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KARORI RESIDENTS ASSOCIATION
He waka eke noa

NEW KARORI TUNNEL PROPOSAL 2020

Author Bill Guest 10 September 2020

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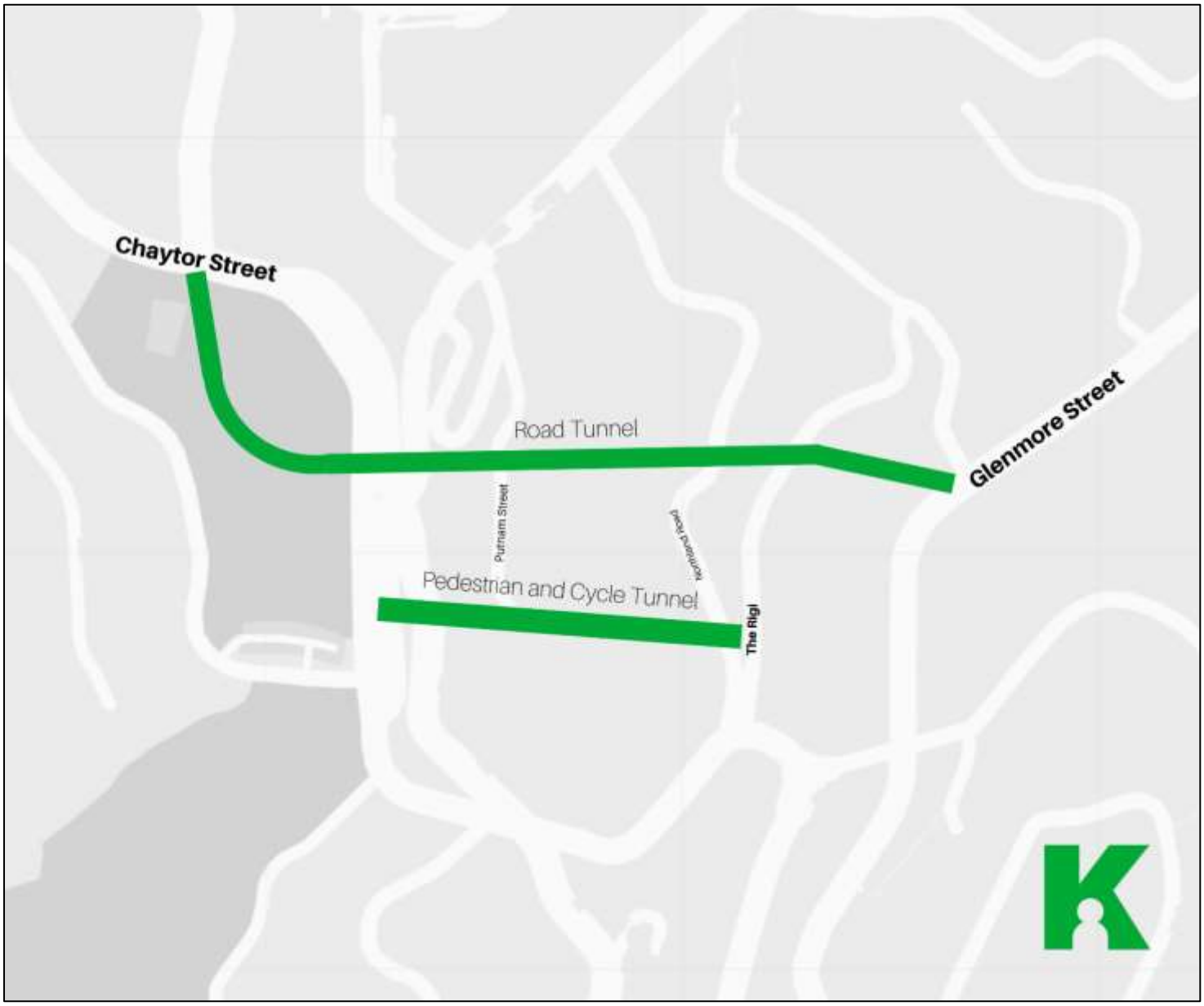
Suggested new tunnel route



William *(Bill)* Guest

Bill is a retired civil engineer who has lived in Karori for 26 years. He graduated with a B.E. (Civil) from the University of Canterbury in 1968, and later earned an M.E. (Civil) (First Class) from the University of Auckland in 1976. This postgraduate degree was focussed on transportation engineering. He later completed Diplomas in Business Administration and in Business Computing from Massey University.

Bill spent most of his career in transport, much of it in or associated with railways, including senior management roles. The last seven years of his career were with Veolia Transport (now Transdev) in Auckland, first as Safety Manager than then as Strategy and Network Development Manager. In these roles, Bill was part of the management team that overhauled the rail passenger operations in Auckland.

Bill retired in early 2011 and returned to his home in Karori. After spending some time renovating the house, he became interested in local Karori issues. Subsequently he joined KRA as Infrastructure Coordinator and has spent a lot of time (with assistance from other members) on drainage, transport planning, and public transport matters.

KARORI TUNNEL IS UNFIT FOR PURPOSE

When Karori Tunnel opened in 1900, the population the valley was around 1100. The tunnel's main purpose was to encourage the expansion of housing, which was in short supply in Wellington. By 1954, when Karori's population was 9,000, there were doubts about the capacity of the tunnel. Nothing was done. In 1962, when the population was 10,000 the issue arose again. Consultants were engaged, but again nothing was done. In 1972 Council decided to postpone any work indefinitely. The population was around 12,000. In 2020, when the population of Karori alone is between 16,000 and 18,000, and the tunnel serves 25,000 western suburbs residents, it is time to re-visit the issue and this time, take action.

Introduction

Karori Tunnel and its approach roads are not satisfying the transport needs of Karori, Northland, Wilton, and Makara. The main problems are:

1. The tunnel is undersized and cannot take large vehicles. Double deck buses will not be possible through the tunnel as it is. Even the present single deck buses have difficulty without infringing over the centreline.

2. One lane in each direction is inadequate for traffic flows during much of the day, but especially at peak hours during the working week.

3. There is no provision for cyclists, and the tunnel is a serious hazard to all cyclists.

4. The footpath (87-92cm wide) is quite inadequate for pedestrians.

5. Traffic to and from Kelburn and Thorndon are frequently delayed at the mini roundabout at the end of the Kelburn Viaduct.

6. The Chaytor Street/Curtis Street/Raroa Road intersections are poorly designed, unsafe for cyclists, and with no reasonable provision for pedestrians.

This paper examines the tunnel and argues for the revival of a proposal first advanced nearly 70 years ago for a second tunnel.

The Tunnel Now

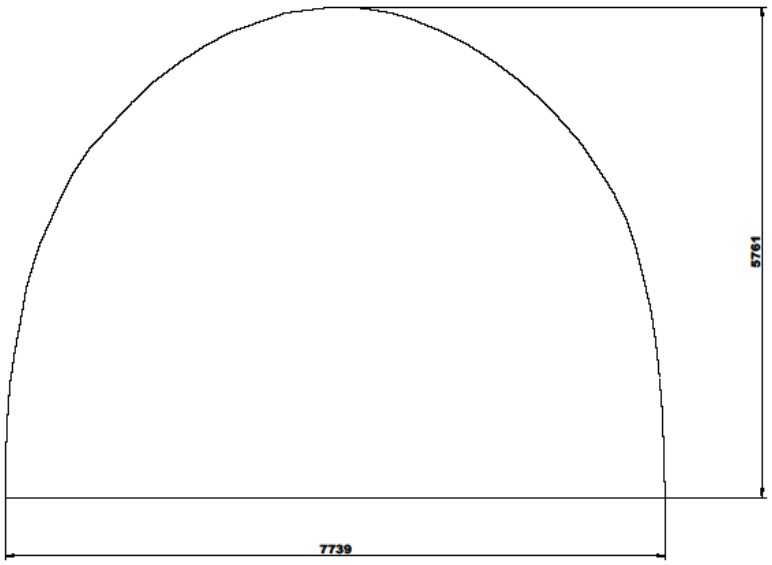
Let us begin by looking at the tunnel as it is now.

Photograph Taken from the Western End 26 April 2020 During the Covid19 Lock Down.

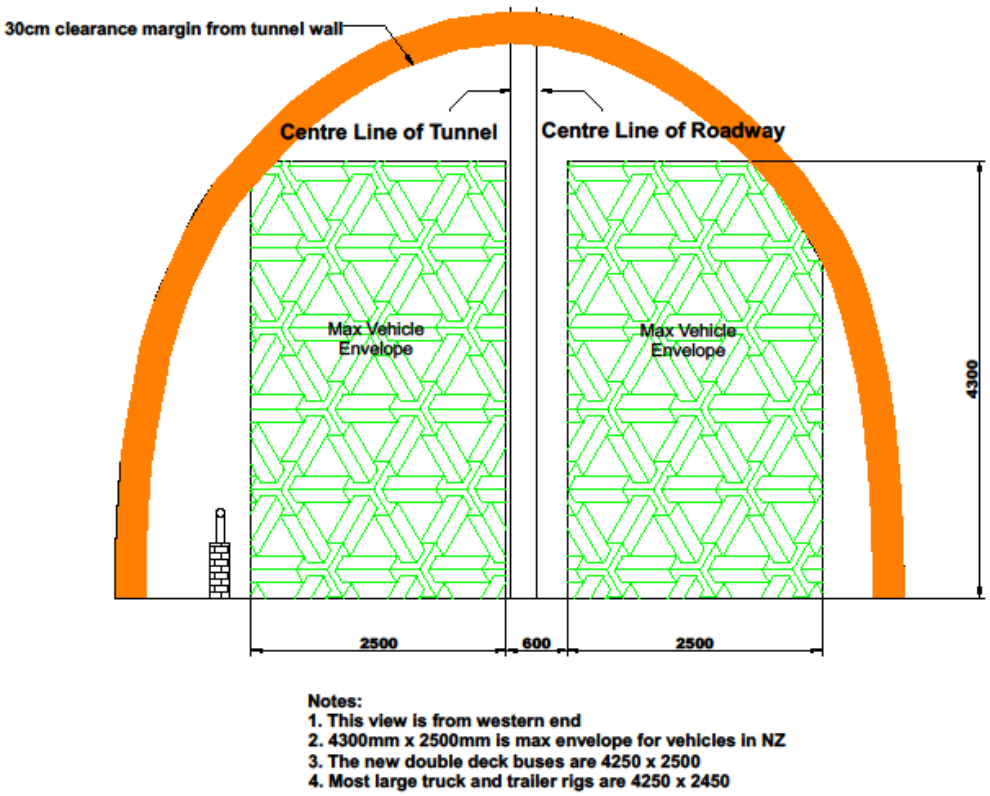
The footpath takes up 120cm of the base width of the tunnel, but by the time a small kerb and the barrier wall are subtracted, the footpath is 92cm at the western end, reducing to 87cm at the eastern end. (The interior doors of houses are typically 75cm wide, and front doors 80-85cm.) It is difficult for pedestrians to pass each other. A single pushchair is around 50cm wide so passing pushchairs is impossible. The narrow footpath is a serious impediment to persons with physical disabilities.

Obtaining an accurate dimensioned cross-section profile of the tunnel proved to be difficult. Two relatively old plans supplied to me were in imperial dimensions, and one of them was a draftsman's nightmare and was impossible to re-draw without making assumptions. Historical documents tended to give only the height and the width at the base of the walls, when clearly the shape of the curves is essential to assess what sized vehicles can pass through.

Eventually, using a mixture of photographs and various measurements, the curve below was deemed satisfactory for analysis:



Adding some details (next page):



Explaining:

1. A 30cm safety clearance is marked in orange to allow for driver error and vehicle swaying. (It is not important at the lower levels of the tunnel, or by the footpath.)

2. The centre line of the roadway is shown, displaced to the right of the tunnel centreline because of the footpath.

3. The maximum vehicle heights and widths of 4300mm and 2500mm are drawn in, but truncated where they infringe the safety margin. The vehicle envelopes have an infill of an Escher pattern (whimsically chosen to represent transport planning in Wellington) and coloured lime green (because our new buses are about that colour).

4. A centre safety gap of 600mm was allowed between the vehicle envelopes because they could contain moving vehicles, leaving approximately 300mm at the sides to the static wall and footpath barrier. These are extremely poor safety gaps even for an urban area.

The problems with the tunnel size now become apparent. A full-size bus or truck might be able to travel from west to east if precisely placed and close to the centre line. There is no chance whatsoever of getting a full-sized bus or track to travel safely from east to west except by straddling the centre line. Further, there is no safety margin for cyclists on either side or in the middle.

It will come as no surprise that some truck-drivers have tried:

How Many People Does Karori Tunnel Serve?

Using data found on the Wellington City Council web site, it was found that the population of the Onslow-Western Suburbs ward was a little over 45,000 people. The ward is shown as containing several discrete areas, with a population given for each area.

After deducting those areas which would clearly use Ngauranga Gorge, Ngaio Gorge, Garden Road, or Raroa Road to reach the city, **KRA** reached the conclusion that about 25,000 people rely significantly on Karori Tunnel for transport to the CBD. This was an empirical exercise which required some assumptions and was repeated several times with variations to the assumptions being tested. The result seemed reasonably stable at 25,000 across all reasonable assumptions.

Karori Tunnel is not only for Karori. It is also used by Makara, Creswick Valley, Wilton, Northland, and Otari residents.

The Capacity of Karori Tunnel

Suppose in a single lane of a road there is a string of vehicles with 20 metres between the noses of each vehicle, and moving at 30 km/hr. A few calculations show that the number of vehicles passing any point is 1496 per hour.

While this is a simplistic scenario, it is a starting point for assessing the traffic capacity of Karori Tunnel, and it is not far off the actual situation at peak hours. Traffic engineers use more complex mathematics to introduce some statistical variability into the traffic flow, but methods used by NZTA and the US Federal Highway Administration give similar results for single lane capacity in urban areas.

In 2016, Wellington City commissioned AECOM consultants to undertake a review of the potential impacts of increasing medium density housing in Karori on the traffic corridor to and from the central business district of Wellington. **KRA** is critical of some of the methodology described in the report, but there is some data that is revealing. (More on the methodology later).

Table 1 of the AECOM report gives the number of vehicles travelling "through the Chaytor Street corridor" as 1795 in 2012, 1810 in 2013, 1660 in 2014, and 1746 in 2015. Sloppily, the paragraph before Table 1 states "Table 1 displays the volume of cars, buses, taxis, and cyclists at the Chaytor Street bus lane travelling through the corridor over the 2.5-hour morning peak period". There are several problems with this statement:

1. It must be inferred by looking at other parts of the report that the totals are vehicles **per hour** during the morning peak period, and not the total for the 2.5-hour peak period.

2. Chaytor Street runs from the top of Glenmore Street through the tunnel, and up to the intersection with Karori Road outside the Karori Fire Station. There are bus lanes in both directions, with eastbound one stretching most of the way from Karori Road to the bus stop outside the tunnel, opposite the Birdwood Street intersection. So exactly where did the vehicle count for Table 1 take place? Elsewhere in the report much is made of the Karori Road section "east of Flers Street". But is this is taken as "between Flers Street and the Fire Station" then is it safe to infer that the "Chaytor Street corridor" count was taken just below the Fire station intersection, but before Curtis Street? The point is this: the eastbound traffic count in the tunnel must be –

Eastbound on Chaytor Street	+/- any change from Curtis Street (probably +ve) +/- any change into Raroa Road (probably -ve) +/- any change from Northland Tunnel Road (prob +ve) +/- any change from Birdwood Street (prob +ve) +/- any change from Waiapu Road (minimal)

3. It is surprising that a report assessing the capability of the current corridor to absorb additional traffic from proposed medium density housing growth should pay so little attention to the narrowest bottleneck in the corridor – the Karori Tunnel.

It seems reasonable to conclude that the morning peak hour eastbound traffic counts exceed the figures given in Table 1 of the AECOM report on the simple premise that the additional inflows from Curtis Street, Northland Tunnel Road, and Birdwood Street would greatly exceed the outflow into Raroa Road. In other words, the demand for vehicles to travel east through the tunnel during morning peak times exceeds the counts given for the Chaytor Street corridor, which in themselves exceed an estimate of the tunnel capacity.

Even the Table 1 figures exceed the estimated capacity of each lane of the tunnel, at 1500 vehicles per hour. The consequence is hinted at in the executive summary of the AECOM report where it states (but not specifically in respect of the tunnel right now): "[Where]…the demand exceeds the available capacity of the link and excessive delays and queuing are anticipated along the route".

Other Problems with the AECOM Report.

1. The analysis of the traffic flows is very superficial. Table 1 of the report lists counts only under the headings of:

    a. Cars
    b. Buses
    c. Taxis
    d. Cycles

This is an extremely limited breakdown and seems to imply that all traffic consists of commuters. This is far from the truth. Transport is an essential element of all commerce in goods and services. (Both Wellington City Council and AECOM need to upgrade their concepts of transport within the city. This problem is evident also in Council's planning and parking strategies). A better analysis would give definitions for each class of travel. A possibility is:

A. Private cars taking people to a single-location job (commuters)
B. Private cars taking people to be customers of shops or leisure activities, professional services, local or central government agencies etc
C. Cars or small commercial vehicles taking employed persons to a location from which they will regularly relocate during the day (e.g. aged care workers, cleaners, land agents, inspectorial staff, couriers).
D. Taxis, shuttles.
E. Public transport buses
F. Private transport buses (charters, tourists)
G. Small commercial vehicles used by tradespeople (builders, plumbers, electricians, painters, etc)
H. Large commercial vehicles (delivery trucks, large construction vehicles, large primary industry vehicles such as logging or stock trucks etc)
I. Motorcycles over 125cc engine size
J. Motorcycles 125cc and under
K. Electric powered bicycles.
L. Manual bicycles

All these classes may require parking at their destination or destinations. But ONLY the persons in classes A, and I through L have the full option to move to public transport. (Class B might have some option, but many will have appointments that must be met or be carrying goods or papers that they choose to carry by car).

2. In Appendix D, AECOM report some calculated ratios of traffic counts to road capacity at peak hours. They show these ratios as a percentage, and they distinguish between intersections and links (i.e. sections of roads between intersections). It is not clear to **KRA** why this distinction is made, and the results are puzzling. Generally, the ratio percentages for intersections appear satisfactory (in the range 40% - 65% at present). The ratio percentages for links look satisfactory except for a link called "East of Flers Street" where the current ratio looks to be around 90%.

   AECOM appear to consider this to be acceptable. In **KRA**'s view, it is not. Traffic flows are a form of problem known as queuing theory, where "items" are "processed" by a "server". The arrival of items and the serving time are often subject to variability, and the results becoming intriguing. In this case, the tunnel is the "server" because every vehicle approaching wishes to pass through it, but the same could be said of every link in the roads leading to the tunnel.

   Queuing theory mathematics can get complex, but all problems have one thing in common: the average length of the queue is shown to be proportional to a term:

$$\frac{1}{Capacity - actual\ items}$$

   Or:

$$\frac{1}{C - V}$$

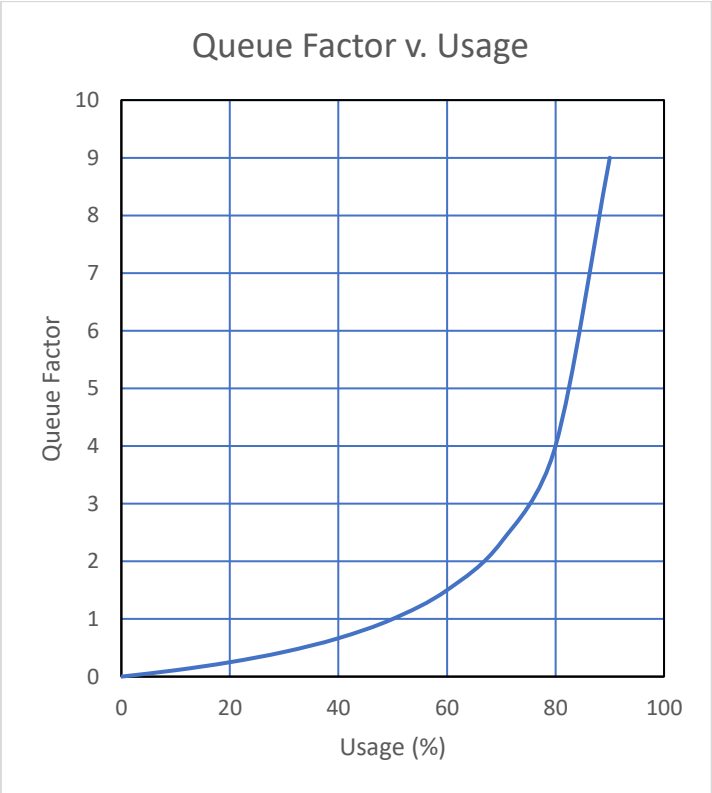
   Where C = capacity of link (in this case, the tunnel)
   V= vehicles seeking to pass through the tunnel

   Both C and V are in the numbers of vehicles over a period. In the AECOM report, they are vehicles per hour. The ratios calculated by AECOM are:

$$Ratio\ as\ \% = \frac{V}{C}\ x\ 100$$

   In **KRA**'s view, AECOM too casually accept high values of the ratios. The expression $\frac{1}{C-V}$ is an inverse, and as the volume of traffic V approaches the capacity C, C-V gets closer to zero (0).

This can be shown qualitatively in this graph:



It must be stressed that this graph is indicative only and does not specifically relate to Karori Tunnel (although many road users will recognise the result from their own experience). When the usage of the tunnel is zero, there is no queue. At about 50% capacity usage, the queue factor has risen to 1. At 60%, it is still only 1.5 but is beginning to rise quite steeply. At 80% it is 4, and at 90% it is 9. It continues to go upwards mathematically.

What is the meaning of this? Surely if the tunnel is being used at capacity, and the traffic is approaching it at the same rate, everything could move smoothly? The answer is that life is not like that, and queuing theory was developed to explain the effects of statistical variations in operations involving "servers". A simple explanation is this: as the server (in our case, Karori Tunnel) reaches its capacity, it only takes the slightest variation in traffic flow to cause a queue because the tunnel has no capacity left to "catch up". The entire flow of traffic becomes unstable, and the queue builds. It would build forever – but of course after a while the volume of traffic does finally decrease and the tunnel "gets a chance to catch up".

The above is a simple explanation of why we in Karori sometimes get a queue that stretches all the way back from the tunnel as far as Campbell Street.

A look at the graph shows that after about 65-70% of capacity, the Queue Factor is rising very steeply. In a wide range of queuing-type situations, operations managers ensure that key servers that are subjected to statistical variations of arrival and service times have sufficient capacity to deal with these variations, by sizing them to operate at 65-70% capacity on average. Their rationale is that large queues lead to delays, take up space, reduce customer satisfaction, and ultimately cost money.

Wellington City Council and our community have "saved money" by doing nothing about Karori Tunnel and its access roads. Have there been any costs incurred because nothing has been done? There is a large amount of research material on the real costs of congestion for those who wish to research it. **KRA** recommends Wikipedia as a starting point: "The costs of traffic congestion".

Some History

Note: **KRA** is indebted to the Karori Historical Society for its excellent book "Karori and Its People" (2011) for much of this section. The Society's detail in chronicling our suburb is outstanding. Acknowledgment is also given to the National Library and the Alexander Turnbull Library for online resources such as Papers Past and the digital collection of old photographs.

Some key dates are:

Dec 1897:	Contract let for building Karori Tunnel
Oct 1898:	First contractor discharged, and new contractor engaged
July 1899:	Second contractor discharged, and Karori Borough took over the work.
Dec 1899:	Tunnel opened for road traffic on Boxing Day, but ancillary work remained to finish
Aug 1900:	Electric lights completed in tunnel.
Mar 1907:	Trams commissioned "as far as the cemetery".
May 1911:	Trams extended as far as Karori Park.
1913:	Kelburne-Karori Motor Bus Company begins to compete with the trams.
April1920:	Karori Borough amalgamates with Wellington City
1926:	Wellington City Transport buses begin route to Kelburn
1928:	WCC establishes a Western Access Commission to study improved access to the western suburbs. The study does not include Karori Tunnel.
1929:	WCT buses extend route to Duthie Street
1930:	WCT buses extend as far as Karori Post Office
1931:	Kelburn Viaduct opened.
1938:	Central government blocks WCC options, and Bowen Street work begins.
1938:	Western Access Commission disbanded as studies completed.
Aug 1940:	Bowen St opened and Glenmore St widening opened.
Dec 1946:	Wellington City Council buys out remaining private bus company.
1947:	WCT diesel buses begin routes into hill subdivisions in Karori.
1948:	Engineers estimate that trams need replacing within 7 years.
Oct 1954:	Trolleybuses replace trams in Karori.
1954:	City Engineers' Department identifies need for an additional access route into Karori. Also recommends a pedestrian tunnel just north of the present tunnel. The Mayor, Robert Macalister, agrees with both recommendations.
1954:	Another possibility looked at is a duplication of Karori tunnel and a new road tunnel between Glenmore Street and Norway Street (in the upper reaches of Aro Valley). The estimate was £1,741,000 and was vehemently opposed by the Chamber of Commerce. The Council did not act.
1962:	Council commissions the American consultancy of De Leuw Cather & Co to report on the city's long-term traffic needs. The firm recommended a new tunnel between Waiapu Road and Aro Street. This would provide an east-west connection and take pressure off the existing tunnel. The council dithered and did not act.
1972:	Council decides "to postpone any work indefinitely". In other words, the whole issue goes into the "too hard" basket.
2020:	The problems – now much worse – remain in the "too hard" basket.

Conclusions About the Problems with Karori Tunnel Now

1. With only one lane in each direction, **THE TUNNEL CANNOT HANDLE TRAFFIC DEMAND AT PEAK HOURS**, causing significant queues and delays for motorists.

2. **THE TUNNEL IS SERIOUSLY UNDERSIZED FOR LARGER VEHICLES INCLUDING PUBLIC TRANSPORT BUSES**.

3. The lane widths are narrow, leaving little room for driver error

4. There are no cycle lanes.

5. The tunnel must be considered **UNSAFE FOR CYCLISTS**.

6. The single narrow footpath does not allow pedestrians to pass easily, and often requires physical contact to do so. Pushchairs cannot pass each other or pedestrians. Double width pushchairs cannot enter the tunnel. Wheelchairs and mobility scooters cannot safely travel through the tunnel. Summarising, the tunnel is **UNSUITABLE FOR PEDESTRIANS, PUSHCHAIRS, WHEELCHAIRS, AND MOBILITY SCOOTERS**.

7. **KARORI TUNNEL IS THEREFORE UNFIT FOR PURPOSE.**

8. **THESE PROBLEMS HAVE BEEN DOCUMENTED FOR 66 YEARS, AND COUNCILS HAVE DONE NOTHING**.

Conclusions About the Problems with the Approach Roads Near the Tunnel

1. The AECOM report states that the link on Karori Road east of Flers Street is also at or close to saturation during peak hours.

2. There has been local dissatisfaction expressed with the complex intersection of Chaytor Street with Raroa Road and Curtis Street. This area **is UNSAFE FOR CYCLISTS, DIFFICULT FOR PEDESTRIANS, DIFFICULT FOR MOTORISTS EXITING RAROA ROAD, AND DIFFICULT FOR MOTORISTS CHANGING LANES ACROSS THE CURTIS STREET INTERSECTION WHILE HEADING FOR RAROA RD**.

3. At both ends of the tunnel, Chaytor Street has curves which make it difficult for long vehicles with significant overhang (the distance by which the body of the vehicle extends past the nearest axle) to avoid passing over the centreline.

4. The intersection of Chaytor Street/Northland Road/The Rigi/Kelburn Road/Glenmore Street is at or close to saturation during peak hours. There are significant delays on Glenmore Street in the afternoon peak hour. At this intersection streams of traffic from Kelburn Road and Glenmore Street merge.

Solutions

What options are available to improve the access to and from the western suburbs? Are there any guiding principles that should be considered? **KRA** believes these are important:

Guiding Principles

1. The tunnel must remain open at peak hours and during the day during any construction work. There is no realistic possibility of diverting traffic down Raroa Road, or Northland Road, or Garden Road, or Ngaio Gorge Road.

2. Any solution must make good provision for cyclists, pedestrians, and persons with disabilities.

3. Any solution must not increase the gradient of any road or path used by pedestrians or cyclists.

4. Consideration must be given to separating the streams of traffic to and from Glenmore Street and Kelburn Road.

5. Consideration must be given to improving the layout of the Chaytor St/Curtis St/Raroa Rd intersections in selecting a solution.

6. The overall capacity of the options must be appropriate to the traffic demands now, and at least 25 years into the future.

7. There will always be a demand from residents for personal private transport.

8. Public transport in Karori can be improved, but only if there are adequate routes and a means of giving public transport vehicles priority.

9. Commercial activity will always be carried out by road vehicles and is to be encouraged for economic reasons.

10. Karori will not be served by rail transport within any conceivable time frame. Buses will provide public transport for the foreseeable future.

Can We Fix the Existing Tunnel?

Widening: Not Feasible

We now take the diagram shown on page 3 and add to it a representative cross-section of the walls and foundations. A plan from the archives of the City Council shows the two thicknesses that apparently exist in this manner, but it is only a (useful) draftsman's representation of the actual situation.

During the building of the tunnel in 1898-1899 there were three instances of partial collapse. Two of these were when the soil above the temporary timberwork that protected the building of the walls and arch was saturated with rain, lost its ability to support itself, and was too heavy for the thick timbers to withstand.. The third instance also involved a landslide after rain but may have been a relatively simple slip rather than a collapse of tunnel work.

From a civil engineering perspective, the implication was clear: a significant part of the soil over the tunnel was far from self-supporting by arch action and was therefore dead weight that needed to be supported wholly by the tunnel arch. In these areas, it seems that the thickness of the replacement walls and arches was increased.

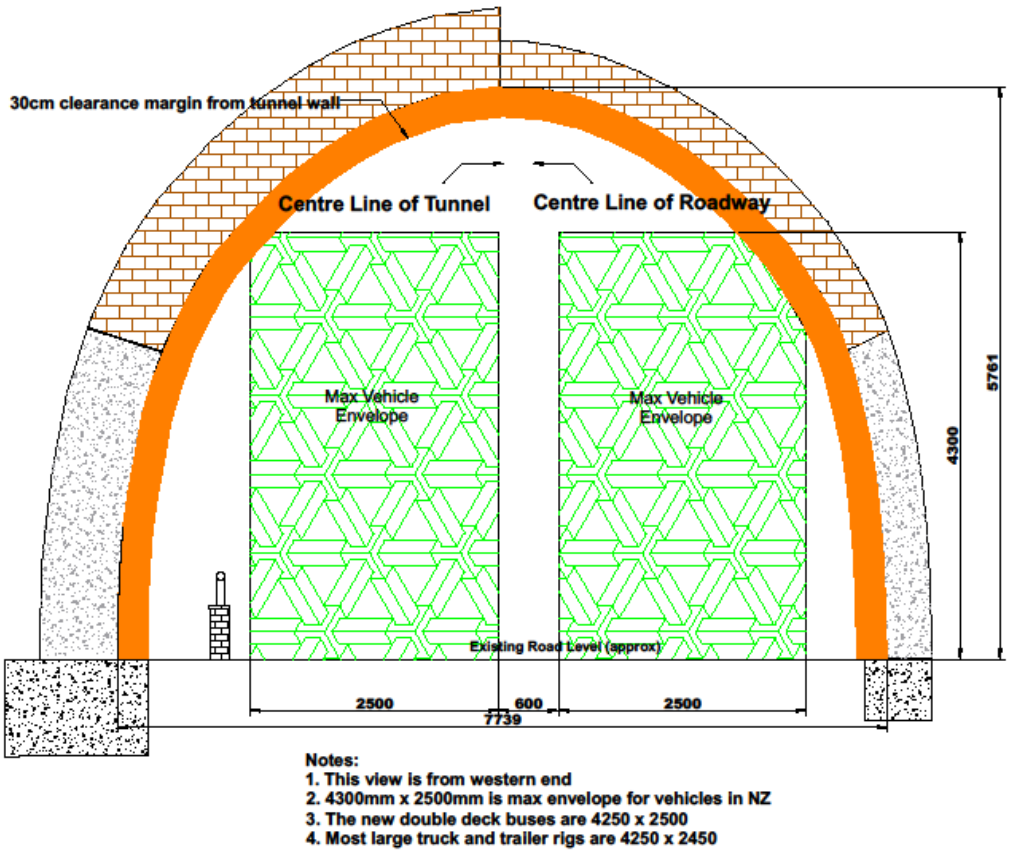
Where the tunnel was driven and the rock and soil basically self-supported, the walls and arch remained thinner.

Both thicknesses are shown in the one plan (which was drawn in 1920). **KRA** has seen no plan view showing exactly which parts of the tunnel have thick walls, and which thin walls.

The lower parts of the walls and the foundations are shown as mass concrete i.e. without any reinforcing steel. The upper arch is built with layers of bricks which by their nature are unreinforced.

There is nothing wrong with the lack of reinforcement in a tunnel structure. The tunnel has been stable for 120 years. However, widening the tunnel requires removal of the walls and arch. We know that the rock and soil collapsed during construction, and removal of the mass concrete walls and foundations and the brick arch will almost certainly bring down the material above the tunnel including Raroa Road and its intersection with Waiapu Road (which serves Highbury).

KRA is open to discussion with tunnelling experts if they know a way in which widening could be achieved, but it seems obvious that the tunnel could not be kept open for traffic during the work, and it seems very unlikely that Raroa Road and Waiapu Road could either. For these reasons, **KRA** regards the idea as infeasible.



Daylighting: Feasible but Complex and Expensive

Daylighting is the term used to describe opening a tunnel up to the daylight by converting it to a cutting. With modern earthmoving machinery, it is often cheaper than tunnelling. It boils down to two issues:

1. Which is feasible?
2. Which is cheaper?

In 1895, a tunnel was selected because otherwise a cutting about 45 metres deep would need to be excavated, and the slopes stabilised. Probably both solutions were feasible, but volume of rock and soil to be moved was very much larger for a cutting than for a tunnel, and there were concerns about how much stabilising with retaining walls would be required. The tunnel option was selected because the feasibility seemed clearer and the cost cheaper.

What about now? Modern hydraulic excavators and heavy trucks could make quite quick work of the excavation. In **KRA**'s view, it is too late. If unretained slopes were wanted, a considerable number of houses would need to be acquired and demolished. It might be possible to used deep bored piles to form a large retaining structure on each side of the tunnel, with a bridge to carry Waiapu Road and Raroa Road over the tunnel, and then excavating underneath to open out the tunnel. This would reduce the number of properties to be acquired and solve the slope stability problems. A construction of this magnitude would be complex, and it would be difficult to keep Raroa Rd and the tunnel open during critical stages of the project.

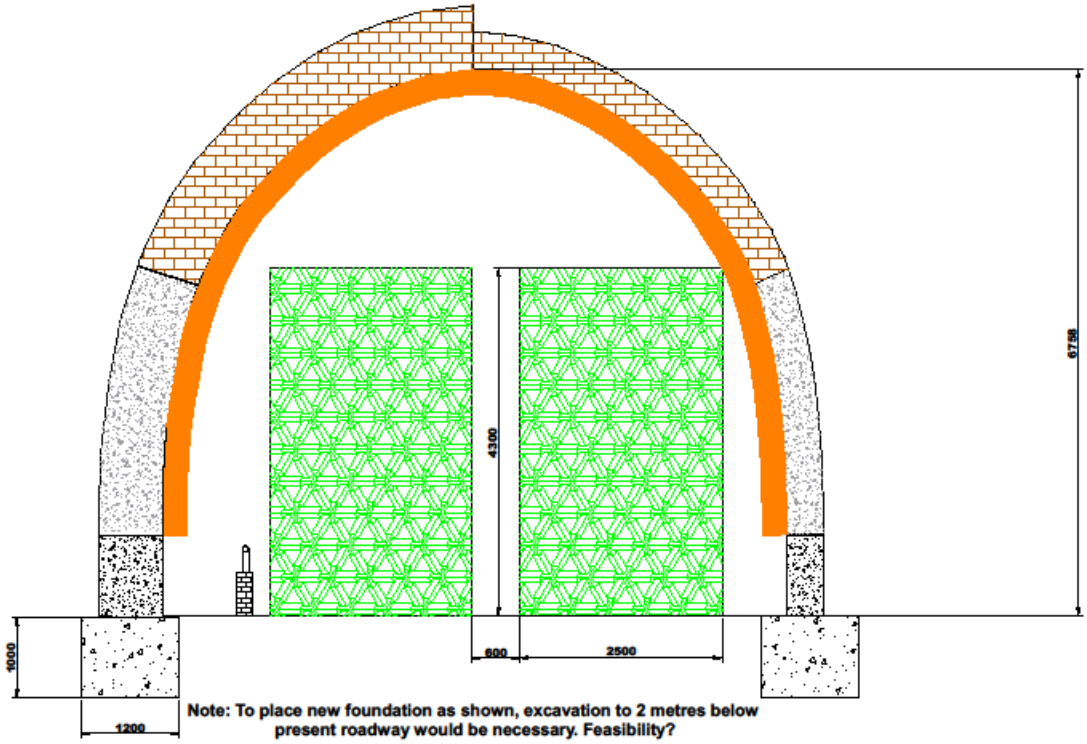
A further objection is that there would be no separation of the flows of traffic, first deemed desirable by De Leuw Cather & Co in the 1960s, and even more desirable today.

KRA rejects this option for its complexity, and its failure to solve any other of the principles 4 and 5 listed on page 10.

Lowering the Floor: Probably Infeasible. Achieves Little.

The idea of lowering the floor of the tunnel to accommodate full sized vehicles has been mooted recently by Greater Wellington City Council. An examination of the plan on page 3 indicates that the roadway would need to be lowered by at least 1 metre. Lowering by 1.25 metres would give a bit more "room to move" for vehicles.

Karori Tunnel showing road lowered 1 metre, with extension to side walls and new foundations



The excavation would need to be deeper to enable new foundations to be inserted under the walls. It seems reasonable to allow 1 metre for the depth of the foundations. The excavation would need to extend across the whole roadway, and it is known that there are several pipes and ducts in the floor of the tunnel. All of these would need to be identified, located, and replaced for a distance that would be appropriate for their purpose.

The excavations under the mass concrete walls which carry the brick arch would be risky and difficult. Even if a successful method were found, it seems likely that the tunnel would have to be closed for months. A collapse of any part of the tunnel would be difficult to repair. A further objection to this proposal is that principles 2, 4, 5, and 6 could not be accommodated.

KRA rejects this option for its technical difficulty, and its inability to make other improvements to the traffic flows and safety.

It seems reasonable to conclude that there is no satisfactory solution to be found by carrying out work on the tunnel alone. A new tunnel appears to offer the best option.

Previous Tunnel Proposals

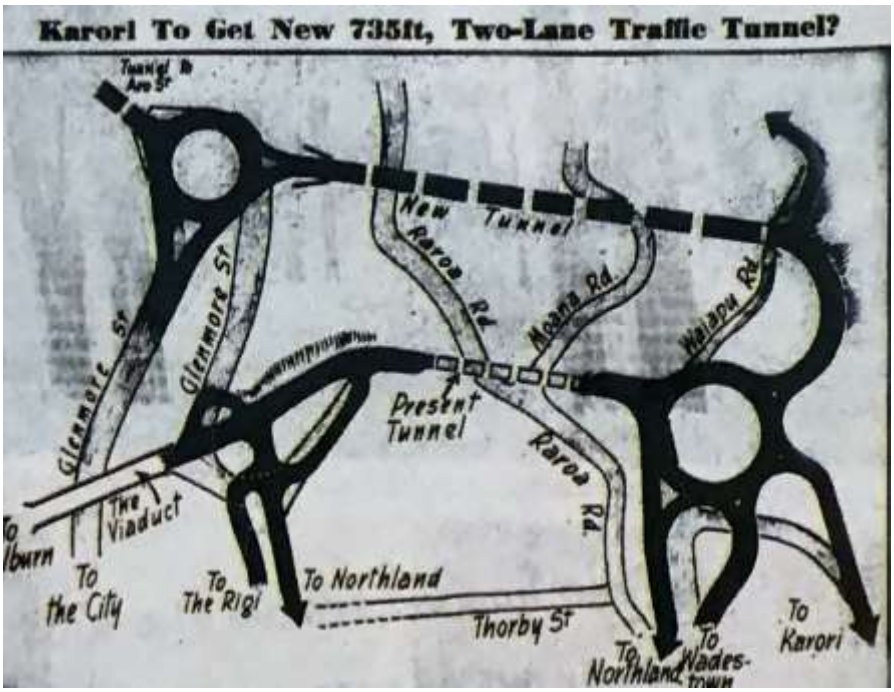
New Tunnel to Norway Street and Aro Street

In 1954 the City Engineer (Mr K. Jefferys) and his staff examined the possibility of improving access to the western suburbs. **KRA** has not searched for the original papers, but there is a brief description of it in a column under the heading "Flashback" in The Dominion dated September 8, 2007. The relevant parts read:

"At 26ft wide with a 6ft path alongside. The tunnel from Glenmore Street to Waiapu Road would be 6ft wider than the Mt Vic tunnel and 735ft long. The project, to cope with rapidly expanding traffic flows, would cost £437,500 (today $19.28 million dollars).

City Engineer F Jefferys was reported as saying that the tunnel was part of the city's east-west traffic plan, though in the meantime the proposed works for another tunnel – linking the new Glenmore Street roundabout with Norway and Aro Street – would have to wait."

The article had a diagram which appears to **KRA** to have had some journalistic licence taken with it for publishing purposes:



There are two features to consider in this diagram. First, the tunnel works consisting of a large roundabout at the hairpin bend on upper Glenmore Street, with the proposed second tunnel passing under the ridge and emerging in Waiapu Road (the access road to what is now Zealandia). The road is then carried across Waiapu Road and swings in a curve on either a bridge or a filled embankment to reach another large roundabout at the intersections of Waiapu Road and Birdwood Street with Chaytor Street. The roundabout distributes traffic to Birdwood Street, Chaytor Street, and Northland Tunnel Road.

The second feature is a plan for street changes at the western end of the Kelburn Viaduct. It appears that the intention was to straighten the road from the viaduct to the tunnel by cutting back the bluff that it still curves around. The westbound lane from the viaduct was to be connected directly to Northland Road, presumably be a bridge. The Rigi would appear to be extended by passing under this new bridge and joining the present exit from the tunnel to a new intersection with the new access to the tunnel.

This second feature seems to **KRA** to have the good intentions of reducing Northland-bound traffic through the tunnel, and also easing the congestion that is plainly evident today at the end of the viaduct. However, it would be a complex and expensive design, and hard to justify once the new tunnel were built.

Returning to the proposed tunnels, **KRA** has used a CAD program to impose them on a topographical view of the terrain:

	LENGTH	RISE	GRADIENT %
UPPER TUNNEL	224m	16m	7.1 %
LOWER TUNNEL	222m	15m	6.75%
NOTE: Lower Norway St has gradient of over 11%			

tures:

1. It provides extra capacity with the second tunnel, thus relieving pressure on the capacity of the existing tunnel.
2. It separates flows of traffic between the north of Lambton Quay, and Aro Flat.
3. The proposal to separate traffic coming off the Kelburn Viaduct would provide better access to Northland without going through Karori Tunnel.

It does have one bad feature. While both tunnels (Glenmore/Waiapu and Glenmore/Norway) are moderately steep, the entire lower part of Norway Street has a grade of about 11%. This is too steep for a major route, and too steep for cyclists.

The time for this proposal has passed. In the 1950s it might have been feasible to widen Aro Street, but there is now much new housing in the area. Further, with the recent construction of Karo Drive, and the increased flow of traffic from Brooklyn, it now looks infeasible to put a proportion of Western Suburbs traffic into Aro Valley.

The concept of diverting some of the west's traffic to the south of the CBD was sound and could have relieved the pressure that even then was building up in Lambton Quay and the CBD.

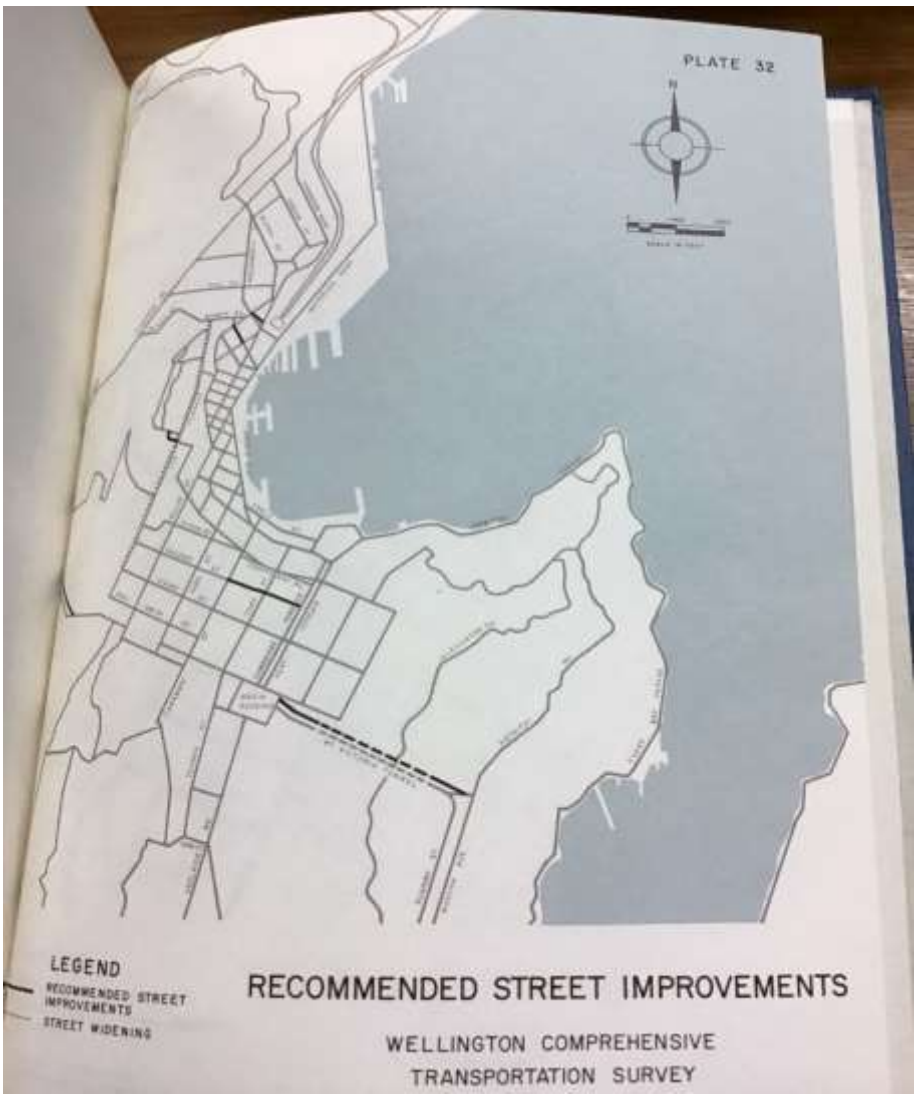
The Work of De Leuw Cather & Co.

De Leuw Cather & Company (DLC) are an international firm of engineering consultants with extensive experience in transportation planning. In 1963 the firm undertook a review of Wellington's transport needs. In 1966, they looked more widely at the region's needs for what was then the Wellington Regional Planning Authority.

In the 1963 report, DLC wrote (page 23):

> "**Aro Street Extension**
>
> Capacity of streets serving Karori is severely taxed by heavy traffic during peak periods. City officials, aware of the need for a relief route to Karori, have planned an extension of Aro Street, as shown on Plate 32.
>
> We have reviewed this plan and concur that it would relieve congestion. It would aid capacity between the Wellington Central area and Karori. It would also disperse traffic, since the new route would connect to the Te Aro area rather than the Thorndon area. We recommend that the Aro Street Extension be included among the principal street improvements undertaken by the City of Wellington within the next few years."

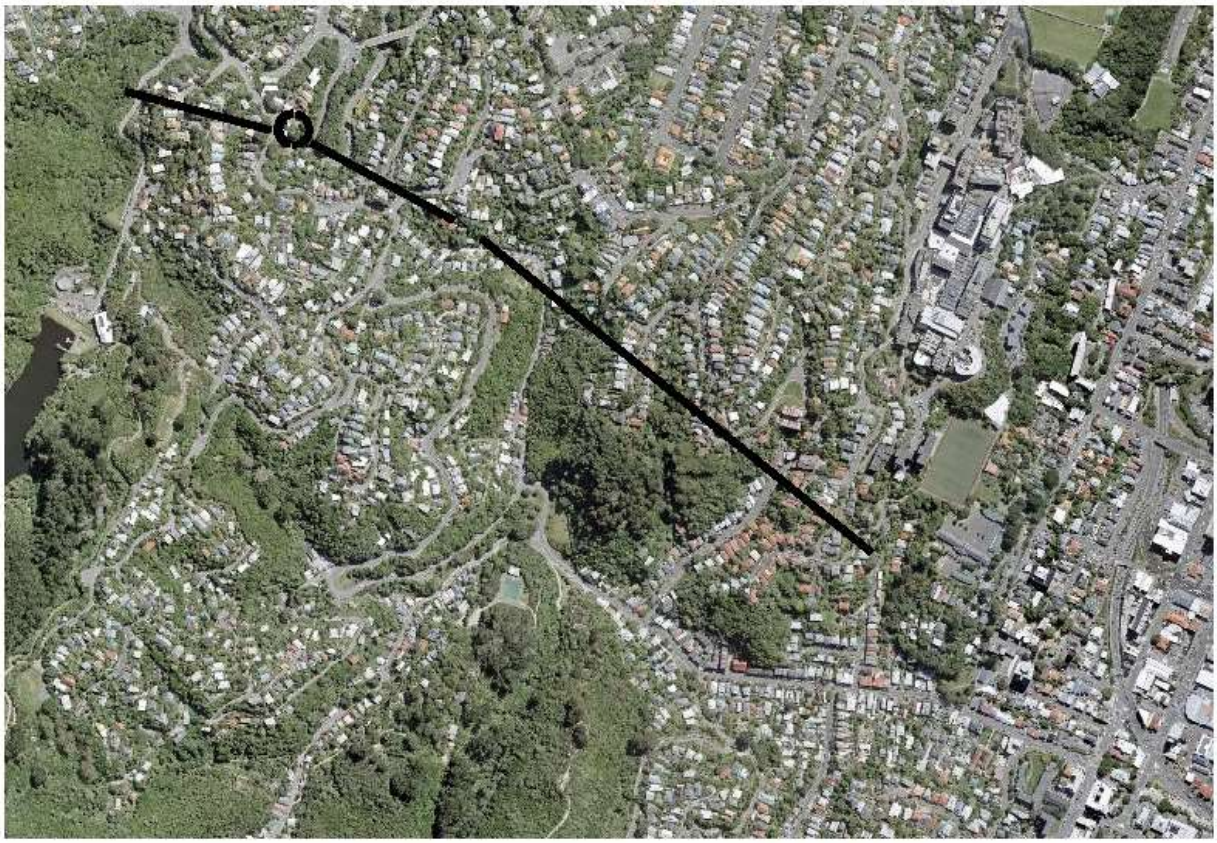
Unfortunately, the only version of the report that **KRA** found was bound, and Plate 32 was not easy to see. It also lacked detail:



Another clue is given in an article in The Dominion dated 26 April 1965. Under the headline "Blueprint for Ease of Access". The relevant extract reads:

> "The Wellington City Council's American roading and transportation consultants are about to recommend a new route to the city's western suburbs, costing millions of pounds.
>
> Part of the proposed alignment will be indicated on the city's draft town plan to be presented tomorrow evening in the Town Hall. The intention is to protect the route from building.
>
> The recommended new route should provide faster higher-capacity vehicle access between Kelburn, Northland, Karori, and the heart of the city.
>
> Peak hour traffic now crawls the length of narrow Aro Street to the Willis Street bottleneck. Glenmore Street is choked by the Bowen Street standstill.
>
> The consultant firm is expected to recommend a new route parallel to the north of Aro Street. The road would connect with Abel Smith and Webb Street Streets, to become one-way streets when the city's adopted master roading plan goes into effect.
>
> The road would tunnel west through hillside for about quarter of a mile from a point southwest of the junction of Aro Street and Raroa Road. It would emerge in Karori north of the Lower Reservoir and connect by ramp to Chaytor Street."

This description is confusing. It appears to be an extension of the City Engineer's proposal in 1954. Further, Plate 32 does not indicate any connection to the top end of Abel Smith Street. Taking the distance "about a quarter of a mile" as 400 metres and centring an arc of that radius at the top of Abel Smith Street, it intersects upper Norway Street at almost the same point as the City Engineer's 1954 proposal.



It seems likely that DLC had extended the City Engineer's proposal by incorporating it into their proposals for managing traffic in the CBD.

KRA has one serious objection. The Abel Smith Street tunnel would have a gradient of 13.5%, which is steep for arterial traffic and almost impossible for cyclists. Even if it were combined into the City Engineer's lower tunnel to the hairpin bend roundabout on Glenmore Street, the grade would be 12.3%, still too steep.

The above analysis is based on using straight tunnels. Some relief to the steep gradients could be achieved by having longer curved tunnels, but this would cost more. Curved tunnels are used all over the world. In New Zealand, examples are the new Waterview Tunnel, the Lyttelton Tunnel, and the Homer Tunnel. The Raurimu Spiral on the railways and the entrance road to the Manapouri Power station powerhouse (not a public road) both use a spiral as the means to achieve a change in elevation in a limited area at a reasonable gradient.

The plain facts of Wellington's geography are:

- The elevation of the Chaytor St/Birdwood St intersection is: 135 metres
- The elevation of the Aro St/Willis St intersection is: 25 metres
- The horizontal straight-line distance between these points is: 895 metres
- The straight-line gradient between these intersections is: 12.2%
- To achieve a gradient of 7%, the tunnel/road length would be: 1571 metres

The proposal to connect to the western end of Abel Smith Street is probably now "dead in the water". The construction of Karo Drive seems to **KRA** to make it impossible in any practical sense.

However, the principle of diverting some traffic out of the CBD and into the Aro Flat and Newtown areas remains sound. The City Engineer saw this in 1954, and his view was reinforced by DLC in 1963. The Ministry of Works also aimed to achieve this goal with the foothills motorway, completed in 1967. Traffic came off the motorway and was directed into Ghuznee Street, irrespective of whether the drivers' destinations were the CBD, the airport and eastern suburbs, or the hospital precinct and Newtown. It is to the discredit of the Wellington City Council that over 50 years later, little else has been achieved.

A Motorway Tunnel Proposal

In 1964-5, the Ministry of Works also considered a scheme to strengthen future motorway access into Wellington. The Ministry realised that SH1 was potentially vulnerable to closure in a large earthquake, particularly where it ran along the main Wellington fault line, next to the harbour's edge. An alternative road was deemed desirable.

In discussions with the city, the MoW considered a concept of a connection from Aro Street, in a tunnel which passed "under the Chaytor Street park" and veering north towards the eastern end of Ohariu Valley, and from there towards the southern end of Tawa, rejoining the main highway again.

The only diagram that **KRA** has seen is taken from The Dominion:

DLC, in their 1966 report for the Wellington Regional Planning Authority, stated:

> "We could find no justification for a major highway facility between Wellington City and Porirua through the Ohariu Valley by 1986, except as an emergency route in the event that the Hutt Road, the motorway or the Ngauranga Gorge Highway were closed to traffic as a result of natural causes."

Karori Residents Association Preferred Solution

The Road Tunnel

KRA looked first at two solutions from Chaytor Street down to Glenmore Street. The first was from a position slightly south of Karori Tunnel to the hairpin bend in Glenmore Street. We rejected it because of the gradient that would have been necessary. Subsequently, we saw the proposal of the City Engineer in 1954, which was similar – and which we had also rejected because of the gradient.

The second was north of Karori tunnel, about halfway along the Chaytor Street retaining wall, and running to a point near the Talavera Tennis Club. That solution also had a gradient that was too steep.

We realise that a longer roadway was needed to get a reasonable gradient. Our solution is to start that roadway from the Curtis Street/Chaytor Street intersection, sloping down from there in a reasonable curve (probably in a cutting with retaining walls on each side, curving east and passing about 15 metres under Chaytor St near the midpoint of the retaining wall, in a straight tunnel towards the Talavera Tennis Club on Glenmore Street.

There might need to be a slight curve near the Glenmore Street end to ensure that the tunnel does not interfere with building foundations nearby.

The resultant gradient is 6.8%.

The length of the tunnel as shown is approximately 350 metres, and the length of the curved ramp to the Curtis Street intersection is approximately 150 metres.

We noted that it is not easy to give access to the new road tunnel from Birdwood Street, and we have omitted any such possible connection. Vehicles from Birdwood Street heading into the city will still use the existing tunnel, and Glenmore Street as they do now.

Although we have called it the road tunnel (the reason will become clear shortly) we believe that it should provide a generous provision for pedestrians and cyclists as well.

Sketch Showing Impression of Ramp and Portal for Road Tunnel Appleton Park End

Lower Tunnel Portal to be in This Vicinity in Glenmore St

The Pedestrian Tunnel

The new road tunnel does not solve one important problem. It does not provide safe and convenient pedestrian and cycling access to Kelburn and Victoria University. **KRA** believes this is an important issue. The present Karori Tunnel falls a long way short of Council's policies on provision of pedestrian and cycle access in the city.

In 1954 the City Engineer proposed a smaller tunnel just north of the current tunnel. (His view was endorsed by Mayor Macalister at that time.) **KRA** believes that the concept was correct, but that a more generous solution is warranted in the light of population growth, the advent of electric assistance for cyclists, and the current policies relating to cycling and walking in the city.

We propose a tunnel between Chaytor Street and a point approximately in lower Northland Road or the top of The Rigi:

	LENGTH	RISE	GRADIENT %
ROAD TUNNEL INC.CUTTING	500m	34m	6.8 %
PEDESTRIAN/CYCLE TUNNEL	214m	6m	2.8%

We rejected a shorter tunnel connecting directly to the proposed road tunnel on the grounds of grade, and the undesirability of having any kind of intersection in the road tunnel.

We note that the injection of cyclist traffic into the Northland Road/Rigi/Glenmore Street intersection might add to complexity, but maybe this would also be a good opportunity for The Rigi to be closed to through traffic. This issue would be a matter for detailed design and consultation.

A careful design would also be needed at the Chaytor Street entrance/exit to ensure safety, but this must be feasible.

Cyclist and pedestrians from Birdwood Street would easily access this tunnel.

Impression of Entrance to Pedestrian/Cycle Tunnel

Possible Portal Location at Top of The Rigi

Another Possible Portal Location in Lower Northland Road

Other Issues

Appleton Park

KRA believes that most citizens are prepared to relinquish Appleton Park for improved transport purposes. (This has been tested in surveys.) However, respondents to our surveys have also expressed a wish that good quality planting – especially of Pohutukawa – should maintain a good streetscape. The present Pohutukawa around the Chaytor Street border are a much-loved feature of the entrance to Karori.

KRA has long advocated for a commuter car park on part of Appleton Park. A park and ride facility and a good bus shelter near the Curtis Street intersection would enhance the attractiveness of bus public transport. Access to the car park from Birdwood Street would be desirable, and maybe essential.

Resilience

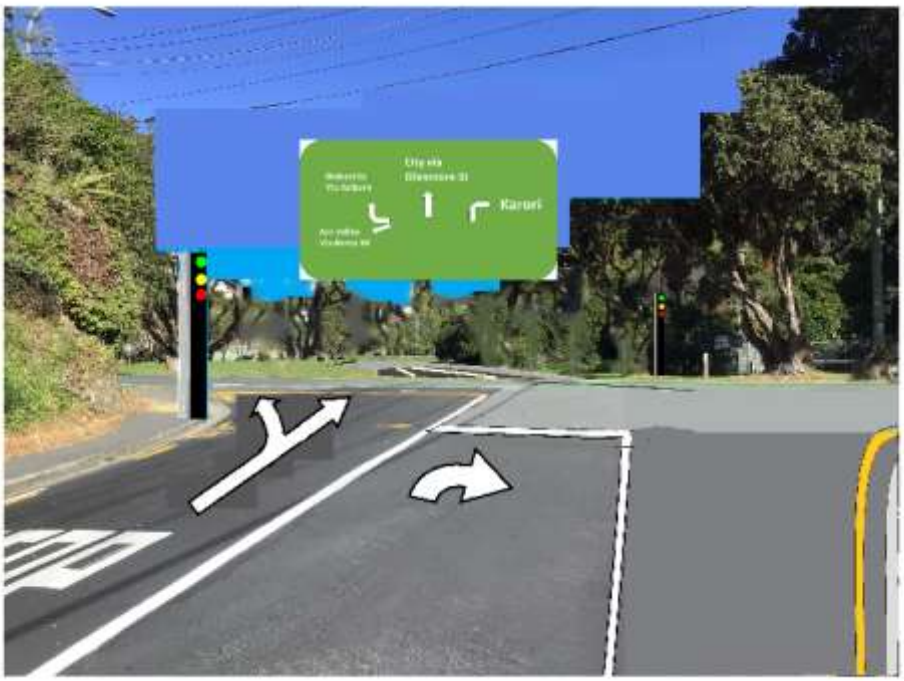
A second tunnel of modern design will increase the resilience of the road network to the western suburbs.

Overall Route Length

The alternative route through the new road tunnel will be around 500 metres shorter than the present route using Glenmore Street. This happens because all traffic now must move about 250 metres south to the hairpin bend, and then the same distance back.

The Chaytor Street/Raroa Road/Curtis Street Intersection

KRA notes that there is a lot of scope for detailed design work on the intersection where the new tunnel ramp will join Chaytor Street. We have not attempted to analyse this intersection in depth, but as we expect that a large proportion of the current traffic will use the new road tunnel, the traffic flows using Raroa Road would find it easier to access Chaytor Street. We offer no opinion on whether a roundabout of traffic lights would be best to control this new intersection.



What Are "Acceptable" Gradients?

A fanciful standard on the WCC website calls for a maximum grade of 5% on major routes. It seems to fly in the face of Wellington's geography.

Some grades on important roads around Wellington:

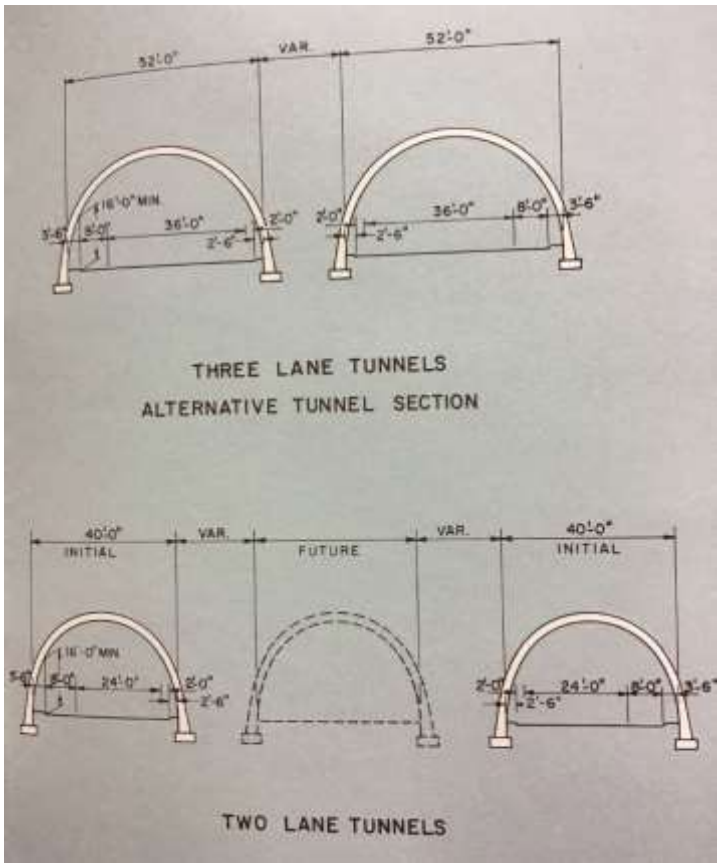
From Talavera Tennis Club on Glenmore St to the top of Glenmore:	5.6%
From Curtis St to the top of Chaytor St	5.0%
Salamanca Road (past the University)	7.6%
Lower Raroa Rd	8.3%
Lower Ngauranga Gorge (SH1)	7.5%

At 6.8%, KRA's proposal is comparable with many other roads around Wellington.

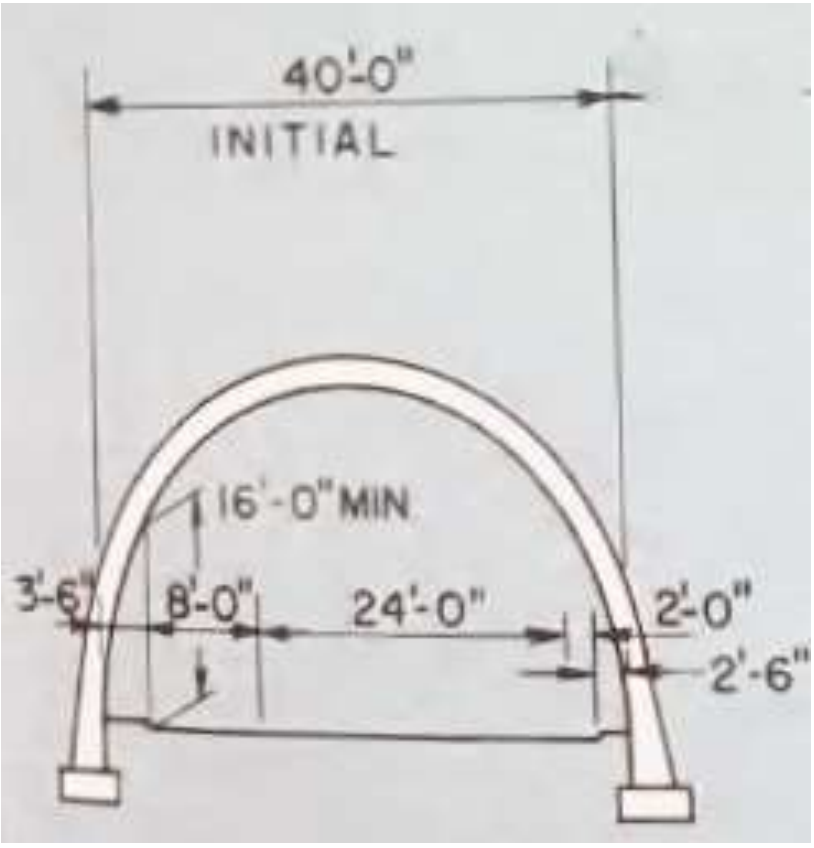
How Big Should the Tunnel Be?

The tunnel now is 7.78 metres wide (25ft-6in). What is a reasonable design figure? Clearly the height must be enough to accommodate full-sized vehicles of 4.3m height in each vehicle lane.

DLC recommended a standard 12ft lane width for vehicles. They did not discuss in any detail the width of footpaths and cycleways, but in one of their reports they included a diagram for two and three lane tunnels:



The diagram is distorted because it was photographed from a bound volume. The important diagram for considering a profile of a new tunnel for western suburbs is the bottom left-hand one:



DLC have suggested two 12-ft (3.66m) lanes plus an 8-ft pedestrian and cycleway. They give extra space to allow for the inward curve of the tunnel walls, to give a total width at the road level of 40-ft (12.2 metres).

In 1954, the City Engineer was proposing a 26-ft carriageway plus a 6-ft footpath, a total width of 32-ft (9.75 metres). No mention seems to have been made of height at that time.

Current Australian and New Zealand practice is to provide standard traffic lane widths of 3.5 m. Traffic lanes are measured to the face of the kerb or to the lane line for multi-lane roads, or roads with shoulders.

The provision of standard lane widths of 3.5 m allows for large vehicles to pass or overtake, without either vehicle having to move sideways towards the outer edge of the lane. Research has shown that there is no evidence (Elvik et al. 2009) that supports the assumption that road safety is increased with wider traffic lanes. It was also reported that most freight-efficient vehicles could travel comfortably along roads that have a useable lane width of 3.5 m, although vehicles such as the rigid-plus-three and the A-triple require 3.7 m wide lanes (Prem et al. 1999) due to the tracking capability from the multi-combination trailers. Where the operation of Type 2 (triple) road trains (or even larger vehicles) is anticipated, designers should consider the use of wider traffic lanes.

Traffic lane widths may also need to be widened on curves to accommodate the extra tracking width required by trucks (refer to Section 7.9). Horizontal curve radii larger than 300 m should be used to avoid lane widening

The use of lanes wider than 4.6 m because of lane widening is not favoured because of the possibility of two cars travelling side-by-side within the lane. If greater width is required for truck tracking, an edge line should be placed at 3.5 m and full pavement depth widening should be provided for the remainder of the width.

Table 7.13 of the Austroads Guide sets out the increase in lane width that should be provided for various radii of curvature and typical lengths of vehicles:

Table 7.13: Curve widening per lane for current Austroads design vehicles

Radius (m)	Single unit truck/ bus (12.5 m)	Long rigid bus (14.5 m)	Articulated bus (19 m)	Prime move and semi-trailer (19 m)	Prime move and semi-trailer (25 m)	B-double (25 m)	B-double (26 m)	A-double (Type I) (36.2 m)	B-triple (35.4 m)	A-triple (53.4 m)
30	Use Turning Templates									
40	1.00									
50	0.80		1.00							
60	0.70	1.00	0.80							
70	0.60	0.90	0.70	1.00						
80	0.50	0.80	0.60	0.90		1.10				
90	0.50	0.70	0.50	0.80		1.00	1.10			
100	0.40	0.60	0.50	0.70		0.90	1.00			
120	0.30	0.50	0.40	0.60	1.00	0.70	0.80	1.00	1.10	
140	0.30	0.40	0.30	0.50	0.90	0.60	0.70	0.90	0.90	
160	0.30	0.40	0.30	0.40	0.80	0.60	0.60	0.80	0.80	1.10
180	0.20	0.30	0.30	0.40	0.70	0.50	0.50	0.70	0.70	1.00
200	0.20	0.30	0.20	0.30	0.60	0.40	0.50	0.60	0.70	0.90
250	0.20	0.20	0.20	0.30	0.50	0.40	0.40	0.50	0.50	0.70
300	0.10	0.20	0.20	0.20	0.40	0.30	0.30	0.40	0.40	0.60
350	0.10	0.20	0.10	0.20	0.30	0.30	0.30	0.40	0.40	0.50
400	0.10	0.20	0.10	0.20	0.30	0.20	0.20	0.30	0.30	0.40
450	–	0.10	0.10	0.20	0.30	0.20	0.20	0.30	0.30	0.40
500	–	0.10	–	0.10	0.20	0.20	0.20	0.20	0.30	0.40
600	–	0.10	–	0.10	0.20	0.10	0.20	0.20	0.20	0.30
700	–	–	–	–	0.20	0.10	0.10	0.20	0.20	0.30
800	–	–	–	–	0.20	0.10	0.10	0.20	0.20	0.20
900	–	–	–	–	0.10	–	0.10	0.10	0.10	0.20
1000	–	–	–	–	0.10	–	–	0.10	0.10	0.20
1200	–	–	–	–	0.10	–	–	0.10	0.10	0.10
1400	–	–	–	–	–	–	–	–	–	0.10
1600	–	–	–	–	–	–	–	–	–	0.10

Notes:

Use turning templates for area in green.

The use of lanes wider than 4.6 m is discouraged (see Section 4.2.4). Where tabulated values plus nominal lane width exceeds 4.6 m, pavement widening should be determined using turning paths. If the resulting lane width is greater than 4.6m, give consideration to increasing radius of curve.

The curves in the approach to Karori Tunnel are 41 metres radius (East end) and 83 metres radius (West end).

The curve in the proposed new Curtis Street ramp as shown is 70 metres radius.

The table indicates that for a long rigid bus of 14.5 metres length, the lanes should have 90 centimetres added to the width to allow for overhang sweep of the bus in a 70-metre radius curve. Western suburbs motorists and cyclists will be familiar with the difficulty bus drivers have in keeping left of the centre line as they enter and leave the tunnel. (The task is geometrically impossible).

How Wide Should the Footpath and Cycling Lane be for Pedestrians?

The Road Tunnel

KRA has assumed that there would be only one footpath and cycling way in the road tunnel. The reason is that there should be no temptation for people to be crossing the road inside the tunnel or western approach ramp.

The footpath should be wide enough to allow pushchairs and mobility scooters to pass with care, but no real difficulty. 2.0 metres is probably enough.

Cyclists also need to be able to pass with care but no danger. Wellington City Council has a policy dated 2015 that states that a two-way cycling lane should be 2.5 metres wide. This seems reasonable.

This leaves the question as to whether pedestrians and cyclists can share the same space. **KRA** believes that the experience of citizens is that having cyclists and electric scooters on footpaths together is undesirable. The road tunnel will have a gradient of 6.8%, and downhill cyclists will travel quickly. Separation of cycles and pedestrians seems essential.

KRA envisages that a safety barrier would be provided between the vehicle lanes and the cycling/pedestrian space.

The Cycling/Pedestrian Tunnel

The two-way cycling space must be 2.5 metres.

Given that the gradient is only 2.8%, it might be possible to allow only 1.5 metres for a pedestrian footpath, with a moderate degree of space sharing. In other words, a 4.0-metre-wide tunnel, (which is a little more than half the width of the Karori Tunnel, to give a word picture).

Environmental Impacts

Global Warming

No impact except during the construction phase. Greenhouse gas and particulate emissions might reduce as a large proportion of traffic will travel a shorter distance by not having to travel the distance on upper Glenmore Street. Further, traffic congestion will almost certainly be eased, reducing the time spent with idling engines. Finally, the new pedestrian/cycling tunnel will certainly encourage more cycling and walking to and from western suburbs.

The construction of better road access to the western suburbs will provide more transport efficiency for all types of vehicles. It will assist economic activity and public transport. **KRA** does not believe they will increase the number of commuter cars as the Council's parking policies within the CBD discourage commuting (as they should).

Reduction in Size of Appleton Park

Appleton Park was formed by covering over a closed rubbish dump. It was designated as a park in 1950. Its uneven surface and the presence of old rubbish makes it unsuitable for sports. It forms a pleasant green streetscape when entering Karori. In recent years, Council has permitted the construction of an "overflow" car park for Zealandia, which is also used by commuters when not in peak demand by Zealandia visitors.

KRA has been advocating for a larger commuter car park to be built on part of Appleton Park for some time to encourage more use of public transport into the CBD.

KRA believes that the benefits to the wider community of reconfiguring Appleton Park far outweigh the limited recreational uses of the park. **KRA** supports a change provided a thorough landscaping design retains a well planted green streetscape as far as possible.

Impact on Talavera Tennis Club

The proposed location of the road tunnel was identified by surface inspection and aerial photographs and maps. No technical or property investigations other than alignment and gradient were undertaken.

As drawn, the lowest part of the road tunnel would cut through the property occupied by the Talavera Tennis Club. Dealing with this property encroachment would be a task for the Wellington City Council. **KRA** does not advocate the compulsory seizure of private land.

The matter does seem to have some possibilities. The lower part of the tunnel could be built by "cut and cover" allowing the tennis club to be rebuilt about 2-3 metres above its present level over the new tunnel. A new entrance driveway and new clubrooms would need to be provided. It seems to **KRA** that there may be room for negotiation on this issue.

What Will the Project Cost?

KRA does not know. In a document entitled "Draft Business Case Report" released in June 2019, the Lets Get Wellington Moving team included $480M (in 2018 dollars) for a duplicate Mount Victoria Tunnel and associated approach roads. This only shows that we are dealing with large sums. The Mount Victoria tunnel would be longer that our proposal, but then **KRA** has proposed two tunnels. However, our approach road proposals are probably less in scope.

KRA notes with concern that the Let's Get Wellington Moving project has expressed various platitudes about improving transport but has never considered the need to upgrade and future proof the inadequate access to the western suburbs.

When the Mt Victoria tunnel (and/or the Terrace tunnel) is duplicated, there will be tunnelling equipment and skills in Wellington. That would be an excellent time to build the new Western suburbs tunnel. The overheads and set up costs could be shared across both tunnels.

Aspects of the Benefit-Cost Ratio

In June 2013 The New Zealand Institute of Economic Research published a paper entitled "Appraising transport strategies that induce land use changes". The paper is in the public domain on the NZIER web site. The principal author of the paper is a member of **KRA**. At 36 pages length, the paper is too long to include in this paper, but some of its conclusions and recommendations are relevant to assessing the benefits of the tunnel **KRA** is advocating.

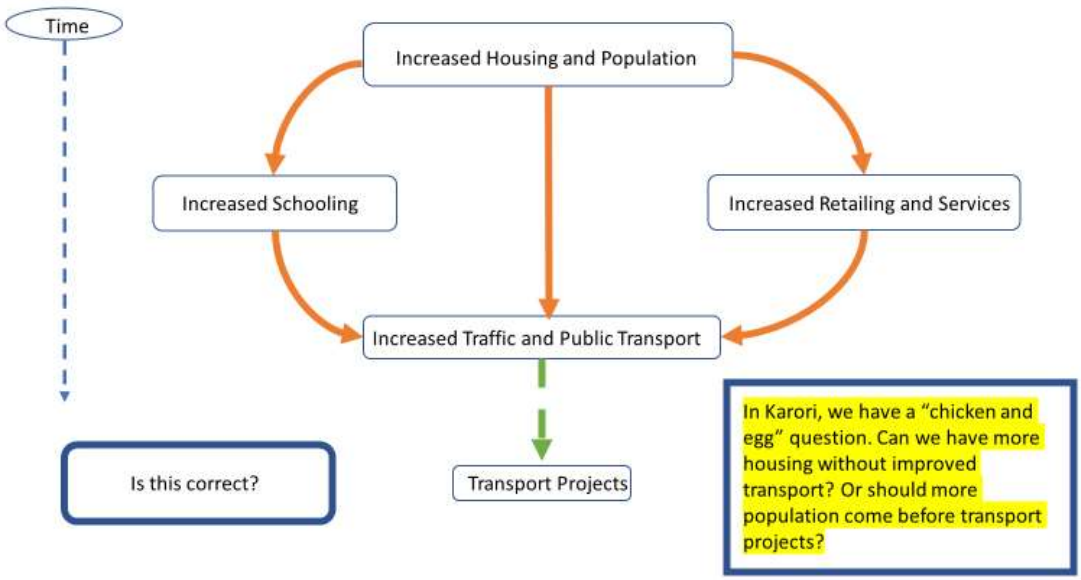
Traditionally (at least in New Zealand), cost-benefit appraisals for transport projects have focussed only on the short-run impacts of transport schemes, implying that populations and their associated activities are fixed in the short to medium term. The NZIER points out that there are many instances where transport projects induce significant changes to land-use, especially population and employment changes.

Most transport demand is linked to land-use. Transport is rarely commissioned for its own purpose, but is a resource used to achieve other purposes. (The exception is leisure activities with transport as the focus e.g. rail enthusiasts' journeys.) Present and future land-use is critical to the accurate evaluation of long-term transport project evaluation. **KRA** can think of two extreme cases of faulty land-use assessments leading to errors in transport investment in New Zealand:

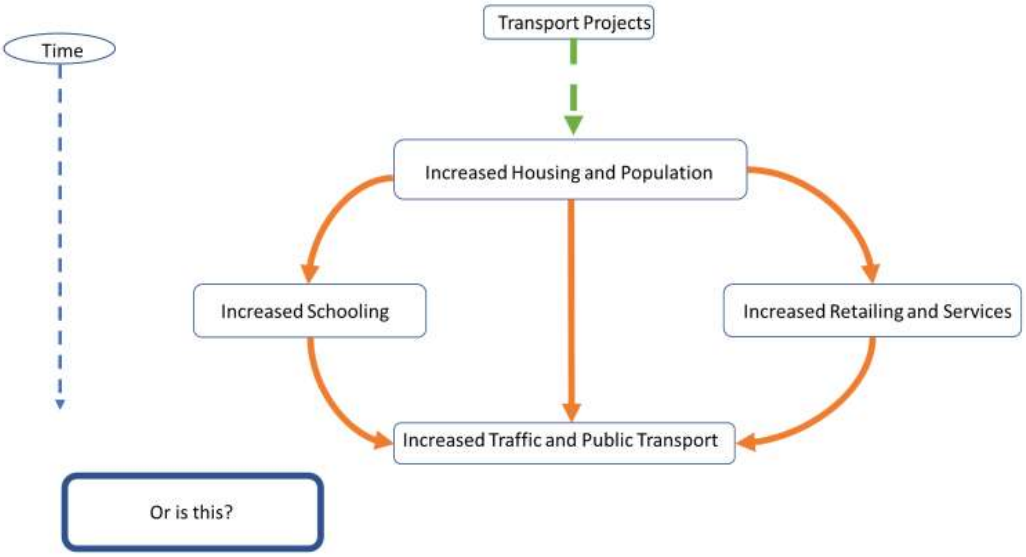
1. After WWI, the government opened up land in the King Country to returned soldiers, providing some roads to give access. The land was not suitable for sustained pastoral farming, and the now famous "Bridge to Nowhere" remains as a monument to faulty land-use planning.

2. In the 1950s, the government decided that a harbour bridge in Auckland would be a "good thing". They built it with 2 lanes in each direction, and no lanes for cyclists, no footpaths, and no dedicated provision for public transport. The bridge opened in 1959, and with 5 years it was obvious that the bridge was inadequate for the growth in population and traffic on the North Shore. It had always been envisaged that additional lanes could be added to the piers (perhaps about 1990 -2000), but they (the "Nippon clip-ons") were added and opened in 1968. This is a case where the induced land-use changes were clearly underestimated. Auckland Harbour Bridge remains too small to this day.

The situation in Karori and the western suburbs of Wellington is somewhat simpler. The main change in land-use that will be induced by any improvement to the road access will be an increased densification of housing, together with some associated increase in retailing and services. The increase in medium- and high-density housing is entirely in accord with recent Council policies. But which of the following diagrams is more correct?



Or:



KRA is firmly on the view that no increase in population in the west should be permitted to occur until the road network – and mainly the tunnel – is substantially improved.

The NZIER paper analyses these questions with a detailed and rigorous economic analysis. It is not, however, a panacea leading to positive benefit-cost ratios. It does not provide simple formulae into which a few figures can be plugged and quick answers emerge. **KRA** believes that the value of the NZIER paper is its "big picture" approach and its description of the link between land-use and transport demand. It is a significant advance over the more traditional approaches.

However, to make use of the NZIER model, detailed studies involving town planning, engineering, architecture, and economics are essential. Such studies take time and cost money, but **KRA** believes they would be valuable.

The benefits

The benefits will need to exceed the costs, probably by at least 50%-100% (ie, a benefit-cost ratio, or BCR of 1.5-2) to get public revenue funding from the Land Transport Fund under present policies.

The main benefits would largely comprise of:

- "level of service" (LOS) improvements for existing travellers (faster, more convenient, more reliable travel).
- LOS benefits to new travellers attracted by the improved access.
- urban growth and development benefits, relating to the value of real estate impacts from zoning changes, increasing planning permissions, and increased economic activity.

Strategically, calculating the full costs and benefits should include a wider network perspective, to prevent people just getting to the next bottleneck. This means thinking about capacity along the full main routes, from Karori to/from the north of Lambton Quay along Glenmore; Kelburn to the CBD via Ghuznee St; and Newtown/Brooklyn via Aro Valley. This means thinking about bus lanes, clearways, parking removals, route straightening/widening, intersections etc. Not all of these costs would necessarily be added directly to the cost of the tunnel project, but might well be justified in their own right by overall network travel improvements in the city.

How Will the Proposal be Financed?

KRA believes that the funding must come from:

1. Central government grants perhaps delivered through the Let's Get Wellington Moving program once that group's objectives have been strategically adjusted to address all of Wellington's transport needs.

2. Rates, perhaps targeted towards the benefits received by western suburbs residents and all businesses.

3. Tolls on road vehicles.

4. Long term loan finance (repaid from the targeted rates).

Conclusions About New Tunnel Proposals

1. Proposals from 1954 and 1963 recognised the need for improved western suburbs access but were too steep and connected to Aro Street. They are no longer appropriate.

2. Karori Tunnel cannot always be daylighted or widened while still retaining adequate access to the western suburbs during the work.

3. The feasibility of lowering Karori tunnel is doubtful, but even if it happened, the tunnel is simply too narrow for vehicle traffic, cyclists, and pedestrians to be worthwhile.

4. Karori Tunnel does not comply with current Council policy for pedestrians and cyclists.

5. At least one new tunnel is essential. It should connect to upper Glenmore Street.

6. **KRA** proposes a road tunnel and approach ramp that joins Glenmore Street at the Talavera Tennis Club to the intersection of Chaytor Street and Curtis Street.

7. **KRA** recognises that a road tunnel to Glenmore Street would do nothing for pedestrians and cyclists wishing to connect to Kelburn and Victoria University. **KRA** proposes a separate pedestrian/cycling tunnel on the north side of Karori Tunnel, from Chaytor Street approximately to the top of The Rigi.

8. Approximately 25,000 residents of western suburbs depend on Karori tunnel. Their needs have not been recognised by the poorly focussed Let's Get Wellington Moving project.

9. After 66 years of inaction by Council, **KRA** believes that planning for improvements must be given commitment by the Council.

10. A better connection to the western suburbs would allow more medium density housing to be developed in those suburbs. Karori sees this option as equal or better than building many more high-rise apartments in the central business district to cope with a projected increase in population.

11. **KRA** acknowledges that the cost is large, but if we are to have the city that the Council's own policies aspire to, it must be done. Council should enter discussions with central government about funding major infrastructure projects.

12. **KRA** notes that the proposal to duplicate the Mt Victoria tunnel is still well-received by Council. Every argument that can be made for that project also applies to Karori tunnel.

Next Steps

Wellington City Council

1. Wellington City Council must embrace the strategic concept of absorbing some of the projected population growth in the city in the western suburbs, and planning for and providing the transport infrastructure essential to allow this growth to happen.

2. KRA believes WCC and NZTA should fund a strategic transport study of the route, which considers transport impacts and urban development impacts jointly. The study team would need economists, civil and transport engineers, traffic modellers, urban planners, and architects to be involved. This would align not just with LGWM, but also with the "planning for growth" work, which amongst other things, also aligns with the government's recently released "National Policy Statement of Urban Development".

3. The brief for this study would be the preparation of the strategic economic analysis of the broad benefits and costs to determine if further resources should go towards more detailed design studies. The study should include an analysis of how the western suburbs transport problems relate to the Lets Get Wellington Moving project.

4. The project team should report to a Project Steering Committee made up of nominees of the funding agencies and of key stakeholders. KRA would want to be a member of the study steering group, to help ensure that the local western suburbs communities have a voice.

5. Wellington City to acknowledge that urgent action is needed to improve the safety and convenience of pedestrian and cyclists between Chaytor Street and Kelburn Viaduct, and actively pursue a solution. **KRA** recommends the construction of a small tunnel for this purpose.

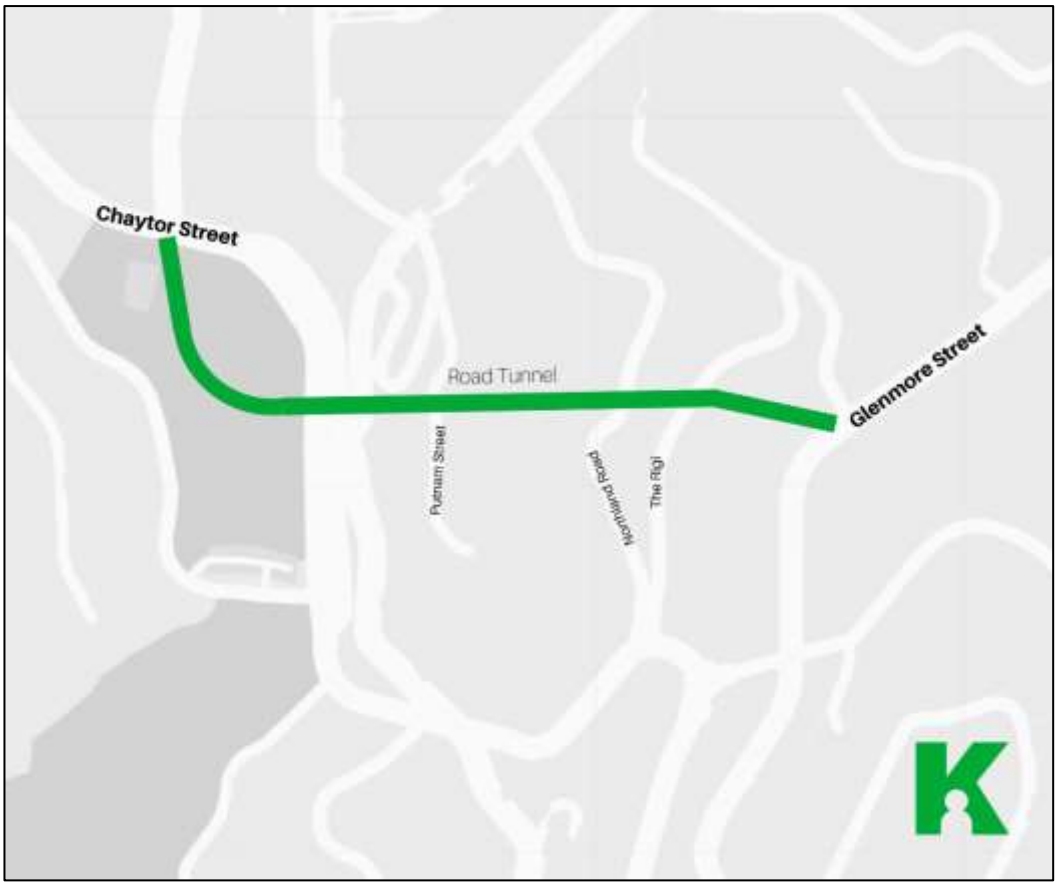
6. Wellington City to place an appropriate notice on any property that is needed for improving access to the western suburbs. This includes re-designating Appleton Park.

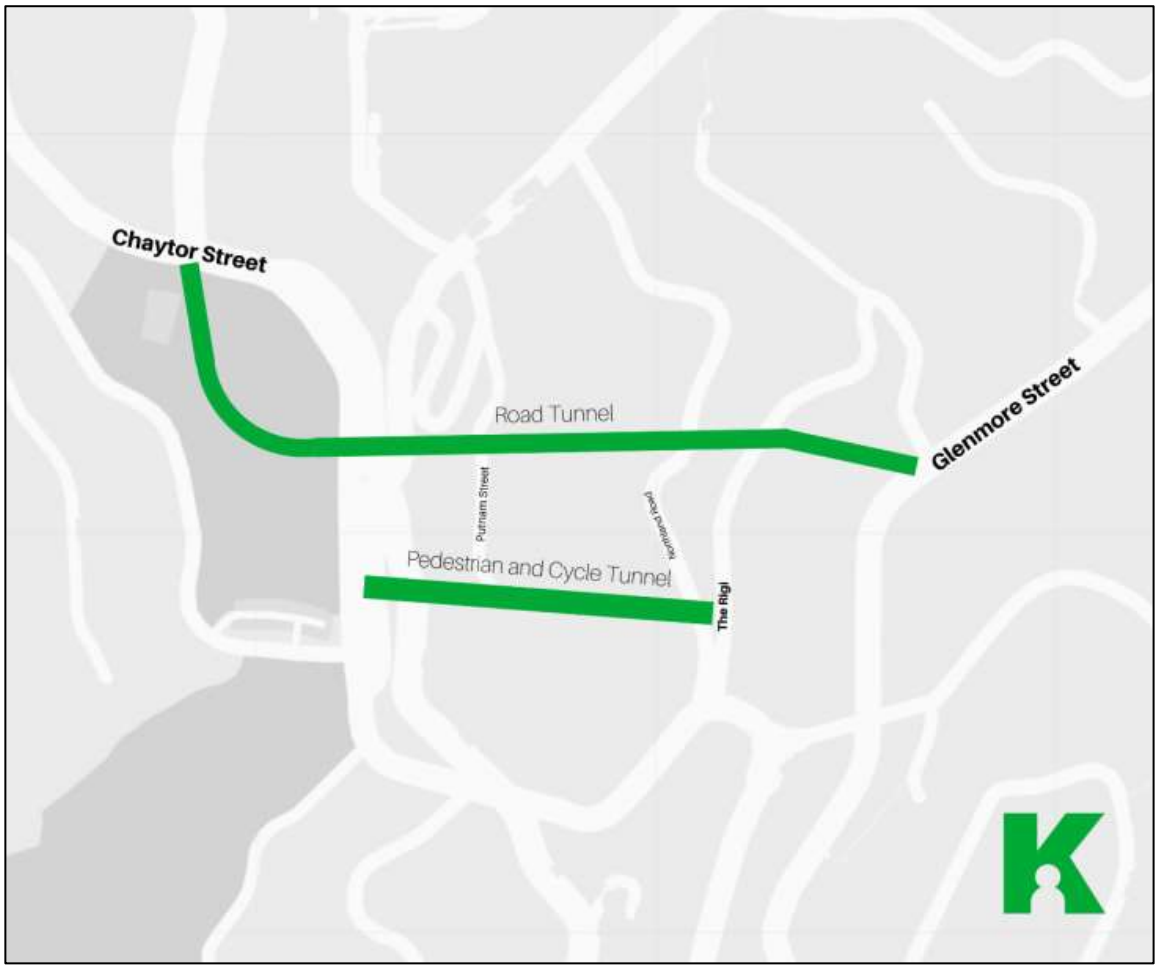
7. Wellington City to bring projects to a “shovel ready” stage so that it can readily take advantage of any stimulus packages offered by central government.

Greater Wellington Regional Council

1. GWRC to assist WCC to ensure that the Let’s Get Wellington Moving project is wider focussed than the Ngauranga to airport corridor i.e. State Highway 1.

2. GWRC to work with WCC to ensure that public transport improvements benefit all parts of Wellington City.





EMBARGOED AGAINST ANY DELIVERY UNTIL 11am 24 NOVEMBER 2020

KARORI RESIDENTS ASSOCIATION

He waka eke noa

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