1	364.3	77.5	231.6
4 (D1B)	Route D1, E1, TG(N) & B	193.8	176.0	47.1	115.2
5 (D1K)	Route D1, E2, TG(S) & Kenepuru Dr Link	597.0	536.6	81.5	330.1
6 (D51)	Route D5 & E (to Warspite Ave only)	353.6	320.2	74.6	205.7
With Transmission Gully					
7 (D1G)	Route D1 (to join TG Route)	523.9	473.4	99.5	300.5
8 (D5G)	Route D5 (to join TG Route)	505.4	456.0	88.2	286.9

It is believed that methods A and B both overstate the true benefits of the project, because the 2011 values are unrealistically high, as the congested travel times rise at an unrealistic rate. The vehicle operating costs (VOC) values change by 62% (for the Do Minimum) between 1996 and 2011, but the travel time costs (TTC) rise by 139%.

Method C almost certainly understates the benefits because some congestion growth greater than the traffic growth rate would be expected.

Method D probably represents a reasonably sensible compromise between the other methods, because it recognises that the predicted level of future year benefits may be unreasonably high, so it places that level of benefits a long way into the future. As a result the benefit growth rate over the analysis period is more realistic.

Accidents have not been included in the analysis. As the forecast vehicle-kilometres are reduced with the Hutt Valley-Porirua Link it is expected that the accident costs will drop in line with the reduced exposure. The effect will be roughly similar for all schemes.

Excluding the accident benefits therefore gives a conservative estimate of the economic performance of the scheme.

The economic evaluation is subject to a number of uncertainties at this early stage. Listed below is a summary of some of the factors which it is considered may result in either the over or under statament of the 'true' economic benefits;

Reasons why analysis may over-state benefits

- unit value of time could be lower, depending upon the composition of traffic flows in terms of trip purpose

Reasons why analysis may under-state benefits

- accident benefits have not been evaluated
- travel time and vehicle operating costs have been aggregated over the normal weekday periods throughout the year. Benefits will also accrue during weekend, holiday and night-time periods

5.2.1 Benefit - Cost Ratio

The time streams for all of the routes and schemes analysed assumed that design and construction would take 2 years. A base date of July 1996 was adopted with the first benefits occurring in year 4. Variations which delayed the construction of the more "distant" components of the overall scheme (such as SH1 - Whitford Brown Avenue interchange) by 5 years were also examined for some of the options. The results are given in Table 19.

The benefit-cost ratios for Routes D1/E and D5/E are also given in Table 19. An assessment of the robustness of the results has been made through a sensitivity check using variations suggested in the TNZ Project Evaluation Manual. The B/C ratio was calculated for a range in cost of -20%/+30%. The range in benefits due to variations in traffic base volume and growth rates, traffic mix, occupancy etc was simplified to be +/- 25% of the the sum of VOC and TTC.

6 SUMMARY AND CONCLUSIONS

6.1 The more detailed investigation into Route D/E has indicated that a scheme which generally follows the Route D/E corridor is technically feasible, and has the potential to be economically viable as well.

Variations to this route (D1 and D5) exist at the Hutt valley end, in particular at Speedys Reserve, but all connect to the Kennedy Good Bridge link into Hutt City.

Alternatives at the Porirua end are to connect to

- Warspite or Whitford Brown Avenues,
- Kenepuru Drive via Transmission Gully alignment,
- James Cook Drive via Transmission Gully alignment.

6.2 The predicted, generalised traffic volumes for a connection between Kennedy Good Bridge in the Hutt Valley and terminating in Porirua at either Porirua East (Warspite/Whitford Brown Aves), Whitby (James Cook Drive) and Kenepuru Drive, using the results of the modelled 1996 flows, are given below. These volumes are based on the 11-hour figures given in Table 10, factored by 1.33 to represent the 24 hour volumes or AADT.

- The daily traffic volumes on a route which links into Porirua East are predicted to be 10,000 to 11,000 vpd (two way), increasing by approximately 30% by the Year 2011 to be 14,000 to 15,300 vpd. The volume on the Link is largely independent of whether the link terminates at Warspite Avenue or Whitford Brown Avenue.

  With Transmission Gully highway the volumes are higher by approximately 1,000 vpd.

- A link to *Kenepuru Drive* attracts slightly less traffic.

- A link to *James Cook Drive* attracts about 60% of that on the direct link to Porirua East.

- Of the alternative alignments through Speedys Reserve, Option D5 attracts slightly lower volumes than Option D1 because of its greater length.

- With a link to Porirua East, the volume on *SH1 at Ngauranga Gorge* decreases by 5,000 vpd. With a connection to Kenepuru Drive the volume is 700 vpd higher, but approximately 2,500 vpd lower if the connection is to James Cook Drive.

- For a connection to Porirua East, the volume on *SH2 between Ngauranga and Petone* drops by 3,500 vpd. This volume drop is greater by 1,500 vpd with the Kenepuru Drive connection, and less by 1,200 vpd with the James Cook Drive connection.

  The daily volumes on *SH2 on the Wellington side of the Kennedy Good Bridge* intersection increase by approximately 6,500 vpd. These volumes fluctuate between

5,200 and 6,800, depending on the location of the connection into Porirua City.

On the *Upper Hutt side of the Kennedy Good Bridge* intersection the volumes decrease by aproximately 2,500 vpd.

With Transmission Gully highway in place these volumes are greater at both locations.

- The daily traffic volumes in *Warspite Avenue* could increase by 3,700 vpd if a connection is made in that location.

  With Transmission Gully and a Hutt Valley-Porirua link in place this volume is likely to climb to 6,500 vpd.

- Traffic volumes at the *Whitford Brown Avenue intersection with State Highway 1* will increase by between 4,300 and 6,300 vpd, depending on whether or not a connection is made to Warspite Avenue.

- The volume of traffic crossing *Kennedy Good Bridge* is predicted to increase by between 6,200 and 6,900 vpd and is largely independent of the location of the connection at the Porirua City end.

  In year 2011 the volumes are likely to be two to three times higher than at present, ie of the order of 28,000 vpd.

- The traffic volumes on *State Highway 58 east of Pauatahanui* decrease by approximately 5,700 vpd irrespective of the location of the connection into Porirua East. The effect is approximately 1,500 vpd less with the James Cook connection, and 1,100 vpd less with the Kenepuru Drive connection.

  With Transmission Gully highway alone the volumes on SH58 increase by about 5,400 vpd but with the introduction of the Link a reduction of 5,700 vpd occurs.

  The traffic volumes on *State Highway 58 west of Pauatahanui* are only significantly affected by one of the schemes. The connection of the Link into James Cook Drive increases the traffic volumes by approximately 100%, ie 4,000 vpd.

All of the above volumes, including changes in volumes, will increase with time. The predicted Year 2011 volumes are between 30 and 50% higher, except for State Highway 58 where higher increases of up to 90% are predicted.

The directional flows at all sites are generally not equal (ie 50/50 split), and the ratios differ throughout the network. The most notable difference occurs on Kennedy Good Bridge and the adjacent section of SH2 to the south. On Kennedy Good bridge the volume of westbound traffic exceeds that for the eastbound direction by up to 4,700 vpd. For SH2, the ratio of southbound to northbound traffic volumes is 0.53/0.47.

6.3 The design speed is of the order of 70 km/hr (operating speed 80 km/hr) and there are substantial lengths of highway with grades as steep as 8%.

The preliminary design of the trial alignment indicates that a large excess volume of earthworks may occur. Finetuning of the alignment and easing of batter slopes will help in reducing the quantity. However, use of surplus material will need to be investigated in following phases.

6.4 The scheme costs range from $55 to $78.5 million.

6.5 The accuracy of the alignment details and estimates of cost are such that the route should be considered as a corridor.

6.6 The environmental concerns primarily relate to the impacts on the urban areas of Kelson, Belmont, and Waitangarua and Speedys Reserve. The impacts are significant and will need to be addressed early in any following investigation phase before a commitment to the proposal is made.

6.7 From the range in results obtained in the analysis (which is to be expected with the level investigation conducted) a cautious approach to the interpretation of the economic results is recommended. Thus, the "lower bound" figures are quoted as the representative benefit-cost values.

- *Without Transmission Gully*

  The economic calculations, based on the traffic data used and cost estimates indicate that a route linking Kennedy Good Bridge with Kenepuru Drive via Route D1 and part Transmission Gully (Option 5) has the highest benefit-cost ratio (B/C = 3.7).

  Routes D1/E to Warspite Avenue (Option 1), and Route D1/E to Whitford Brown Avenue (Option 2) have the next highest benefit-cost (B/C = 2.8 and 2.6 respectively).

  On an incremental benefit-cost basis, Option 5 (Route D1, Part TG and link to Kenepuru Drive) is favoured.

- *With Transmission Gully*

  If Transmission Gully is in place, Route D1 which joins the Transmission Gully highway has a slightly higher benefit-cost ratio (B/C = 4.0) than Route D5. Both assume that a link between Transmission Gully Highway and Warspite Ave/Whitford Brown Avenue already exists.

7 RECOMMENDATIONS

7.1 A corridor based on Routes D1/E2/Part Transmission Gully and a link to Kenepuru Drive should be the subject of further investigation before a firm commitment is made to it's adoption. This investigation should be undertaken to Transit New Zealand's Scheme Plan standards.

7.2 Investigations into the geometry of the route should include:

- examining the optimal choice of number of lanes,
- fine tuning the alignment to seek a balance between operating speed, grade, and earthworks balance,
- reducing the impact on environmentally sensitive features.

7.3 The earthworks component of the estimated construction cost is significant. To ascertain the volumes and extent of the earthworks more fully and confirm the estimates it will be necessary to:

- obtain a more refined topographic model of the corridor,
- determine more closely the slope and stability parameters throughout the length of the recommended route.

7.4 The traffic analysis should be refined using the Wellington Regional Council's updated GATS model which includes the latest available census information. Additional aspects to be examined would include:

- the effects on the local road network, (particularly within Hutt City and Porirua City),
- stage construction, such as delaying some of the construction which has been assumed to be part of the scheme in this study, (eg the duplication of the Kennedy Good Bridge),
- determining an appropriate time when the project should proceed based on capacity limitations within the present arterial network and other relevant factors.

Some additional modelling work will be necessary to evaluate turning movements at intersections.

7.5 The calculated range of traffic benefits is high. This obviously needs to be examined further in conjunction with the traffic volume forecasts to enable more robust economic forecasts to be made. The economic evaluation should include:

- the impacts the proposed Hutt Valley-Porirua Link would have on a future Transmission Gully Highway,

- public transport issues.

7.6 A closer examination of the environmental effects be conducted over the complete corridor and in particular for Speedys Reserve. The examination should include:

- early consultation with the Department of Conservation, Wellington Regional Council and Hutt City Council to ascertain their likely support for the proposal and the values of the Reserve in detail.
- the impacts on residents in the vicinity.
- reviewing the options, including the use of Major Drive

It is recommended that work directly relating to evaluating the impact which the routes would have on the Reserve be given priority in the next phase of developing the scheme.

APPENDIX A1

Traffic Flow Diagrams

(Refer to Working Paper Appendices)

SUMMARY OF ROUTE SECTION LENGTHS
SCHEMES WITH TRANSMISSION GULLY

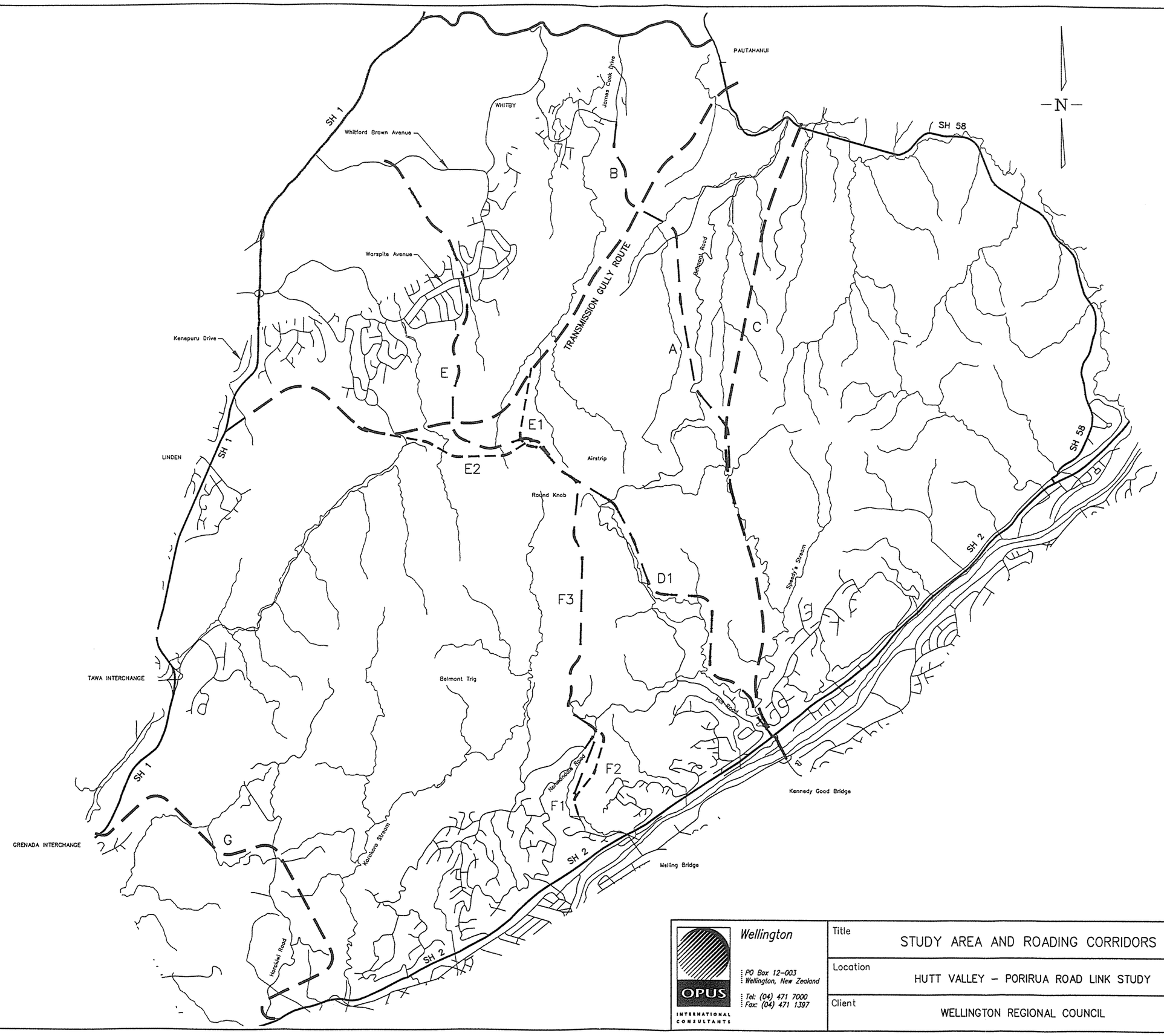
Scheme	Length of Sections of Route (km)	Comments
1: Routes A & E (TG to Warspite)	A 7.7 E 2.0	
2: Routes A, E (TG to Whitford Brown)	A 7.7 E 3.8	
3: Routes A, E (TG to Whitford Brown) & B	A 7.7 E 3.8 B 1.3	Total A+B 9.0 km
4: Routes D & E (TG to Warspite)	D 8.0 E 2.0	Total D+E 10.0 km
5: Routes D, E (TG to Whitford Brown)	D 8.0 E 3.8	Total D+E 11.8km
6: Routes D, E (TG to Whitford Brown) & B	D 8.0 E 3.8 B 1.3	Total D+E 11.8 km
7: Routes F & E (TG to Warspite Ave)	F 6.8 E 2.0	Total F+E 8.8 km Additional length along ex street to SH2 is 0.9 km
8: Routes F & E (TG to Whitford Brown)	F 6.8 E 3.8 B 1.3	Total F+E 10.6 km Additional length along ex street to SH2 is 0.9 km
9: Routes F, E (TG to Whitford Brown) & B	F 6.8 E 3.8 B 1.3	Total F+E 10.6 km
10: Route C & E (TG to Warspite)	C 8.4 E 2.0	
11: Route C, E (TG to Whitford Brown) & B	C 8.4 E 2.0 B 1.3	
12: Route G, E (TG to Whitford Brown) & B	G 6.6 E 3.8 B 1.3	

SUMMARY OF ROUTE SECTION LENGTHS
SCHEMES WITHOUT TRANSMISSION GULLY

Scheme	Length of Sections of Route (km)	Comments
13: Routes A & B	A 7.7 B 1.3	Total A+B 9.0 km
14: Routes D & E (TG to Warspite Ave)	D 6.5 E 3.5	Total D+E 10.0 km
15: Routes D, E (TG to Whitford Brown)	D 6.5 E 5.3	Total D+E 11.8 km
16: Routes F & E (TG to Warspite)	F 5.3 E 3.5	Total F+E 8.8 km
17: Route F, E (TG to Whitford Brown)	F 5.3 E 5.3	Total F+E 10.6 km
18: Routes D, TG & B	D 7.9 TG 2.6 B 1.3	Total D+TG+B 11.8 km
19: Routes F, TG & B	F 6.7 TG 2.6 B 1.3	Total F+TG+B 10.6 km Additional length along ex street to SH2 is 0.9 km
20: Route C	8.4	
21: Route D (no link to SH1)	11.5	
22: Route G	6.6	
23: Eastern Hutt Rd Link	1.0	
24: Upgrade SH58		

APPENDIX A2

Summary of Route Section Lengths and Plan of Routes



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Title	STUDY AREA AND ROADING CORRIDORS INVESTIGATED	
Location	HUTT VALLEY – PORIRUA ROAD LINK STUDY	Job No. 5C8709.00
Client	WELLINGTON REGIONAL COUNCIL	Figure A2

APPENDIX A3

Summary of Utilities Effected

AFFECT OF ROUTE SECTIONS ON UTILITIES
NUMBER OF CONFLICTS

	Scheme Section	Transpower Cables/Lines	Power Direct Cables/Lines	Natural Gas Corp Pipelines	Gas Direct Pipelines	Regional Council Water Main	Comment
A	SH2 Belmont (KGB) to Transmission Gully	4	1 (?)	2	2	2	
B	Transmission Gully to James Cook Drive	1				1	
C	SH2 Belmont (KGB) to SH58	4	1 (?)		1	1	
D	SH2 Belmont (KGB) to Airstrip Junction	3			1		
E	Airstrip Junction to Warspite Ave	2		1	1	1	
E1	Airstrip Junction to TG North	1					Does not include TG Link
E2	Airstrip Junction to TG South (Takapu Rd)	3		1	1	1	
F1 F2	SH2 (Melling) to Normandale Rd - alternative alignments	1 (?)					
F3	Normandale Rd to Airstrip Junction	1			4		
G	SH2 (Horokiwi Rd) to Grenada/(Tawa i/c)	3					
TG Link				2	1	1	Takapu Rd (approx) to James Cook Drive

Notes: This list is preliminary only. Consultation with the utility owners/operators has not been undertaken for this stage.

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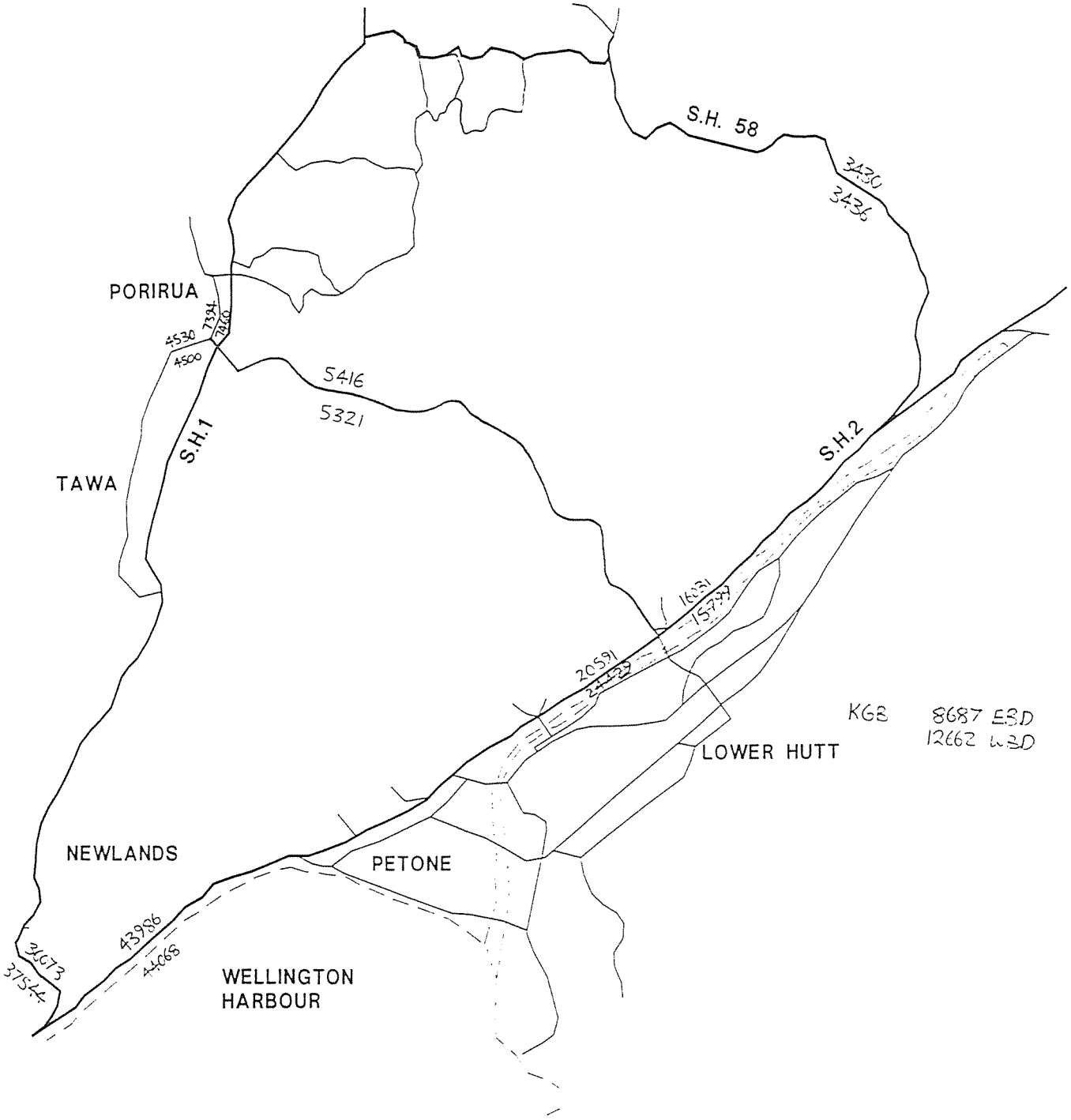
APPENDIX A4

Summary of Overall Environmental and Social Features, and Evaluation

(Refer to Working Paper Appendices)

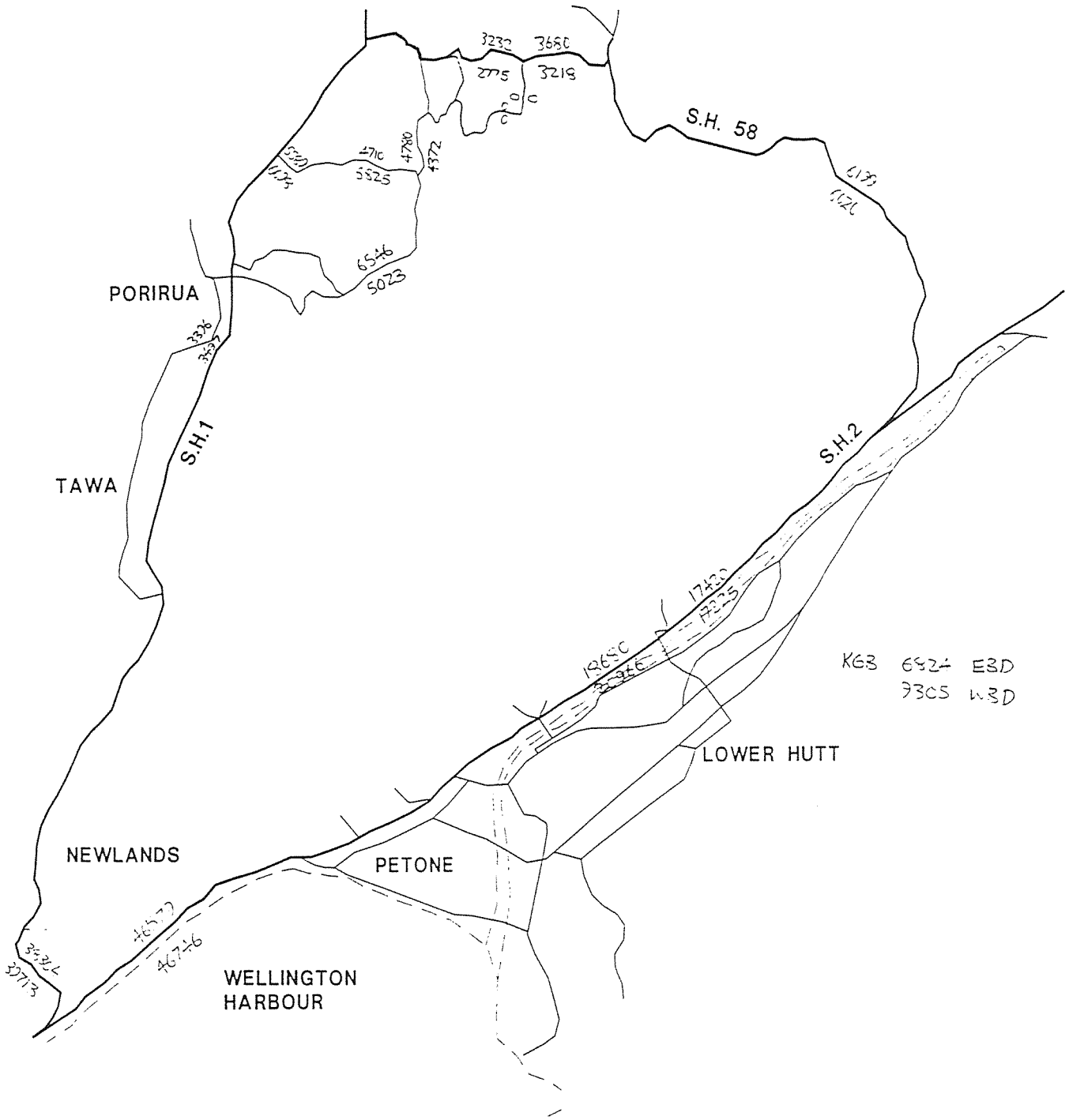
APPENDIX B1

Traffic Flow Diagrams



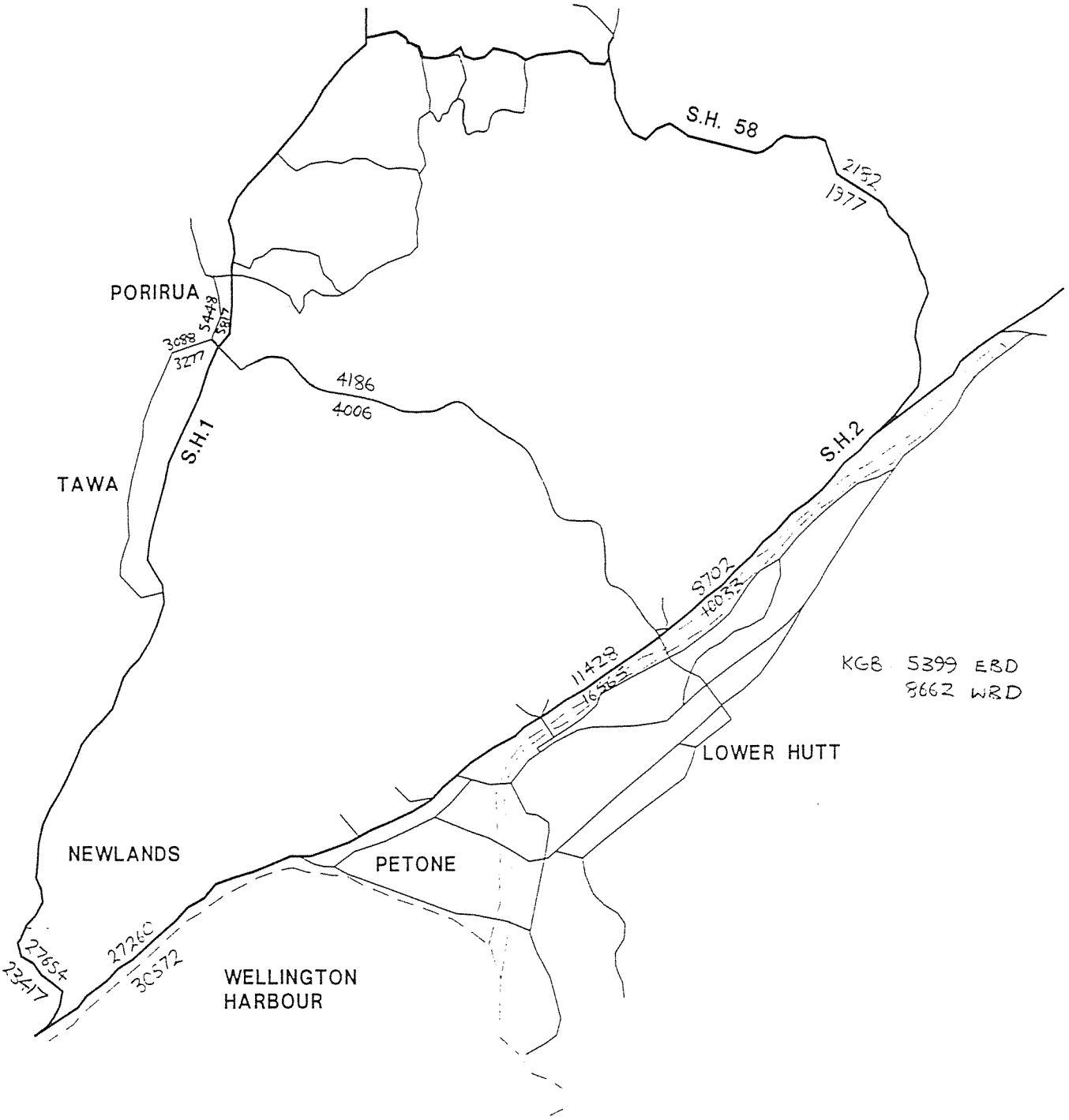
2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D1K - Route D1, E2, Part TG & Kenepuru Dr Link



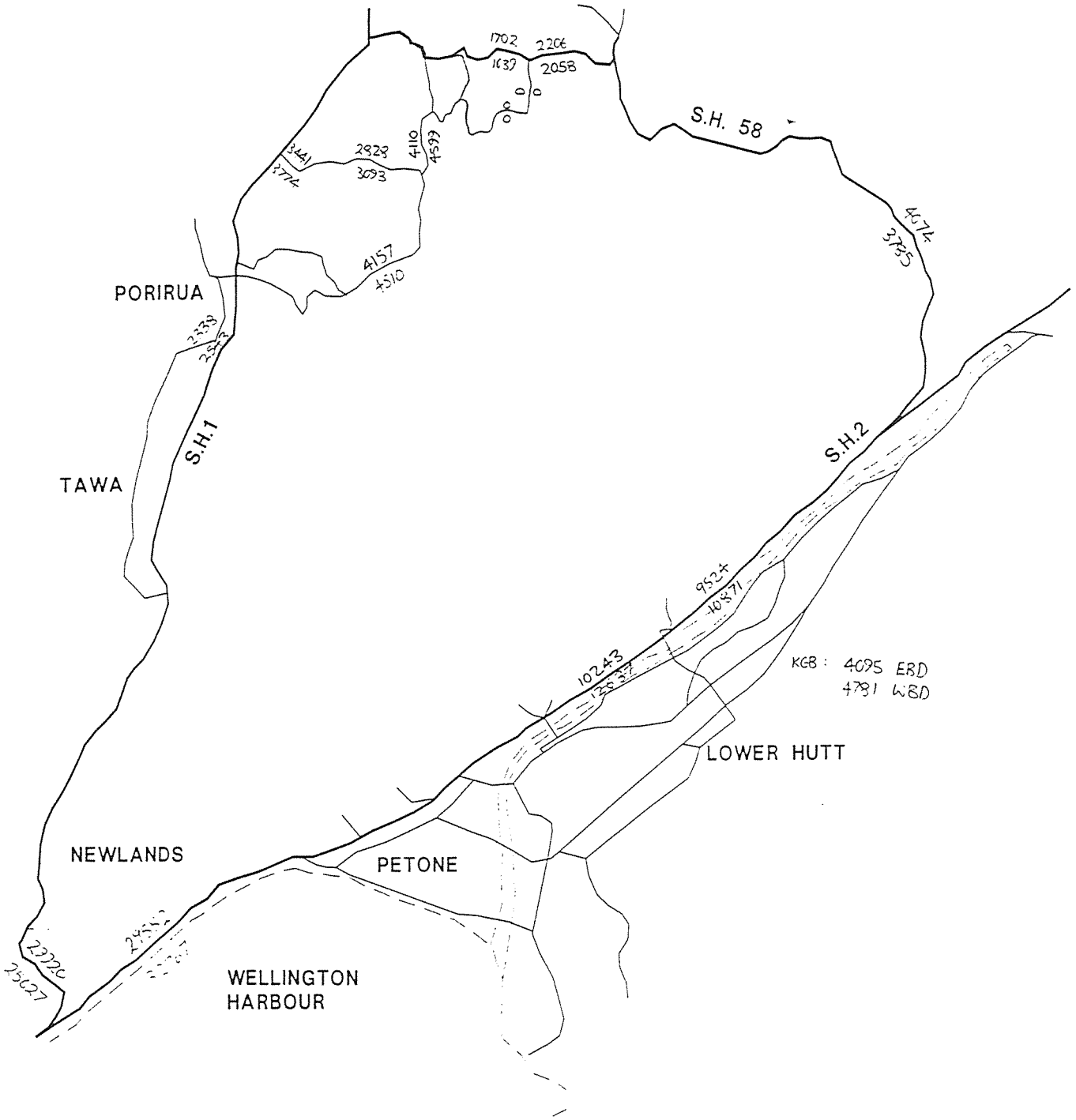
2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option 000 - Do Nothing



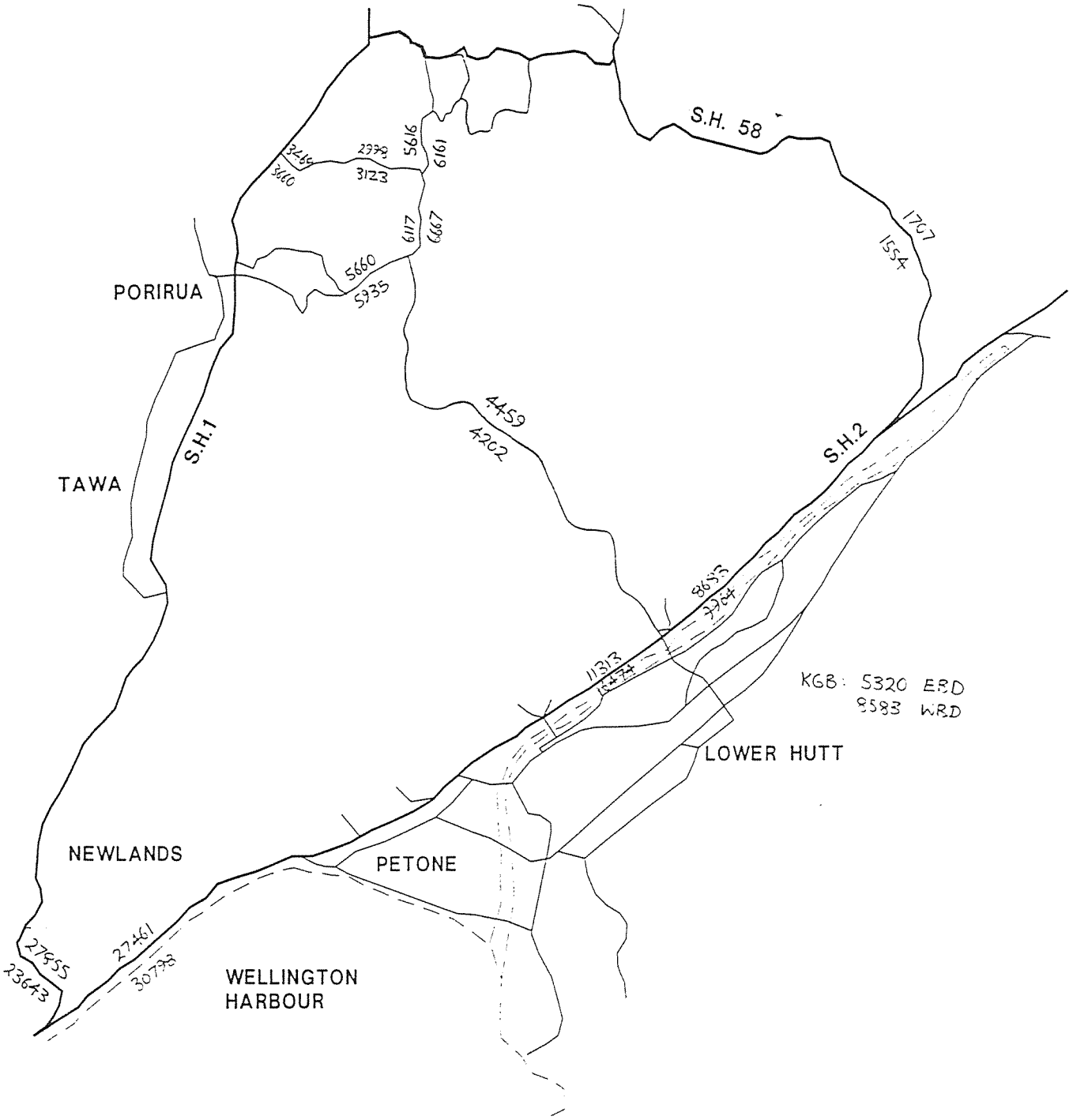
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D1K - Route D1, E2, Part TG & Kenepuru Dr Link



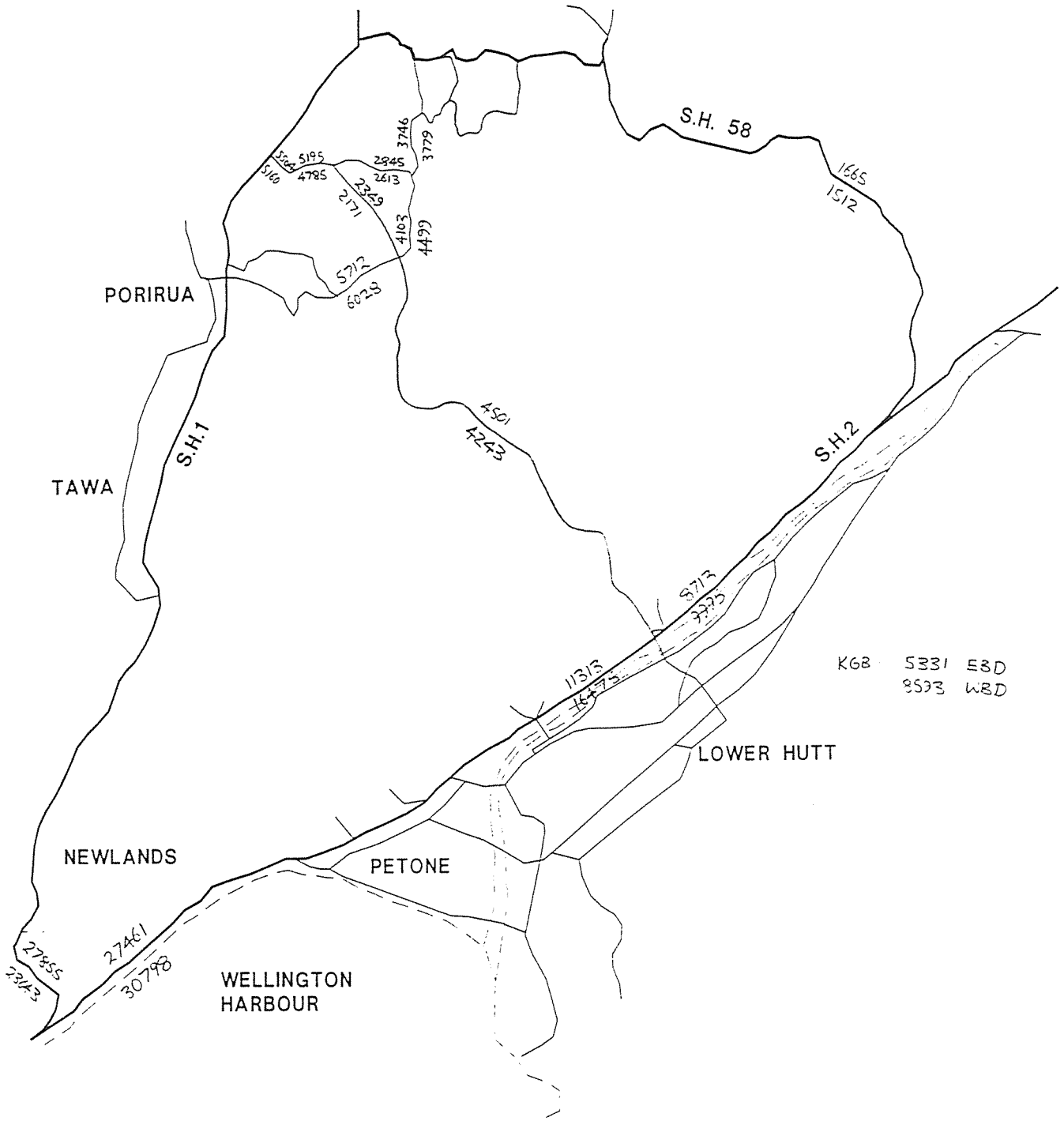
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option 000 - Do Nothing



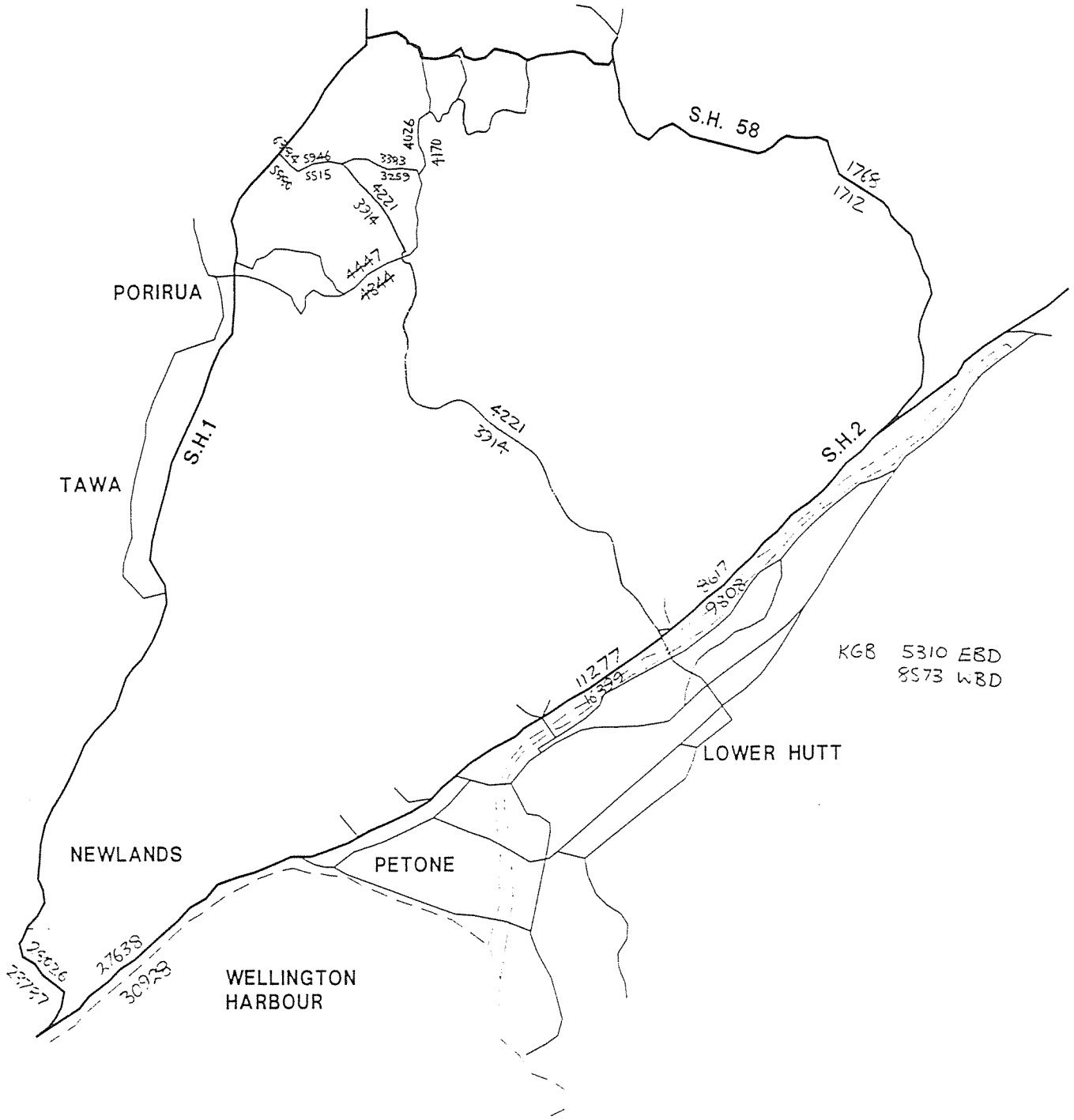
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D11 - Route D1 & E (To Warspite Ave Only)



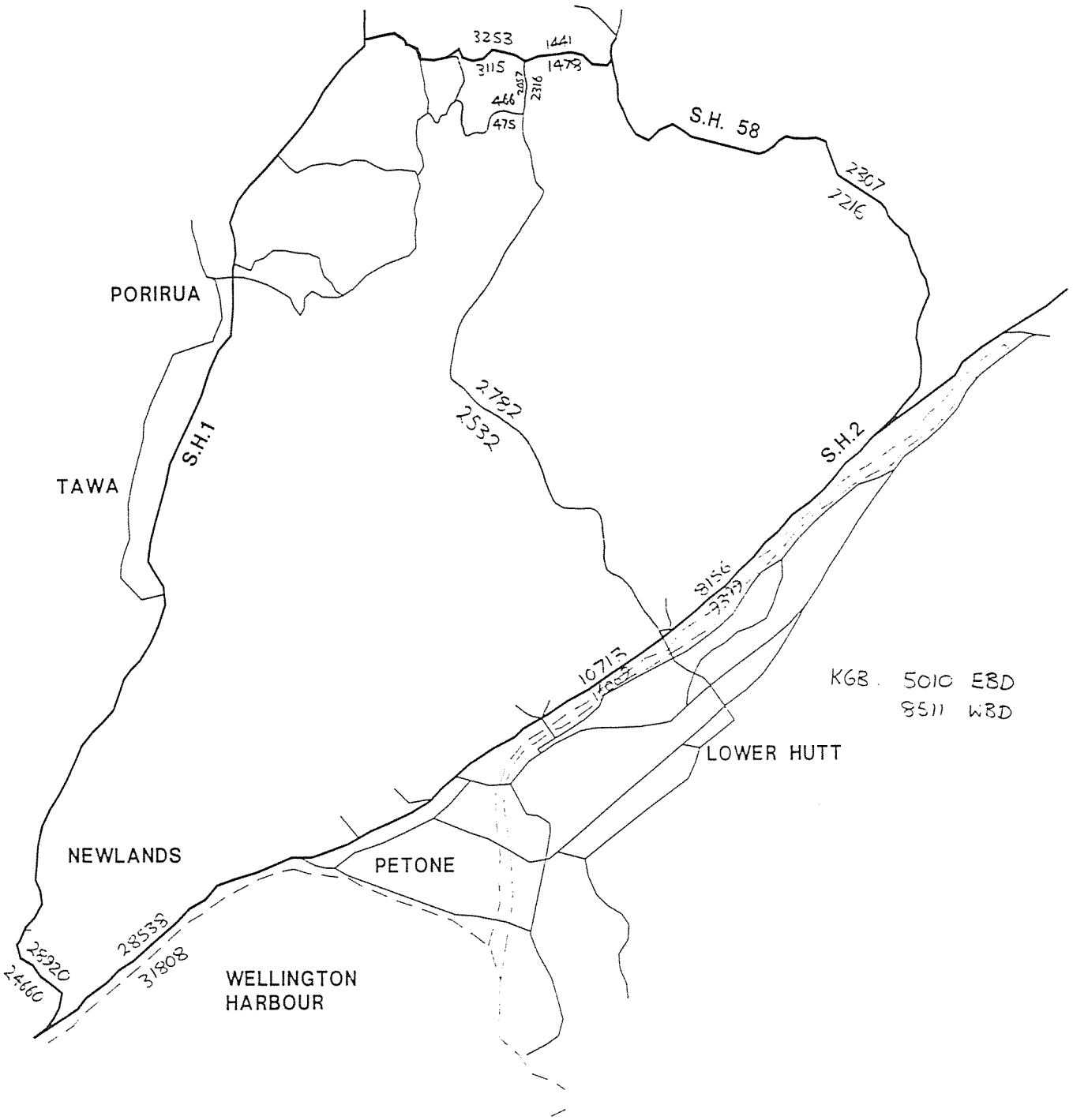
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D12 - Route D1 & E (To Warspite Ave & Whitford Brown Ave)



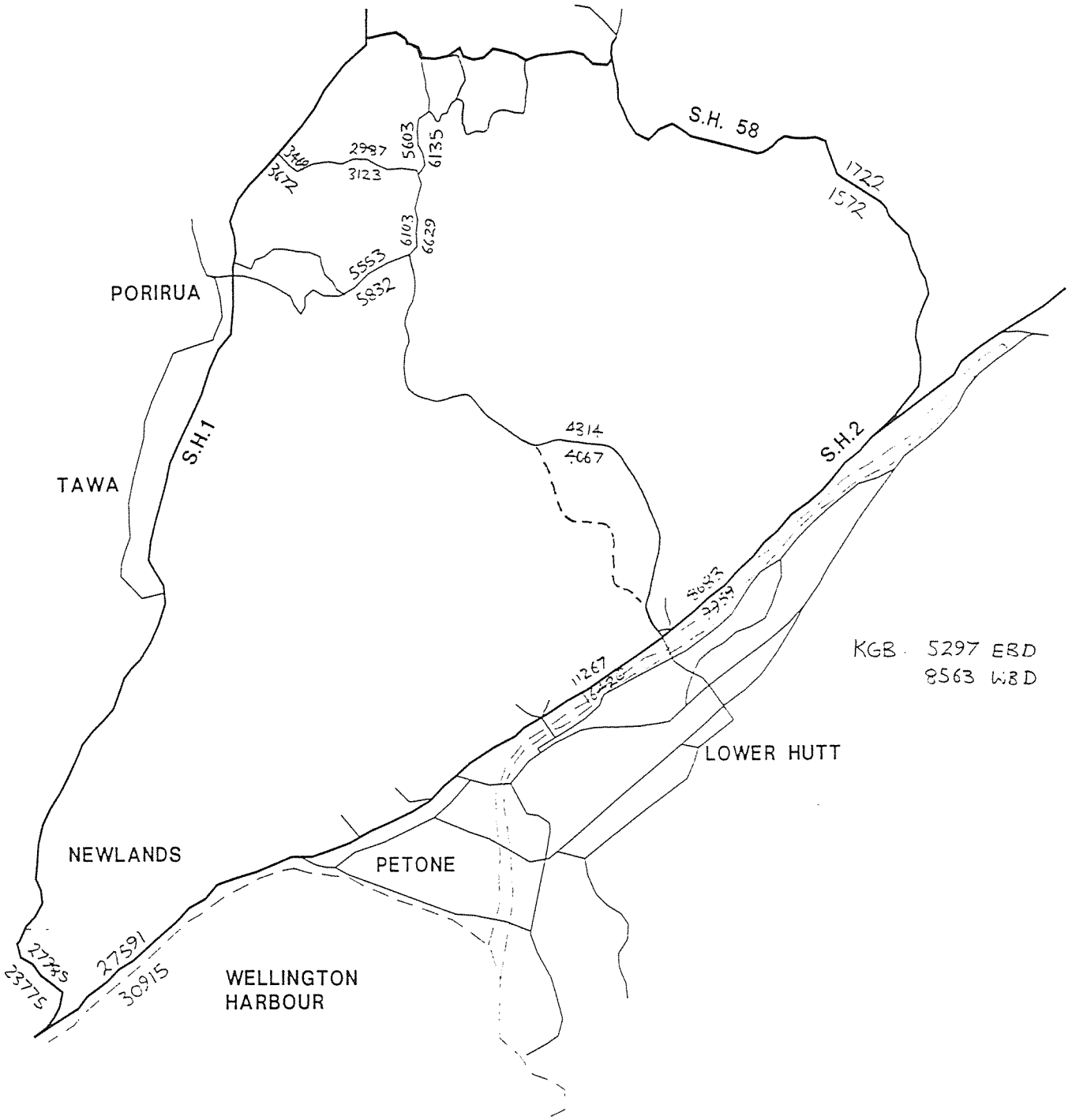
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D13 - Route D1 & E (To Whitford Brown Ave Only)



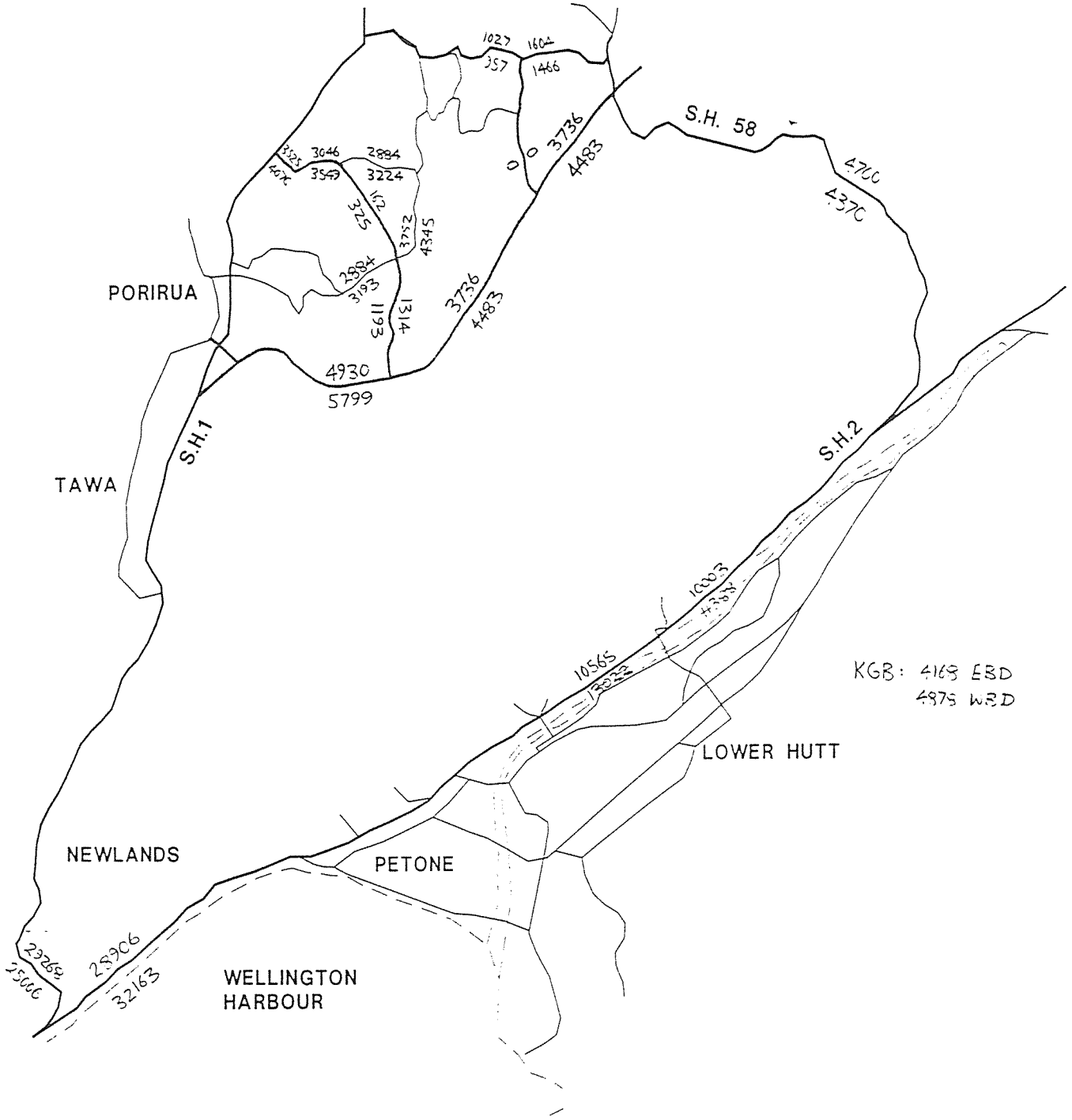
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D1B - Route D1, E1, Part TG & B



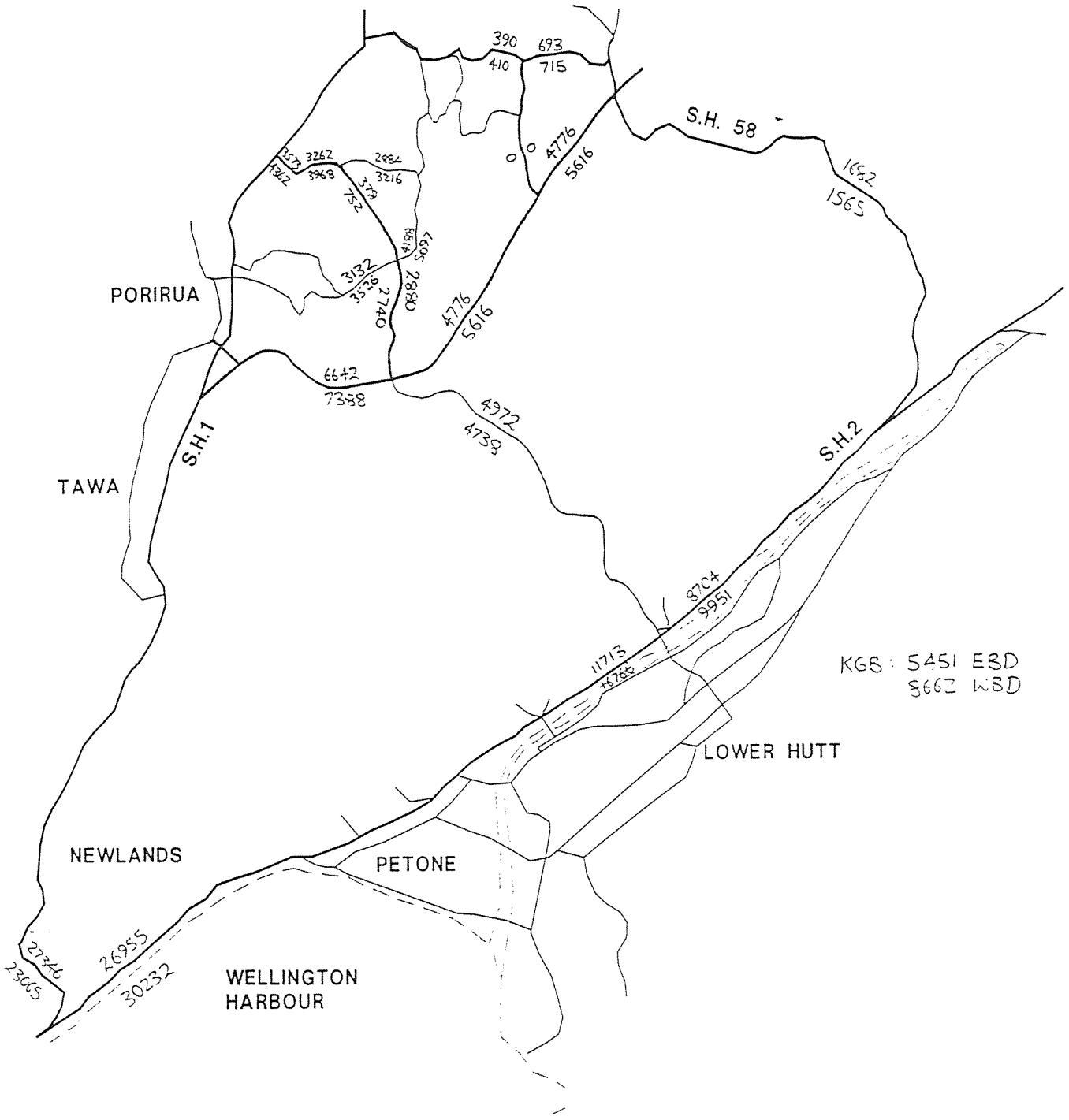
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D51 - Route D5 & E (To Warspite Ave Only)



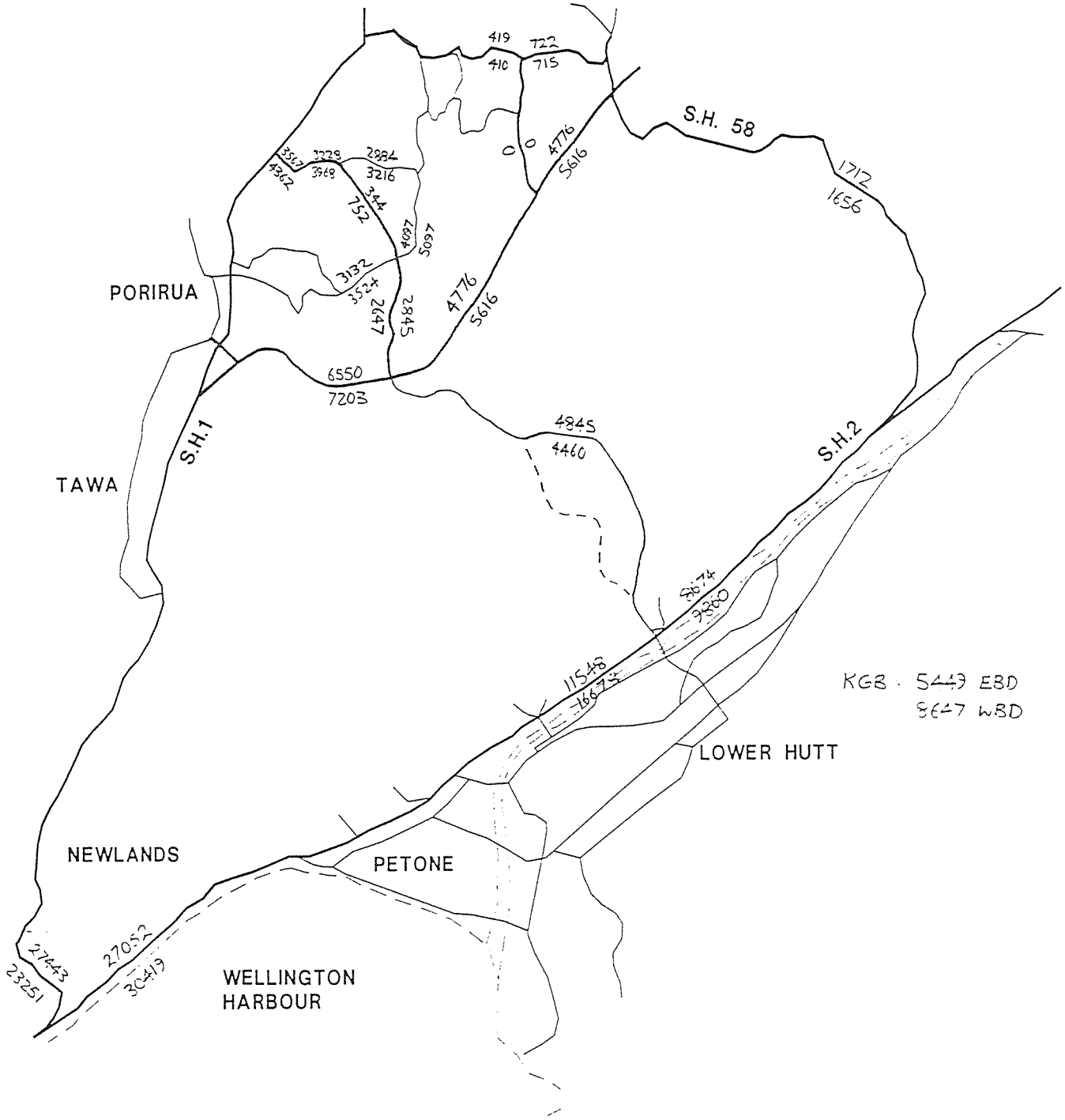
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option 00G - Do Nothing (With Transmission Gully Route)



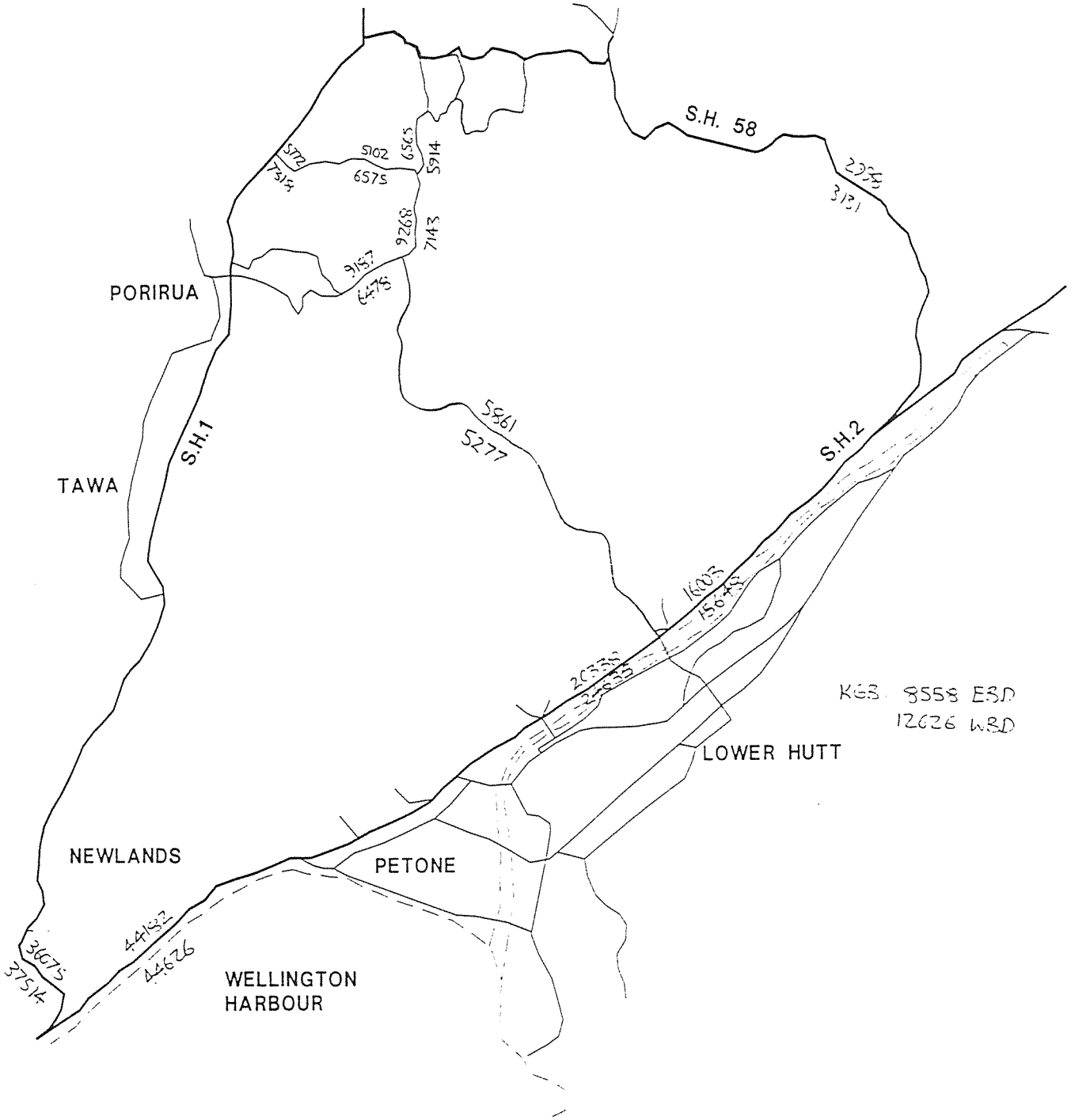
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D1G - Route D1 & E (To Join Transmission Gully Route)



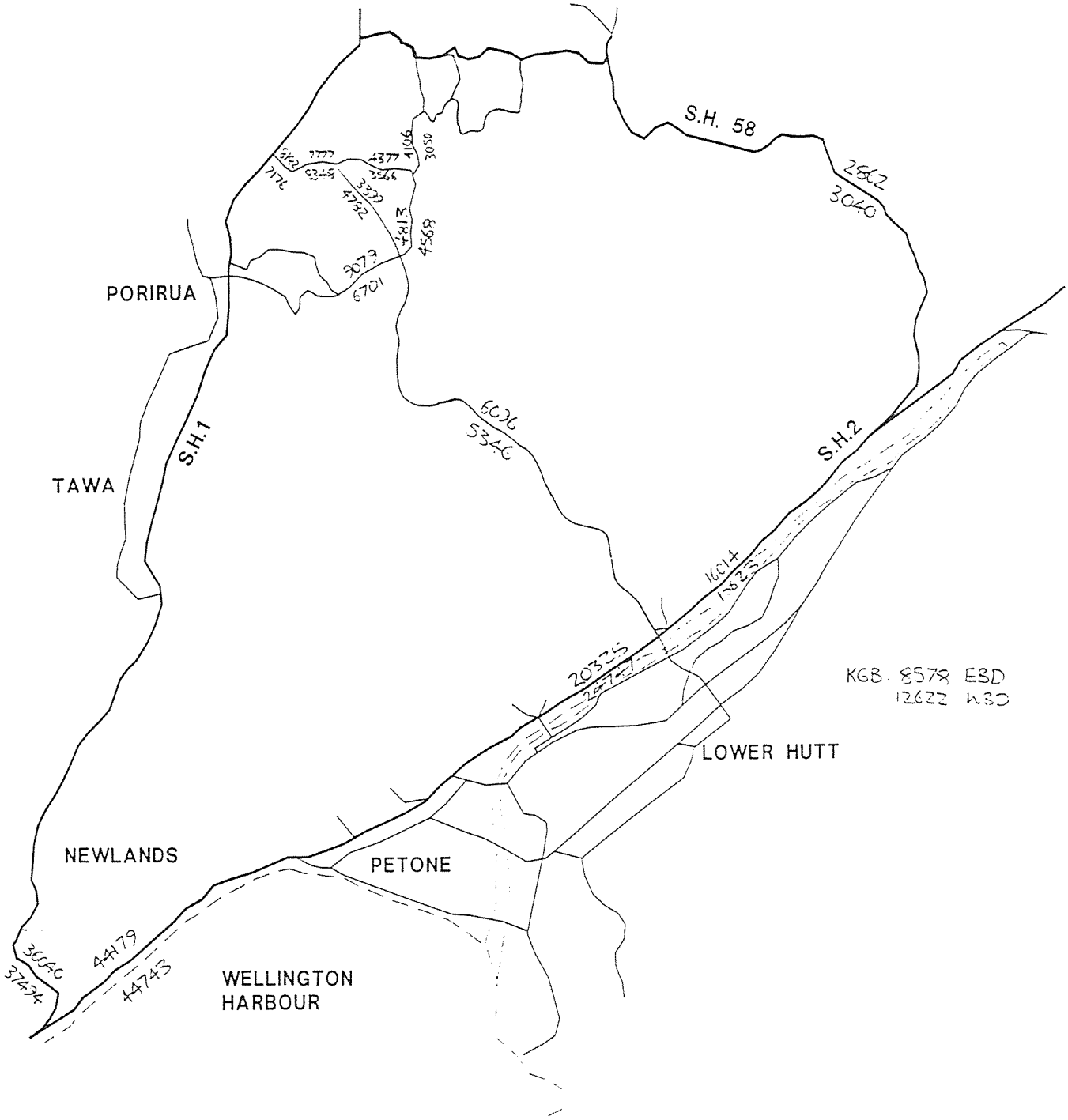
1996 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D5G - Route D5 & E (To Join Transmission Gully Route)



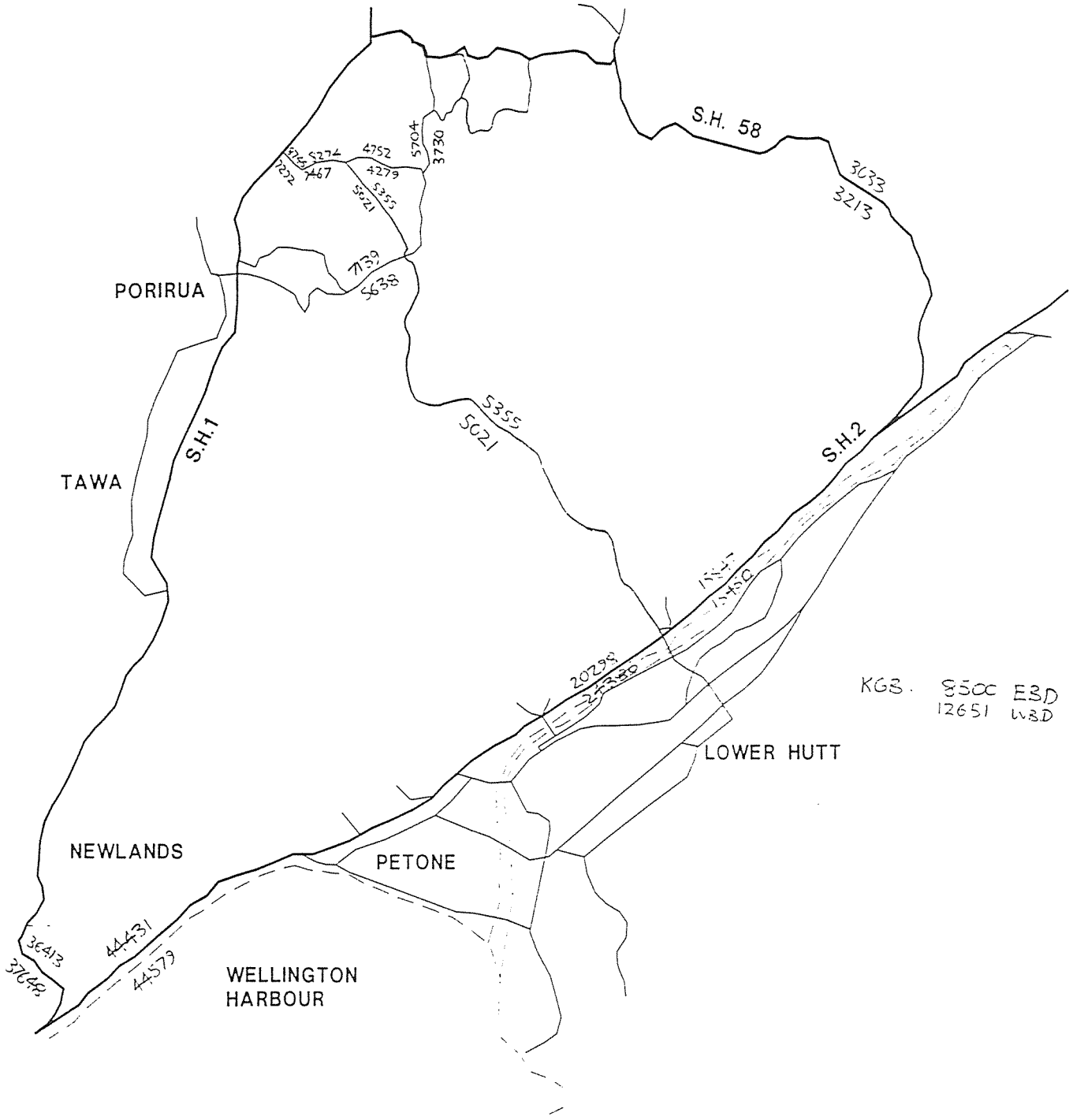
2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D11 - Route D1 & E (To Warspite Ave Only)



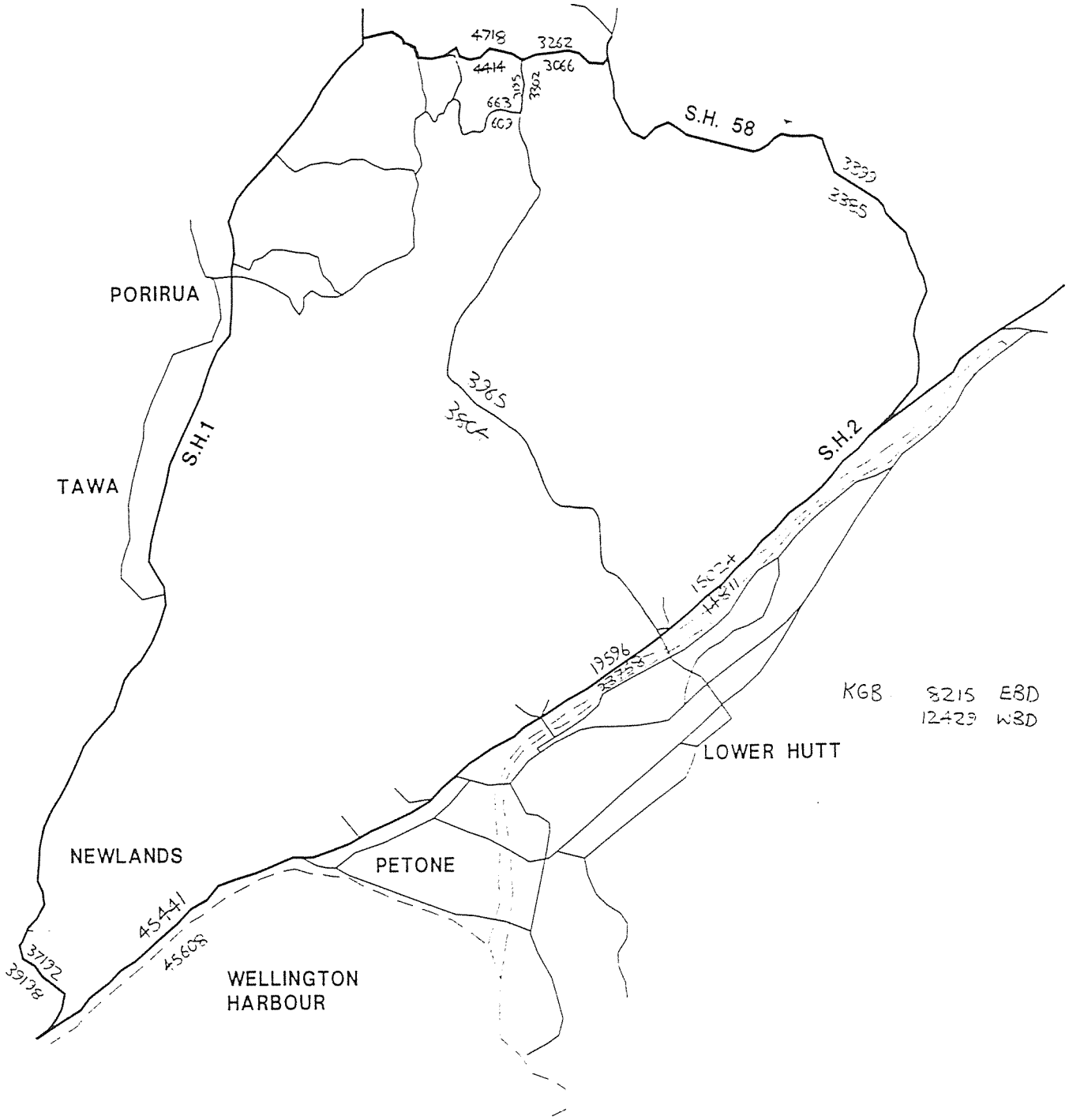
2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D12 - Route D1 & E (To Warspite Ave & Whitford Brown Ave)



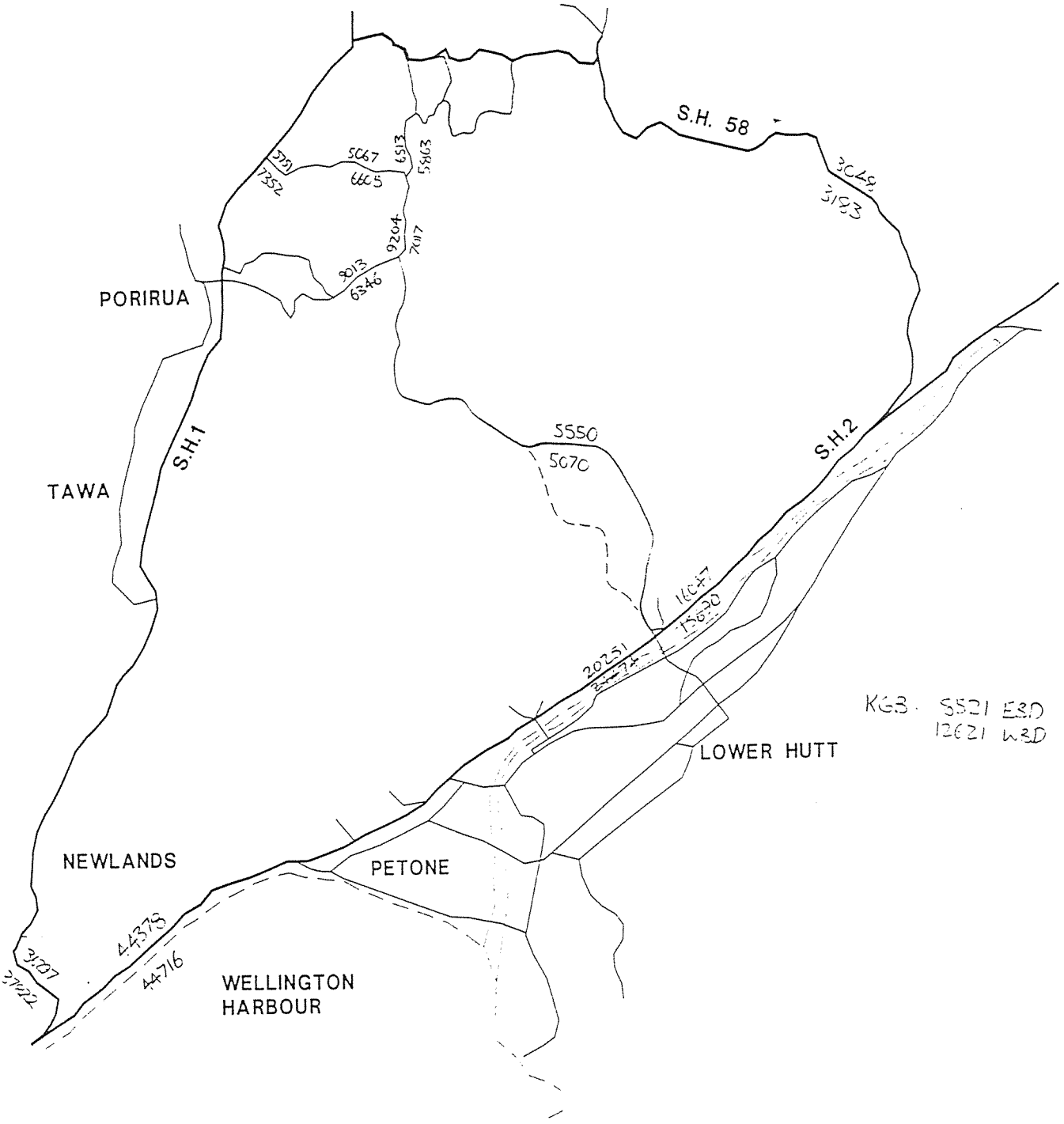
2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D13 - Route D1 & E (To Whitford Brown Ave Only)



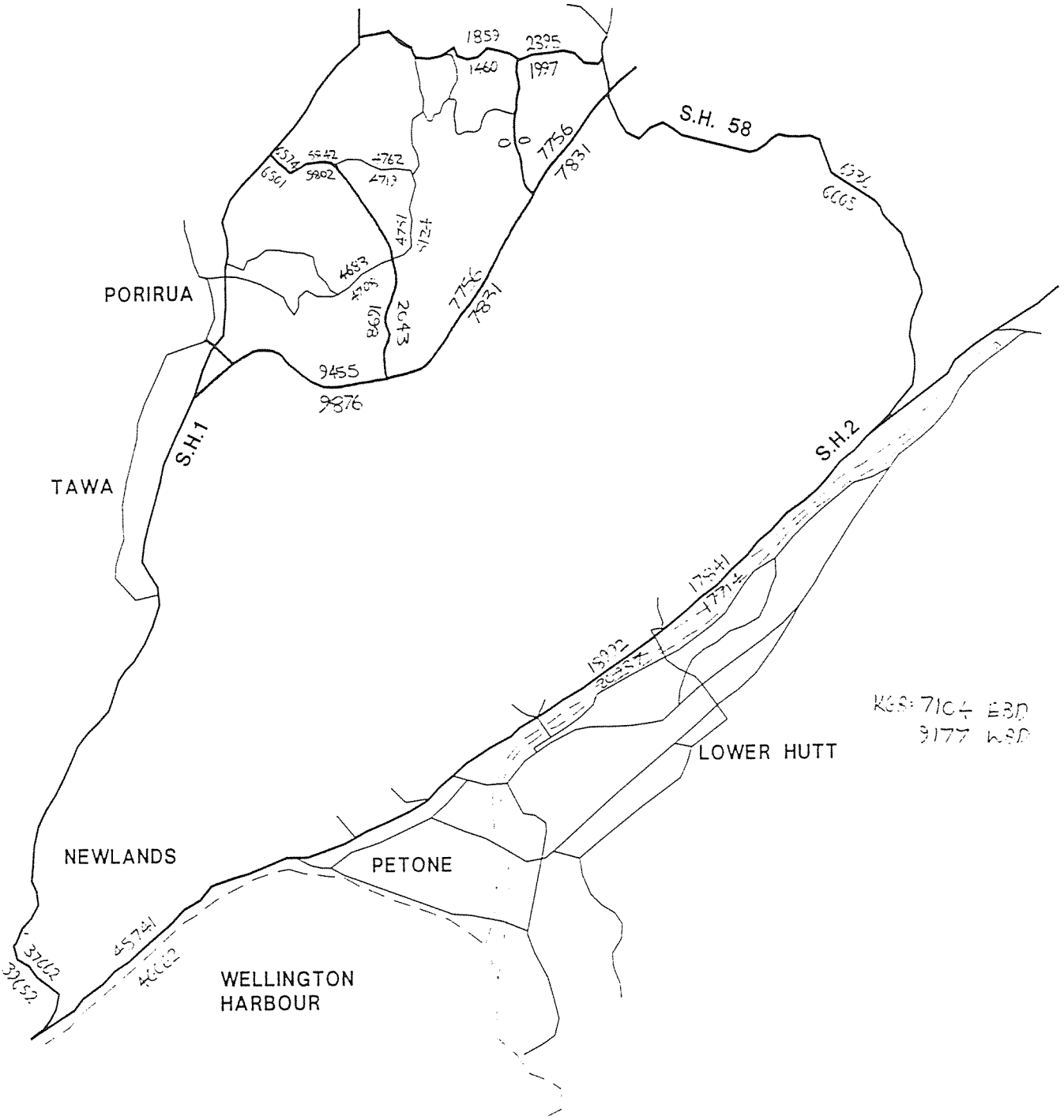
2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D1B - Route D1, E1, Part TG & B



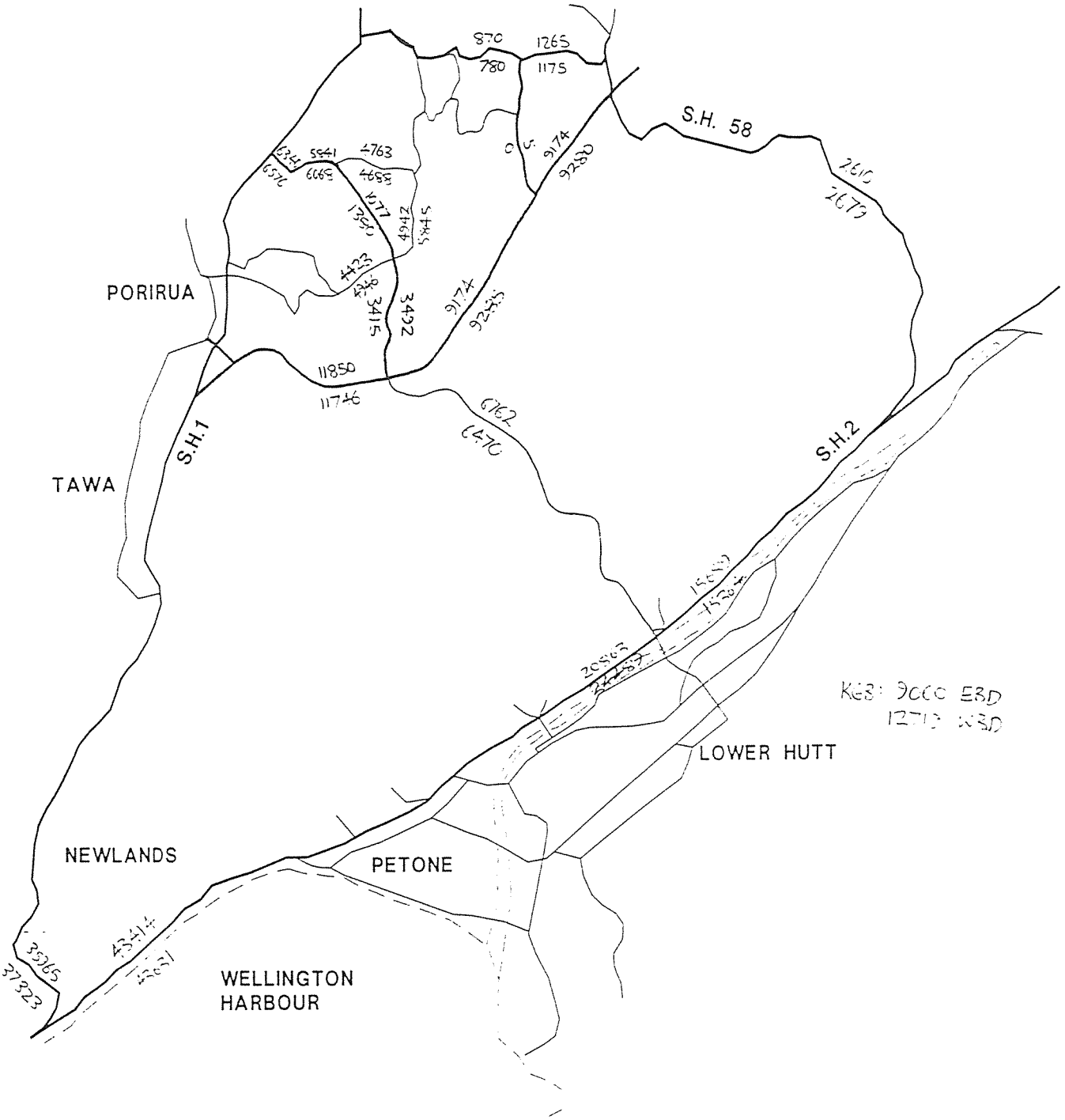
2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D51 - Route D5 & E (To Warspite Ave Only)



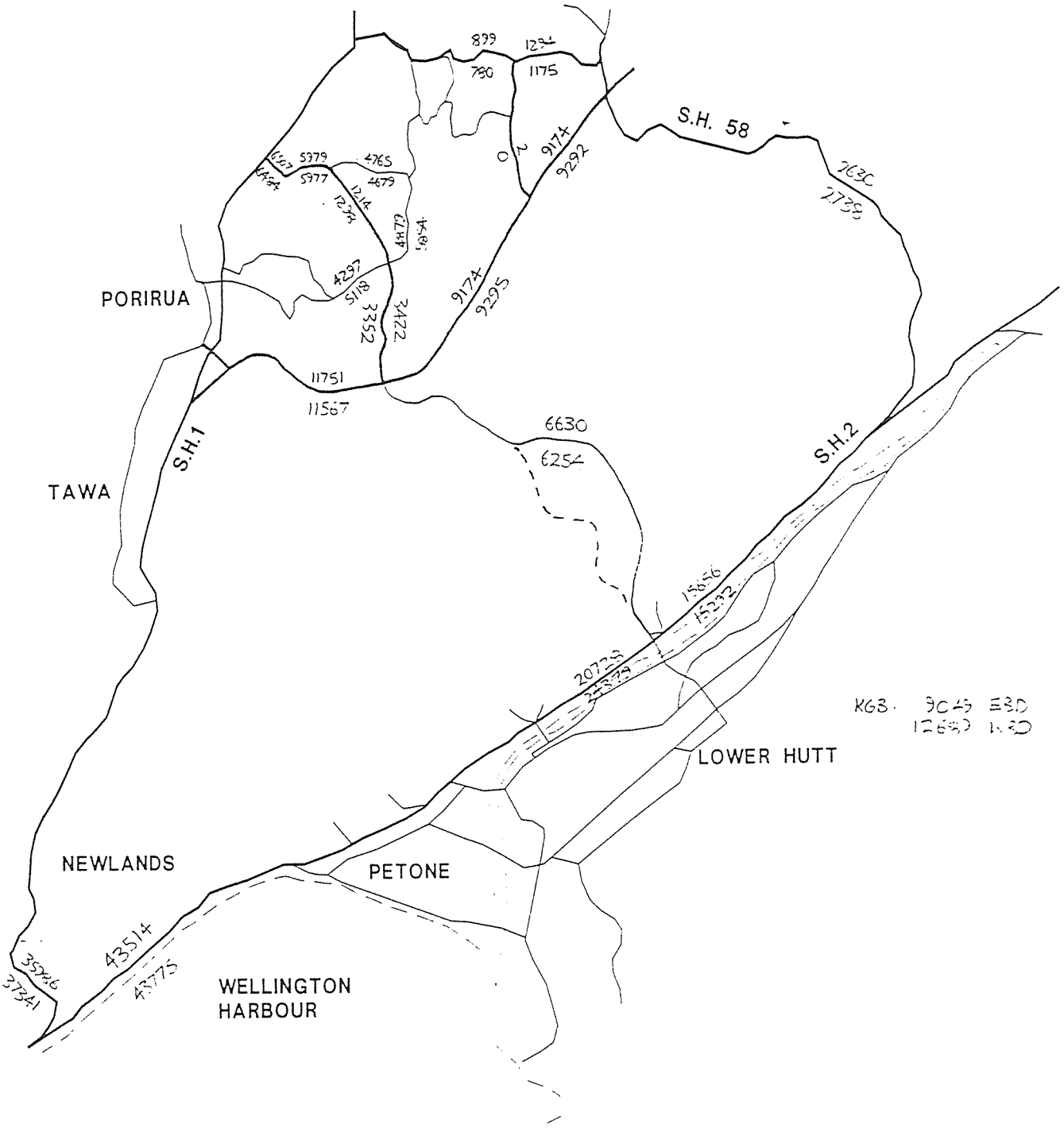
2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option 00G - Do Nothing (With Transmission Gully Route)



2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D1G - Route D1 & E (To Join Transmission Gully Route)

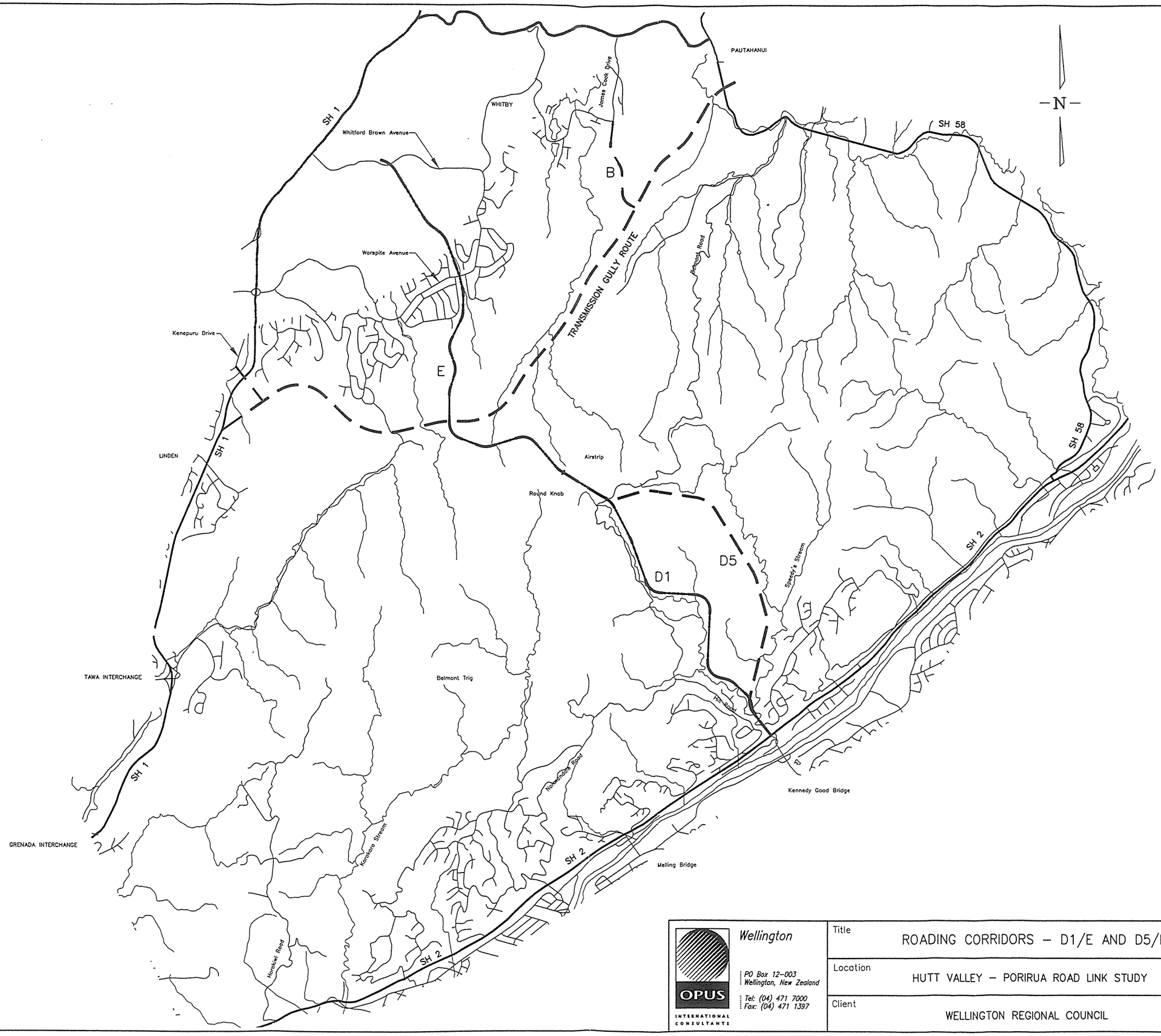


2011 - ALL DAY (7:00 AM - 6:00 PM) MODELLED TRAFFIC FLOWS

Option D5G - Route D5 & E (To Join Transmission Gully Route)

APPENDIX B2

Location of Routes D1/E and D5/E



Wellington

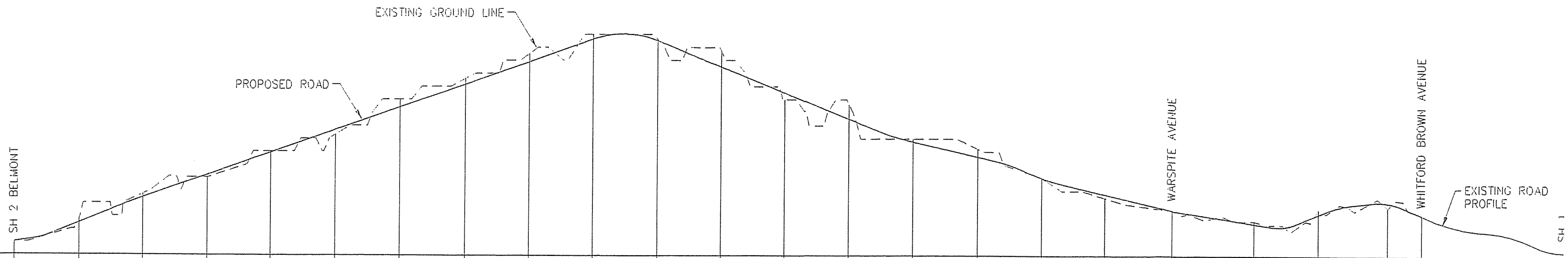
PO Box 12-003
Wellington, New Zealand

Tel: (04) 471 7000
Fax: (04) 471 1397

Title	ROADING CORRIDORS – D1/E AND D5/E	
Location	HUTT VALLEY – PORIRUA ROAD LINK STUDY	Job No. 5C8709.00
Client	WELLINGTON REGIONAL COUNCIL	Figure B2

APPENDIX B3

Long section Route D1/E, SH 2 to Whitford Brown Avenue



'PROPOSED ROAD LEVEL'	20.000	56.643	94.876	128.851	163.348	198.542	232.392	268.233	303.079	337.082	324.120	284.120	244.120	204.120	171.744	148.687	115.395	91.403	70.000	51.073	69.393	81.617	63.000
'EXISTING GROUND'	20.000	56.412	94.069	120.000	160.000	185.972	240.000	272.040	310.569	340.000	332.470	314.523	240.000	232.482	180.000	164.488	120.148	89.184	70.000	54.200	72.200	75.000	63.000
DISTANCE (m)	1000.000	1500.000	2000.000	2500.000	3000.000	3500.000	4000.000	4500.000	5000.000	5500.000	6000.000	6500.000	7000.000	7500.000	8000.000	8500.000	9000.000	9500.000	10028.536	10530.000	11040.000	11540.000	

VERTICAL GRADES: +3% | VC | +8.0% | VC | +7.0% | VC | -8.0% | VC | -4.6% | VC | -8.0% | VC | -4.5% | VC | -3.2% | VC | +8.0% | VC | +2% | VC | -8.5% | EXISTING PROFILE OF WHITFORD BROWN AVENUE

OPUS INTERNATIONAL CONSULTANTS
Wellington
PO Box 12-003
Wellington, New Zealand
Tel: (04) 471 7000
Fax: (04) 471 1397

Title	OPTION D1/E – SH 2 TO WHITFORD BROWN AVENUE LONGITUDINAL SE
Location	HUTT VALLEY – PORIRUA ROAD LINK STUDY
Job No.	5C8709
Client	WELLINGTON REGIONAL COUNCIL
Figure	83

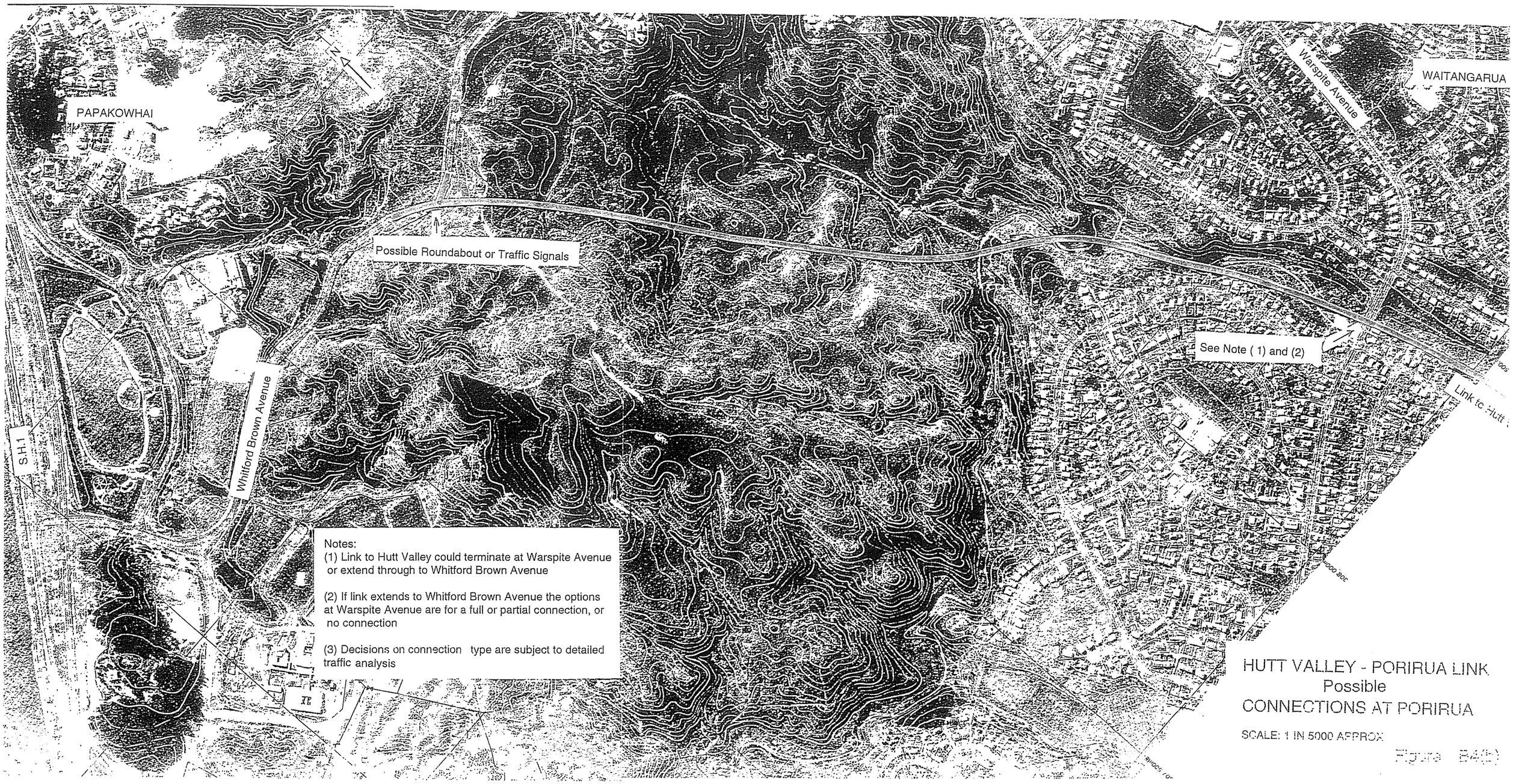
APPENDIX B4

Possible Connections at Hutt Valley and Porirua Ends of Link

HUTT VALLEY - PORIRUA LINK
Possible
CONNECTIONS AT HUTT VALLEY

SCALE : 1 IN 5000 APPROX

FIGURE B4(a)



HUTT VALLEY - PORIRUA LINK
Possible
CONNECTIONS AT PORIRUA

SCALE: 1 IN 5000 APPROX

Figure B4(b)

APPENDIX B5

Streams and Watercourses - Summary Tables of Preliminary Assessment of Requirements for Routes D1/E and D5/E

STREAMS AND WATERCOURSES

Summary Table of Preliminary Assessment of Requirements

ROUTE D1/E

Station (m)	Watercourse Name	Culvert	Diversion
1260	Speedy Stream	Two 3.48 m x 2.21 m corrugated pipe arch	
1350	Stream H	Either one 3.05 m dia corrugated pipe or one 3.48 m x 2.21 m corrugated pipe arch	
1500	Speedy Stream		50 m
1800	Stream H	Either one 3.05 m dia corrugated pipe or one 3.48 m x 2.21 m corrugated pipe arch	
2000	Stream H		50 m
2300	Minor watercourse	One 450 mm dia concrete pipe	
2450	Minor watercourse	One 450 mm dia concrete pipe	
2600	Minor watercourse	One 450 mm dia concrete pipe	
2750	Stream H		100 m
3150	Existing Stream	One 1.37 m dia corrugated pipe	
3400	Existing Stream	One 1.37 m dia corrugated pipe	
3550	Minor watercourse	One 450 mm dia concrete pipe	
3550	Stream H		50 m
3750	Minor watercourse	One 900 mm dia concrete pipe	
4000	Stream H		Realign Road
4750	Minor watercourse	One 450 mm dia concrete pipe	
4880	Minor watercourse	One 450 mm dia concrete pipe	
5200	Minor watercourse	One 450 mm dia concrete pipe	
5300	Minor watercourse	One 450 mm dia concrete pipe	
6100	Minor watercourse	One 450 mm dia concrete pipe	
6750	Minor watercourse	One 900 mm dia concrete pipe	
7000	Minor watercourse	One 450 mm dia concrete pipe	
7200	Duck Creek	One 1.53 m dia corrugated pipe	
7650	Minor watercourse	One 450 mm dia concrete pipe	
9800 - 10000	Stream K		200 m or realign road
10000	Stream K	One 1.83 m dia corrugated pipe	

STREAMS AND WATERCOURSES

Summary Table of Preliminary Assessment of Requirements

ROUTE D5/E

Station (m)	Watercourse Name	Culvert	Diversion
1260	Speedy Stream	Two 3.48 m x 2.21 m corrugated pipe arch	
1350	Stream H	Either one 3.05 m dia corrugated pipe or one 3.48 m x 2.21 m corrugated pipe arch	
1800	Minor watercourse	One 450 mm dia concrete pipe	
2150	Tributary of Speedy Stream	One 1.22 m dia corrugated pipe	
2150	Speedy Stream		100 m
2600	Minor watercourse	One 450 mm dia concrete pipe	
2900	Minor watercourse	One 450 mm dia concrete pipe	
3050	Minor watercourse	One 450 mm dia concrete pipe	
3050	Stream S1		100 m
3200	Minor watercourse	One 450 mm dia concrete pipe	
3650	Minor watercourse	One 900 mm dia concrete pipe	
3950	Minor watercourse	One 450 mm dia concrete pipe	
4150	Minor watercourse	One 450 mm dia concrete pipe	
4450	Minor watercourse	One 900 mm dia concrete pipe	
4800	Stream S1		50 m
4900	Minor watercourse	One 900 mm dia concrete pipe	
5130	Minor watercourse	One 450 mm dia concrete pipe	
5800	Minor watercourse	One 450 mm dia concrete pipe	
6100*	Minor watercourse	One 450 mm dia concrete pipe	
6750	Minor watercourse	One 900 mm dia concrete pipe	
7000	Minor watercourse	One 450 mm dia concrete pipe	
7200	Duck Creek	One 1.53 m dia corrugated pipe	
7650	Minor watercourse	One 450 mm dia concrete pipe	
9800 - 10000	Stream K		200 m or realign road
10000	Stream K	One 1.83 m dia corrugated pipe	

* Note that Route D5 is about 500 m longer than D1. The Station value from this point refers to the position along Route D1 and not that along D5.

18 March 1997
A:\PRELIM1.WPD

CONSTRUCTION EFFECTS

The scope of the project involves a wide range of construction activities including bulk earthworks, stream diversions, and culverting. The steep terrain, especially in Speedy's Reserve, has potential for a high rate of erosion and the quantity of sediment transported. Due to the steep terrain, the construction of sediment traps and other sediment control structures will be restrained by space.

It is intended that the construction of the proposed works (by means of tight specifications, appropriate contractor selection, and tight contract supervision), will ensure a high standard of environmental performance. This is likely to include requiring contractors to:

(i) carry out earthworks in the dry wherever possible, with method statements to be prepared for works which need to be carried out in flowing water showing how sediment discharges will be minimised.

(ii) controlling stormwater runoff from the earthworks to ensure that the siltation of local waterways does not occur, and maintaining the quality of the water to acceptable standards.

(iii) have appropriate sediment control measures for stormwater from all active and non-vegetated earth faces.

(iv) all batter slopes are hydroseeded or similar as soon as possible after they are formed.

(v) time particular works which may have an impact on water quality to avoid brown trout spawning (winter) and migration periods for native fish (August - November).

(vi) minimise the risks associated with construction activities discharging contaminants into the waterway, e.g. fuels, oils, cements;

APPENDIX B6

Construction Cost Estimates Summary

TABLE B6 CONSTRUCTION COST ESTIMATES - SUMMARY FOR ROUTES D1/E AND D5/E, BOTH FROM SH2 TO WHITFORD BROWN AVENUE

	Item	**Route D1/E** ($ million)	**Route D5/E** ($ million)
1.1	Preliminary and General	0.94	1.15
1.2	Earthworks	20.14	26.27
1.3	Roading	4.12	4.17
1.4	Natural Drainage	1.20	1.15
1.5	Structures	0.60	0.60
1.6	Landscaping	0.53	0.57
1.7	Utilities	0.84	1.04
1.8	Highway Furniture	0.42	0.43
1.9	Intersections	0.24	0.24
1.10	Warspite to Whitford Brown	4.80	4.80
1.11	Contingency	8.00	10.0
	Subtotal 1	$41.83M	$50.42M
2.1	Property	1.01	1.14
2.2	Professional Services	5.86	7.14
	Subtotal 2	$6.87M	$8.28M
3.1	Grade Separated Interchanges (includes bridge across Hutt River)	34.8	34.8
3.2	Local Street Upgrading	1.00	1.00
	Subtotal 3	$35.80M	$35.80M
	TOTAL	$84.50M	$94.50M

APPENDIX B7

Traffic Benefit Calculations

1996 Year - Annual Vehicle Operating Costs (1996$)

Scheme Description	Ref.	Daily Operating Costs: Intrazonal Time (mins)	Intrazonal Distance (km)	Matrix Totals Time (mins)	Matrix Totals Distance (km)	Matrix Benefits Time (mins)	Matrix Benefits Distance (km)	Base Annual VOC Benefits
Options Without Transmission Gully:								
Do Nothing	000		84,279		5,730,138			
1. Route D1 & E (To Warspite Ave Only)	D11		84,279		5,678,444		51,694	$4,910,237
2. Route D1 & E (To Warsp. & Whit. Br. Ave)	D12		84,279		5,679,514		50,624	$4,808,602
3. Route D1 & E (To Whitford Brown Ave Only)	D13		84,279		5,690,914		39,224	$3,725,754
4. Route D1, E1, Part TG & B	D1B		84,279		5,711,868		18,270	$1,735,405
5. Route D1, E2, Part TG & Kenepuru Dr Link	D1K		84,279		5,690,313		39,825	$3,782,841
6. Route D5 & E (To Warspite Ave Only)	D51		84,279		5,684,987		45,151	$4,288,740
Options With Transmission Gully:								
Do Nothing	00G		84,279		5,724,372			
7. Route D1 & E (To Join TG Route)	D1G		84,279		5,671,012		53,360	$5,068,485
8. Route D5 & E (To Join TG Route)	D5G		84,279		5,675,818		48,554	$4,611,979

BASE FACTORS FOR ECONOMIC ANALYSIS

Equivalent No. of Days per Year	300		
Base Travel Distance Cost (1994$/km)	0.3074	Rural Strategic -	60 km/h, 0% Grade
Veh. Op. Cost Update Factor (to 1996$)	1.03		

Scheme Description	Ref.	Existing Large Gradient Routes: SH 1 (Ngauranga Gorge) 2-Way Flow	SH 1 Grade	SH 1 Grade Length	SH 58 (Haywards Hill) 2-Way Flow	SH 58 Grade	SH 58 Grade Length	Annual VOC Gradient Benefits	Large Gradient Sections of New Route: Section 1 2-Way Flow	Section 1 Grade	Section 1 Grade Length	Section 2 2-Way Flow	Section 2 Grade	Section 2 Grade Length	Annual VOC Gradient Disbenefit	Revised Annual VOC Benefits
Options Without Transmission Gully:																
Do Nothing	000	55,547	8%	1.6	7,859	5%	5.4									
1. Route D1 & E (To Warspite Ave Only)	D11	51,498	8%	1.6	3,261	5%	5.4	$436,931	8661	7%	4.4	8661	8%	4.0	($1,635,723)	$3,711,445
2. Route D1 & E (To Warsp. & Whit. Br. Ave)	D12	51,498	8%	1.6	3,177	5%	5.4	$441,899	8744	7%	4.4	8744	8%	4.0	($1,651,399)	$3,599,102
3. Route D1 & E (To Whitford Brown Ave Only)	D13	51,813	8%	1.6	3,480	5%	5.4	$411,144	8135	7%	4.4	8135	8%	4.0	($1,536,383)	$2,600,516
4. Route D1, E1, Part TG & B	D1B	53,580	8%	1.6	4,523	5%	5.4	$277,463	5314	7%	4.4	5314	8%	4.0	($1,003,606)	$1,009,262
5. Route D1, E2, Part TG & Kenepuru Dr Link	D1K	51,071	8%	1.6	4,159	5%	5.4	$401,208	8192	7%	4.4	8192	8%	4.0	($1,547,148)	$2,636,901
6. Route D5 & E (To Warspite Ave Only)	D51	51,760	8%	1.6	3,294	5%	5.4	$424,305	8381	7%	4.6	8381	8%	4.0	($1,615,991)	$3,097,054
Options With Transmission Gully:																
Do Nothing	00G	54,274	8%	1.6	9,070	5%	5.4									
7. Route D1 & E (To Join TG Route)	D1G	50,411	8%	1.6	3,247	5%	5.4	$501,814	9710	7%	4.4	9710	8%	4.0	($1,833,838)	$3,736,461
8. Route D5 & E (To Join TG Route)	D5G	50,694	8%	1.6	3,368	5%	5.4	$483,128	9305	7%	4.6	9305	8%	4.0	($1,794,153)	$3,300,955

Specific Section - Travel Speed	80 km/h	80 km/h	80 km/h	80 km/h
Specific Section - Travel Distance Cost (1994$/km)	0.3898	0.3429	0.3714	0.3898

2011 Year - Annual Vehicle Operating Costs (1996$)

Scheme Description	Ref.	Daily Operating Costs: Intrazonal Time (mins)	Intrazonal Distance (km)	Matrix Totals Time (mins)	Matrix Totals Distance (km)	Matrix Benefits Time (mins)	Matrix Benefits Distance (km)	Base Annual VOC Benefits
Options Without Transmission Gully:								
Do Nothing	000		91,470		9,265,858			
1. Route D1 & E (To Warspite Ave Only)	D11		91,470		9,254,384		11,474	$1,089,876
2. Route D1 & E (To Warsp. & Whit. Br. Ave)	D12		91,470		9,299,004		(33,146)	($3,148,426)
3. Route D1 & E (To Whitford Brown Ave Only)	D13		91,470		9,315,574		(49,716)	($4,722,354)
4. Route D1, E1, Part TG & B	D1B		91,470		9,196,530		69,328	$6,585,231
5. Route D1, E2, Part TG & Kenepuru Dr Link	D1K		91,470		9,277,682		(11,824)	($1,123,122)
6. Route D5 & E (To Warspite Ave Only)	D51		91,470		9,270,542		(4,684)	($444,917)
Options With Transmission Gully:								
Do Nothing	00G		91,470		9,353,430			
7. Route D1 & E (To Join TG Route)	D1G		91,470		9,253,517		99,913	$9,490,396
8. Route D5 & E (To Join TG Route)	D5G		91,470		9,280,045		73,385	$6,970,592

BASE FACTORS FOR ECONOMIC ANALYSIS

Equivalent No. of Days per Year	300		
Base Travel Distance Cost (1994$/km)	0.3074	Rural Strategic -	60 km/h
			0% Grade
Veh. Op. Cost Update Factor (to 1996$)	1.03		

Scheme Description	Ref.	Existing Large Gradient Routes: SH 1 (Ngauranga Gorge) 2-Way Flow	SH 1 Grade	SH 1 Grade Length	SH 58 (Haywards Hill) 2-Way Flow	SH 58 Grade	SH 58 Grade Length	Annual VOC Gradient Benefits	Large Gradient Sections of New Route: Section 1 2-Way Flow	Section 1 Grade	Section 1 Grade Length	Section 2 2-Way Flow	Section 2 Grade	Section 2 Grade Length	Annual VOC Gradient Disbenefit	Revised Annual VOC Benefits
Options Without Transmission Gully:																
Do Nothing	000	78,017	8%	1.6	12,219	5%	5.4									
1. Route D1 & E (To Warspite Ave Only)	D11	73,589	8%	1.6	6,129	5%	5.4	$540,625	11138	7%	4.4	11138	8%	4.0	($2,103,532)	($473,030)
2. Route D1 & E (To Warsp. & Whit. Br. Ave)	D12	73,534	8%	1.6	5,902	5%	5.4	$556,293	11442	7%	4.4	11442	8%	4.0	($2,160,945)	($4,753,078)
3. Route D1 & E (To Whitford Brown Ave Only)	D13	74,061	8%	1.6	6,246	5%	5.4	$514,476	10376	7%	4.4	10376	8%	4.0	($1,959,620)	($6,167,498)
4. Route D1, E1, Part TG & B	D1B	76,390	8%	1.6	6,784	5%	5.4	$387,772	7769	7%	4.4	7769	8%	4.0	($1,467,260)	$5,505,744
5. Route D1, E2, Part TG & Kenepuru Dr Link	D1K	73,617	8%	1.6	6,866	5%	5.4	$495,890	10737	7%	4.4	10737	8%	4.0	($2,027,798)	($2,655,030)
6. Route D5 & E (To Warspite Ave Only)	D51	74,119	8%	1.6	6,231	5%	5.4	$513,000	10620	7%	4.6	10620	8%	4.0	($2,047,706)	($1,979,623)
Options With Transmission Gully:																
Do Nothing	00G	77,314	8%	1.6	13,541	5%	5.4									
7. Route D1 & E (To Join TG Route)	D1G	73,288	8%	1.6	5,289	5%	5.4	$652,135	13232	7%	4.4	13232	8%	4.0	($2,499,006)	$7,643,525
8. Route D5 & E (To Join TG Route)	D5G	73,327	8%	1.6	5,368	5%	5.4	$645,873	12884	7%	4.6	12884	8%	4.0	($2,484,241)	$5,132,223

Specific Section - Travel Speed	80 km/h	80 km/h	80 km/h	80 km/h
Specific Section - Travel Distance Cost (1994$/km)	0.3898	0.3429	0.3714	0.3898

1996 Year - Annual Travel Time Costs (1996$)

Scheme Description	Ref.	Daily Operating Costs						Annual TT Benefits
		Intrazonal		Matrix Totals		Matrix Benefits		
		Time (mins)	Distance (km)	Time (mins)	Distance (km)	Time (mins)	Distance (km)	
Options Without Transmission Gully:								
Do Nothing	000	125,981		6,819,611				
1. Route D1 & E (To Warspite Ave Only)	D11	125,981		6,769,039		50,572		$5,838,032
2. Route D1 & E (To Warsp. & Whit. Br. Ave)	D12	125,981		6,761,172		58,439		$6,746,198
3. Route D1 & E (To Whitford Brown Ave Only)	D13	125,981		6,760,404		59,207		$6,834,856
4. Route D1, E1, Part TG & B	D1B	125,981		6,778,604		41,007		$4,733,848
5. Route D1, E2, Part TG & Kenepuru Dr Link	D1K	125,981		6,756,447		63,164		$7,291,652
6. Route D5 & E (To Warspite Ave Only)	D51	125,981		6,767,734		51,877		$5,988,681
Options With Transmission Gully:								
Do Nothing	00G	125,981		6,674,919				
7. Route D1 & E (To Join TG Route)	D1G	125,981		6,602,288		72,631		$8,384,523
8. Route D5 & E (To Join TG Route)	D5G	125,981		6,610,426		64,493		$7,445,072

BASE FACTORS FOR ECONOMIC ANALYSIS

Equivalent No. of Days per Year	300	
Base Travel Time Cost (1994$/hr)	22.2	Rural Strategic - Weekday
Travel Time Cost Update Factor (to 1996$)	1.04	

2011 Year - Annual Travel Time Costs (1996$)

Scheme Description	Ref.	Daily Operating Costs						Annual TT Benefits
		Intrazonal		Matrix Totals		Matrix Benefits		
		Time (mins)	Distance (km)	Time (mins)	Distance (km)	Time (mins)	Distance (km)	
Options Without Transmission Gully:								
Do Nothing	000	136,656		16,314,280				
1. Route D1 & E (To Warspite Ave Only)	D11	136,656		15,678,901		635,379		$73,348,152
2. Route D1 & E (To Warsp. & Whit. Br. Ave)	D12	136,656		15,454,312		859,968		$99,274,706
3. Route D1 & E (To Whitford Brown Ave Only)	D13	136,656		15,575,575		738,705		$85,276,105
4. Route D1, E1, Part TG & B	D1B	136,656		16,035,520		278,760		$32,180,054
5. Route D1, E2, Part TG & Kenepuru Dr Link	D1K	136,656		15,266,133		1,048,147		$120,998,090
6. Route D5 & E (To Warspite Ave Only)	D51	136,656		15,697,988		616,292		$71,144,748
Options With Transmission Gully:								
Do Nothing	00G	136,656		15,159,053				
7. Route D1 & E (To Join TG Route)	D1G	136,656		14,334,161		824,892		$95,225,532
8. Route D5 & E (To Join TG Route)	D5G	136,656		14,341,465		817,588		$94,382,359

BASE FACTORS FOR ECONOMIC ANALYSIS

Equivalent No. of Days per Year	300	
Base Travel Time Cost (1994$/hr)	22.2	Rural Strategic - Weekday
Travel Time Cost Update Factor (to 1996$)	1.04	

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth Throughout Analysis Period)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 1 (D11)

Route D1 & E (to Warspite Ave only)

Analysis Year	**1996**	**2011**
Annual Benefits	**$9.549**	**$72.875**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$26.436	$72.875
Annual Benefit Growth Rate	0.0%	16.0%	5.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$212.575**	**$159.980**

NPV OF BENEFITS : - $372.556

OPTION 2 (D12)

Route D1 & E (to Warspite Ave & Whitford Brown Ave)

Analysis Year	**1996**	**2011**
Annual Benefits	**$10.345**	**$94.522**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$32.792	$94.522
Annual Benefit Growth Rate	0.0%	17.1%	5.9%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$271.637**	**$208.637**

NPV OF BENEFITS : - $480.274

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth Throughout Analysis Period)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 3 (D13)

Route D1 & E (to Whitford Brown Ave only)

Analysis Year	**1996**	**2011**	
Annual Benefits	**$9.435**	**$79.109**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$28.015	$79.109
Annual Benefit Growth Rate	0.0%	16.6%	5.9%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$228.897**	**$174.183**

NPV OF BENEFITS : - **$403.080**

OPTION 4 (D1B)

Route D1, Part TG Route & Link B

Analysis Year	**1996**	**2011**	
Annual Benefits	**$5.743**	**$37.686**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$14.261	$37.686
Annual Benefit Growth Rate	0.0%	14.9%	5.7%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$111.538**	**$82.282**

NPV OF BENEFITS : - **$193.820**

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth Throughout Analysis Period)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 5 (D1K)

Route D1, Part TG Route & Kenepuru Drive Link

Analysis Year	**1996**	**2011**
Annual Benefits	**$9.929**	**$118.343**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$38.839	$118.343
Annual Benefit Growth Rate	0.0%	18.6%	6.1%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$334.049**	**$262.901**

NPV OF BENEFITS : - **$596.950**

OPTION 6 (D51)

Route D5 & E (to Warspite Ave only)

Analysis Year	**1996**	**2011**
Annual Benefits	**$9.086**	**$69.165**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$25.107	$69.165
Annual Benefit Growth Rate	0.0%	16.0%	5.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$201.798**	**$151.824**

NPV OF BENEFITS : - **$353.622**

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth Throughout Analysis Period)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 7 (D1G)

Route D1 (with TG Route in place)

Analysis Year	**1996**	**2011**	
Annual Benefits	**$12.121**	**$102.869**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$36.320	$102.869
Annual Benefit Growth Rate	0.0%	16.7%	5.9%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$297.350**	**$226.582**

NPV OF BENEFITS : - **$523.932**

OPTION 8 (D5G)

Route D5 (with TG Route in place)

Analysis Year	**1996**	**2011**	
Annual Benefits	**$10.746**	**$99.515**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$34.418	$99.515
Annual Benefit Growth Rate	0.0%	17.2%	5.9%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$285.695**	**$219.739**

NPV OF BENEFITS : - **$505.433**

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth To 2011, Then Constant Benefit Stream)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 1 (D11)

Route D1 & E (to Warspite Ave only)

Analysis Year	**1996**	**2011**	
Annual Benefits	**$9.549**	**$72.875**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$26.436	$72.875
Annual Benefit Growth Rate	0.0%	16.0%	0.0%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$212.575**	**$124.719**
NPV OF BENEFITS : -	**$337.294**		

OPTION 2 (D12)

Route D1 & E (to Warspite Ave & Whitford Brown Ave)

Analysis Year	**1996**	**2011**	
Annual Benefits	**$10.345**	**$94.522**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$32.792	$94.522
Annual Benefit Growth Rate	0.0%	17.1%	0.0%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$271.637**	**$161.765**
NPV OF BENEFITS : -	**$433.402**		

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth To 2011, Then Constant Benefit Stream)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 3 (D13)

Route D1 & E (to Whitford Brown Ave only)

Analysis Year	**1996**	**2011**	
Annual Benefits	**$9.435**	**$79.109**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$28.015	$79.109
Annual Benefit Growth Rate	0.0%	16.6%	0.0%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$228.897**	**$135.387**
NPV OF BENEFITS : -	**$364.284**		

OPTION 4 (D1B)

Route D1, Part TG Route & Link B

Analysis Year	**1996**	**2011**	
Annual Benefits	**$5.743**	**$37.686**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$14.261	$37.686
Annual Benefit Growth Rate	0.0%	14.9%	0.0%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$111.538**	**$64.496**
NPV OF BENEFITS : -	**$176.034**		

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth To 2011, Then Constant Benefit Stream)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 5 (D1K)

Route D1, Part TG Route & Kenepuru Drive Link

Analysis Year	**1996**	**2011**	
Annual Benefits	**$9.929**	**$118.343**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$38.839	$118.343
Annual Benefit Growth Rate	0.0%	18.6%	0.0%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$334.049**	**$202.533**
NPV OF BENEFITS : -	**$536.582**		

OPTION 6 (D51)

Route D5 & E (to Warspite Ave only)

Analysis Year	**1996**	**2011**	
Annual Benefits	**$9.086**	**$69.165**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$25.107	$69.165
Annual Benefit Growth Rate	0.0%	16.0%	0.0%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$201.798**	**$118.370**
NPV OF BENEFITS : -	**$320.168**		

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth To 2011, Then Constant Benefit Stream)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 7 (D1G)

Route D1 (with TG Route in place)

Analysis Year	**1996**	**2011**	
Annual Benefits	**$12.121**	**$102.869**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$36.320	$102.869
Annual Benefit Growth Rate	0.0%	16.7%	0.0%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$297.350**	**$176.051**
NPV OF BENEFITS : -	**$473.401**		

OPTION 8 (D5G)

Route D5 (with TG Route in place)

Analysis Year	**1996**	**2011**	
Annual Benefits	**$10.746**	**$99.515**	
Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$34.418	$99.515
Annual Benefit Growth Rate	0.0%	17.2%	0.0%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$285.695**	**$170.310**
NPV OF BENEFITS : -	**$456.004**		

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth Rate as per Traffic Growth Rate) Traffic Growth Rate = 2.5%

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 1 (D11)

Route D1 & E (to Warspite Ave only)

Analysis Year	**1996**
Annual Benefits	**$9.549**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$10.504	$13.131
Annual Benefit Growth Rate	0.0%	2.3%	1.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$53.956**	**$24.466**

NPV OF BENEFITS : - $78.421

OPTION 2 (D12)

Route D1 & E (to Warspite Ave & Whitford Brown Ave)

Analysis Year	**1996**
Annual Benefits	**$10.345**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$11.380	$14.225
Annual Benefit Growth Rate	0.0%	2.3%	1.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$58.452**	**$26.505**

NPV OF BENEFITS : - $84.957

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth Rate as per Traffic Growth Rate) Traffic Growth Rate = 2.5%

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 3 (D13)

Route D1 & E (to Whitford Brown Ave only)

Analysis Year	**1996**
Annual Benefits	**$9.435**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$10.379	$12.974
Annual Benefit Growth Rate	0.0%	2.3%	1.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$53.311**	**$24.173**

NPV OF BENEFITS : - $77.484

OPTION 4 (D1B)

Route D1, Part TG Route & Link B

Analysis Year	**1996**
Annual Benefits	**$5.743**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$6.317	$7.897
Annual Benefit Growth Rate	0.0%	2.3%	1.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$32.449**	**$14.714**

NPV OF BENEFITS : - $47.163

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth Rate as per Traffic Growth Rate) Traffic Growth Rate = 2.5%

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 5 (D1K)

Route D1, Part TG Route & Kenepuru Drive Link

Analysis Year	**1996**
Annual Benefits	**$9.929**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$10.921	$13.652
Annual Benefit Growth Rate	0.0%	2.3%	1.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$56.097**	**$25.437**

NPV OF BENEFITS : - $81.534

OPTION 6 (D51)

Route D5 & E (to Warspite Ave only)

Analysis Year	**1996**
Annual Benefits	**$9.086**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$9.994	$12.493
Annual Benefit Growth Rate	0.0%	2.3%	1.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$51.335**	**$23.278**

NPV OF BENEFITS : - $74.613

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Benefit Growth Rate as per Traffic Growth Rate) Traffic Growth Rate = 2.5%

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 7 (D1G)

Route D1 (with TG Route in place)

Analysis Year	**1996**
Annual Benefits	**$12.121**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$13.333	$16.666
Annual Benefit Growth Rate	0.0%	2.3%	1.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$68.485**	**$31.054**

NPV OF BENEFITS : - $99.539

OPTION 8 (D5G)

Route D5 (with TG Route in place)

Analysis Year	**1996**
Annual Benefits	**$10.746**

Period	**1996-2000**	**2000-2011**	**2011-2023**
Start Year	1996	2000	2011
End Year	2000	2011	2023
Duration	4	11	12
Initial Benefits ($)	$0.000	$11.821	$14.776
Annual Benefit Growth Rate	0.0%	2.3%	1.8%
USPWF	3.326	6.815	7.149
AGPWF	6.230	31.048	34.890
SPPWF	1.0000	0.6830	0.2394
NPV of Benefits in Period	**$0.000**	**$60.716**	**$27.531**

NPV OF BENEFITS : - $88.248

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Assume Calculated Year 2011 Benefits would not occur until Year 2026)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 1 (D11)

Route D1 & E (to Warspite Ave only)

Analysis Year	**1996**	**2026**
Annual Benefits	**$9.549**	**$72.875**
Period	**1996-2000**	**2000-2023**
Start Year	1996	2000
End Year	2000	2023
Duration	4	23
Initial Benefits ($)	$0.000	$17.993
Annual Benefit Growth Rate	0.0%	11.7%
USPWF	3.326	9.320
AGPWF	6.230	70.840
SPPWF	1.0000	0.6830
NPV of Benefits in Period	**$0.000**	**$216.673**

NPV OF BENEFITS : - **$216.673**

OPTION 2 (D12)

Route D1 & E (to Warspite Ave & Whitford Brown Ave)

Analysis Year	**1996**	**2026**
Annual Benefits	**$10.345**	**$94.522**
Period	**1996-2000**	**2000-2023**
Start Year	1996	2000
End Year	2000	2023
Duration	4	23
Initial Benefits ($)	$0.000	$21.569
Annual Benefit Growth Rate	0.0%	13.0%
USPWF	3.326	9.320
AGPWF	6.230	70.840
SPPWF	1.0000	0.6830
NPV of Benefits in Period	**$0.000**	**$273.066**

NPV OF BENEFITS : - **$273.066**

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Assume Calculated Year 2011 Benefits would not occur until Year 2026)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 3 (D13)

Route D1 & E (to Whitford Brown Ave only)

Analysis Year	**1996**	**2026**
Annual Benefits	**$9.435**	**$79.109**
Period	**1996-2000**	**2000-2023**
Start Year	1996	2000
End Year	2000	2023
Duration	4	23
Initial Benefits ($)	$0.000	$18.725
Annual Benefit Growth Rate	0.0%	12.4%
USPWF	3.326	9.320
AGPWF	6.230	70.840
SPPWF	1.0000	0.6830
NPV of Benefits in Period	**$0.000**	**$231.572**

NPV OF BENEFITS : - $231.572

OPTION 4 (D1B)

Route D1, Part TG Route & Link B

Analysis Year	**1996**	**2026**
Annual Benefits	**$5.743**	**$37.686**
Period	**1996-2000**	**2000-2023**
Start Year	1996	2000
End Year	2000	2023
Duration	4	23
Initial Benefits ($)	$0.000	$10.002
Annual Benefit Growth Rate	0.0%	10.6%
USPWF	3.326	9.320
AGPWF	6.230	70.840
SPPWF	1.0000	0.6830
NPV of Benefits in Period	**$0.000**	**$115.190**

NPV OF BENEFITS : - $115.190

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Assume Calculated Year 2011 Benefits would not occur until Year 2026)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 5 (D1K)

Route D1, Part TG Route & Kenepuru Drive Link

Analysis Year	**1996**	**2026**
Annual Benefits	**$9.929**	**$118.343**
Period	**1996-2000**	**2000-2023**
Start Year	1996	2000
End Year	2000	2023
Duration	4	23
Initial Benefits ($)	$0.000	$24.384
Annual Benefit Growth Rate	0.0%	14.8%
USPWF	3.326	9.320
AGPWF	6.230	70.840
SPPWF	1.0000	0.6830
NPV of Benefits in Period	**$0.000**	**$330.077**

NPV OF BENEFITS : - $330.077

OPTION 6 (D51)

Route D5 & E (to Warspite Ave only)

Analysis Year	**1996**	**2026**
Annual Benefits	**$9.086**	**$69.165**
Period	**1996-2000**	**2000-2023**
Start Year	1996	2000
End Year	2000	2023
Duration	4	23
Initial Benefits ($)	$0.000	$17.096
Annual Benefit Growth Rate	0.0%	11.7%
USPWF	3.326	9.320
AGPWF	6.230	70.840
SPPWF	1.0000	0.6830
NPV of Benefits in Period	**$0.000**	**$205.730**

NPV OF BENEFITS : - $205.730

Total Annual Network Operating Costs

Hutt Valley - Porirua Road Link Study
(Assume Calculated Year 2011 Benefits would not occur until Year 2026)

Analysis Base Year :- 1996
Construction Period :- July 1998 - June 2000

OPTION 7 (D1G)

Route D1 (with TG Route in place)

Analysis Year	**1996**	**2026**
Annual Benefits	**$12.121**	**$102.869**
Period	**1996-2000**	**2000-2023**
Start Year	1996	2000
End Year	2000	2023
Duration	4	23
Initial Benefits ($)	$0.000	$24.221
Annual Benefit Growth Rate	0.0%	12.5%
USPWF	3.326	9.320
AGPWF	6.230	70.840
SPPWF	1.0000	0.6830
NPV of Benefits in Period	**$0.000**	**$300.546**

NPV OF BENEFITS : - **$300.546**

OPTION 8 (D5G)

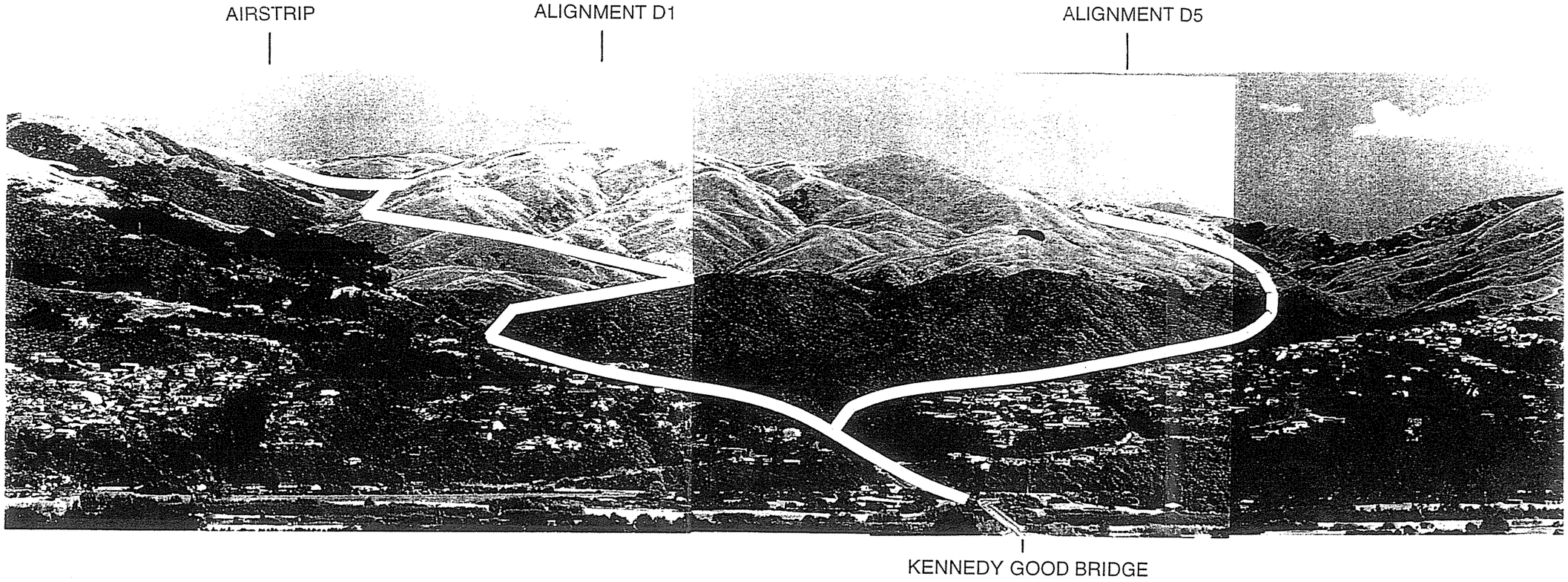
Route D5 (with TG Route in place)

Analysis Year	**1996**	**2026**
Annual Benefits	**$10.746**	**$99.515**
Period	**1996-2000**	**2000-2023**
Start Year	1996	2000
End Year	2000	2023
Duration	4	23
Initial Benefits ($)	$0.000	$22.582
Annual Benefit Growth Rate	0.0%	13.1%
USPWF	3.326	9.320
AGPWF	6.230	70.840
SPPWF	1.0000	0.6830
NPV of Benefits in Period	**$0.000**	**$286.921**

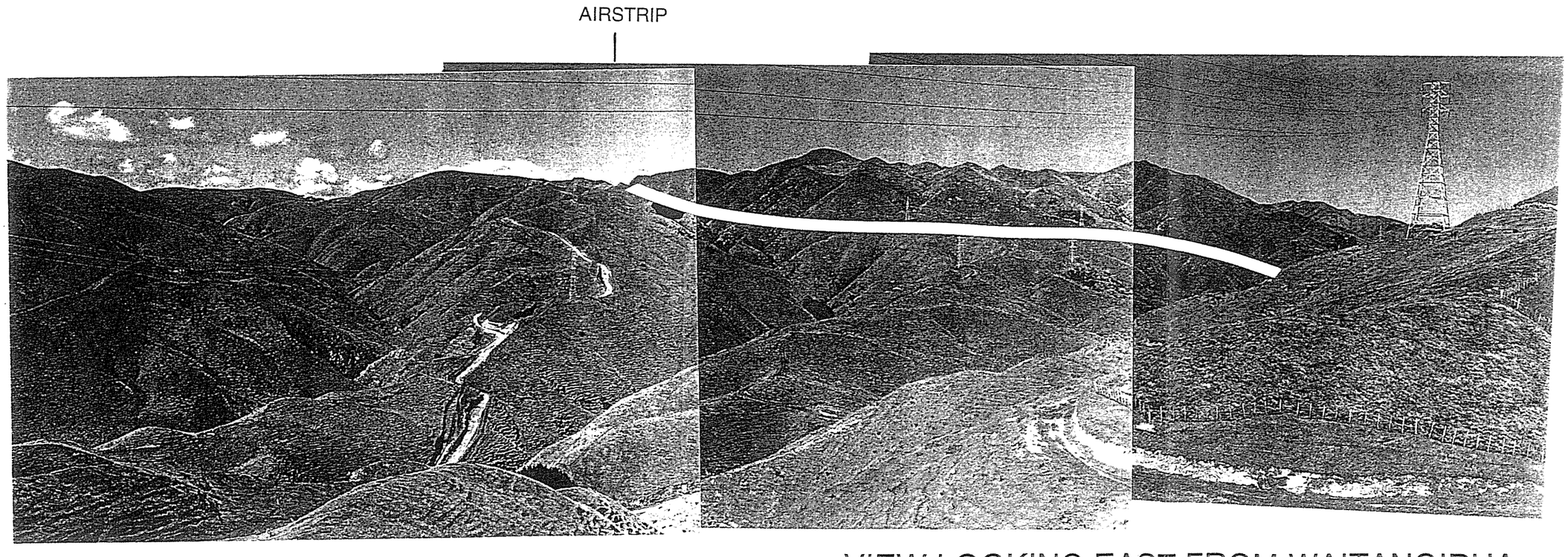
NPV OF BENEFITS : - **$286.921**

APPENDIX B8

Photographic Views with General Location of Route/Corridor Marked on



VIEW LOOKING WEST FROM HUTT VALLEY



VIEW LOOKING EAST FROM WAITANGIRUA