

An Investigation of the Health Implications of the Wellington Northern Corridor Development: A Health Impact Assessment

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Introduction

The Roads of National Significance (RoNS) is a governmental road and transport initiative to allow for economic expansion. The RoNS project has seven components throughout New Zealand. Our focus is on the Wellington Northern Corridor Expressway, which connects Levin to Wellington Airport, with a primary focus on the four-laned expressway from MacKays to Peka Peka.

The justification for the development comes from an economic standpoint. The RoNS project has been described by New Zealand Transport Agency (NZTA) as a 'lead infrastructure' project(1), meaning the aim of the development is to facilitate future economic development, not as a response to current growth. Transportation of goods is a key component of New Zealand's economy, with approximately 92% of freight (by weight) is transported via roads(1). According to the 2006 census data, the population of Kapiti Coast increased by 8.8%³ in the period between 2001 and 2006. This highlights the increased traffic volumes on the road and the potential economic benefits of quicker commutes and more efficient travel(2).

The SAHA report was commissioned by the NZTA to look at the cost benefit profile associated with the RoNS project. The study started in 2009 and has been updated multiple times since then. The SAHA Report concluded through their assessment that "the RoNS portfolio generates substantial economic benefits" and "potential exists for further additional benefits to the economy generated by the RoNS"(3).

There is little to no emphasis placed on the economic cost or gain to health. In each section labelled safety mention is made to:

- Loss of life & permanent disability
- Lost output
- Health care.

Pollution is only mentioned briefly in the appendix. In the critique / peer review of the document no mention was made of the lack of information on health or environmental impacts. From Maori and Child health perspective there is no reference to children or consideration of any form of cultural impact(3).

This projects definition of economic impacts is fairly narrow and makes very limited mention of health impacts and no mention of the cultural benefit or cost of such a project. It has been commissioned by the NZTA and thus may have been influenced by the briefing it was given by them. Being an international firm means it may not have been aware of New Zealand's strong multicultural population and thus was unaware of the need to consider it in its analysis.

NZTA is involved with a large body of research in improving transport systems in New Zealand. They have numerous surveillance measures and have invested in a lot of research into ways to improve New Zealand land transport. Most of their research is based around economic forecasts and road service research. The research and data collection on health and safety is primarily on road crash safety (4).

Although they do research into noise issues, community severance and emissions, they have not linked their research to actual health outcomes in the population surrounding roads

(5). They have recognised that noise is a nuisance and a health problem but they have not quantified the actual impact of noise on community health.

NZTA have also recognised available research of the impact of PM10 on health, but openly discredit it “Land Transport New Zealand has serious doubts about data contained in the report titled *Health and air pollution in New Zealand*.” (6). Subsequently there has been little research into the possible burden of PM10 on the populations surrounding the Northern Corridor Highway. We plan on investigating the possible health effects of PM10 particularly the effects on respiratory health in children and Maori.

Overall the NZTA recognises a lot of the possible health impacts of road transport. However they fail to show much evidence of consideration of the public health in the development of RoNS, particularly with regards to children and Maori health.

The objective of this HIA is to investigate the specific health impacts on Maori and children populations in the context of the Wellington Northern Corridor. This HIA investigated the possible effects the Northern Corridor has on traffic accidents, air pollution, and noise created by roads, particularly focusing on the impacts on child mental health and Maori health. This HIA can also be used to inform policy makers and ministers about public health issues concerning children and Maori health with regards to building new roads and highways.

The Kapiti Coast district lies on the South West coast of New Zealand's North Island. The Tasman Sea lies to the West and the Tararua Mountain Range starts abruptly to the East. As a consequence Kapiti is a dense coastal community. Hence, some areas of the HIA, e.g. surveys and interviews, focus more directly on the Mackays to Peka Peka expressway as it potentially has the greatest implications on child and Maori health. This section of the expressway passes through the Kapiti Coast district, impacting on Raumati South, Paraparaumu and Waikanae.

Demographics:

The Kapiti Coast has a population of 46,197. Maori make up 12.3% of the population, compared to 14.6% for New Zealand (7).

Kapiti District population has a median age of 44.3 years, compared to a national median age of 35.9 years. 19.4% of people in the Kapiti District are aged under 15 years compared with 21.5% for all of New Zealand. 23.3% of people in Kapiti Coast District are aged 65 years and over, compared with 12.3% of the total New Zealand population (7).

For the Maori population in the Kapiti District, the median age is 22.0 years, compared to a national median age of 22.7 years. Of this Maori population, 36.4% are under 15 years of age compared to 35.4% for all Maori in New Zealand. 5.6 percent of Māori in the Kapiti District are aged 65 years and over, compared to 4.1 percent of New Zealand's Māori population (7).

Kapiti Coast on a whole has an older population and less proportion of Maori than the rest of New Zealand but have a higher proportion of Maori under the age of 15 years than the rest of New Zealand. As shown on Figure 4 and 5, the highway passes through areas of high population density and high deprivation.

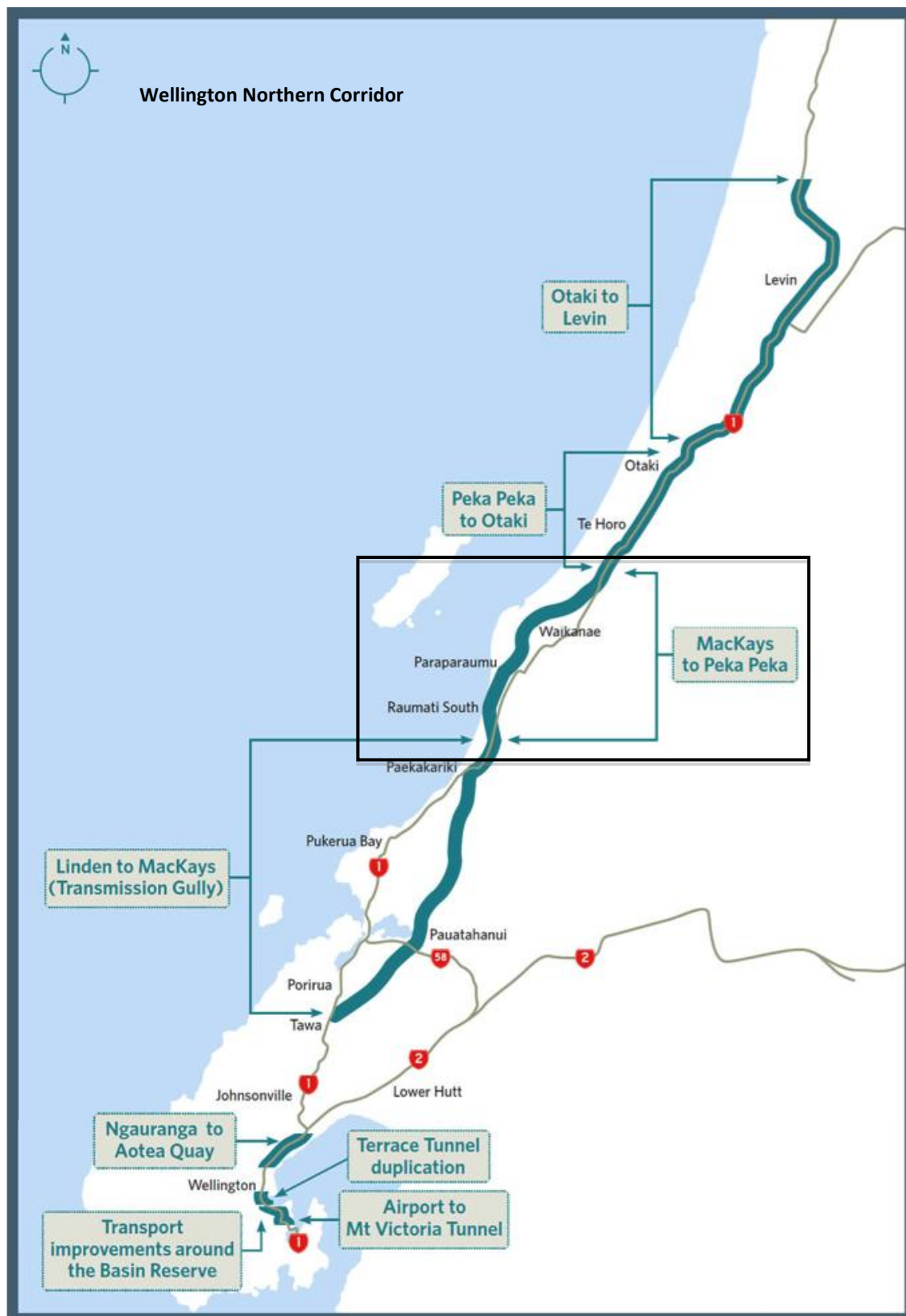
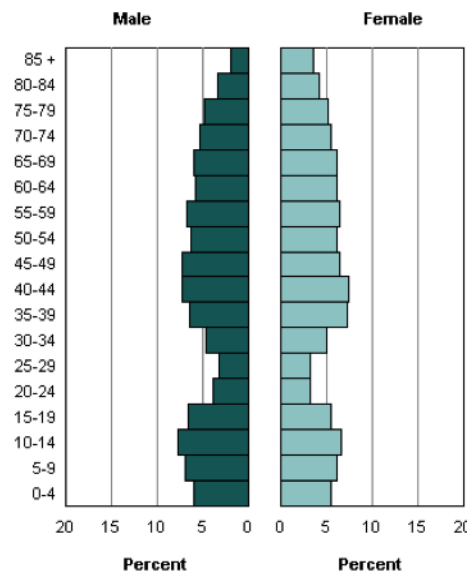


Figure 1. Map of proposed Wellington Northern Corridor

Age Distribution – Kapiti Coast



Age Distribution – New Zealand

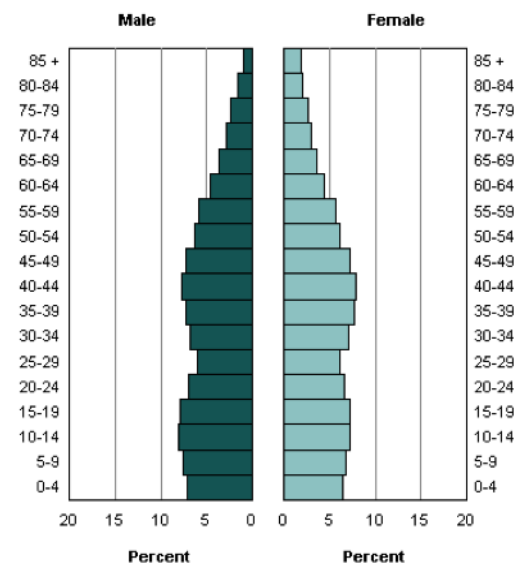
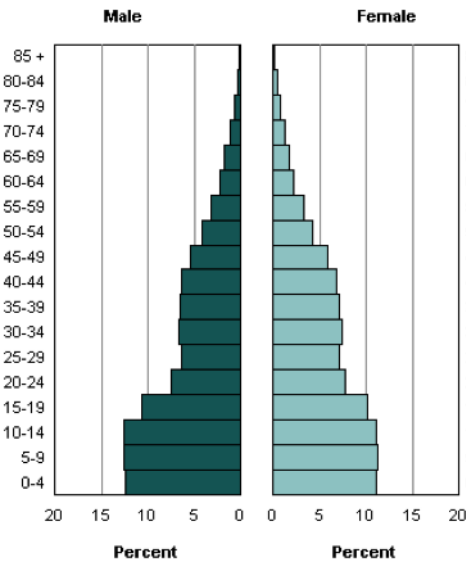


Figure 2. Age distribution of Kapiti Coast and New Zealand, Census New Zealand 2006

Age Distribution (Maori) – Kapiti Coast



Age Distribution (Maori) – New Zealand

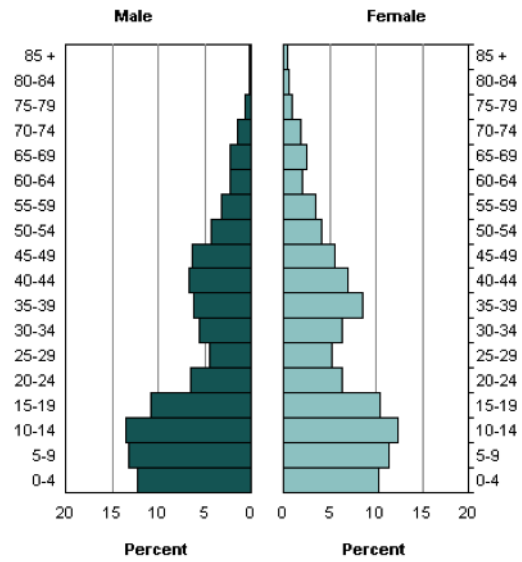


Figure 3. Age distribution of Maori in Kapiti Coast and in New Zealand, Census New Zealand, 2006

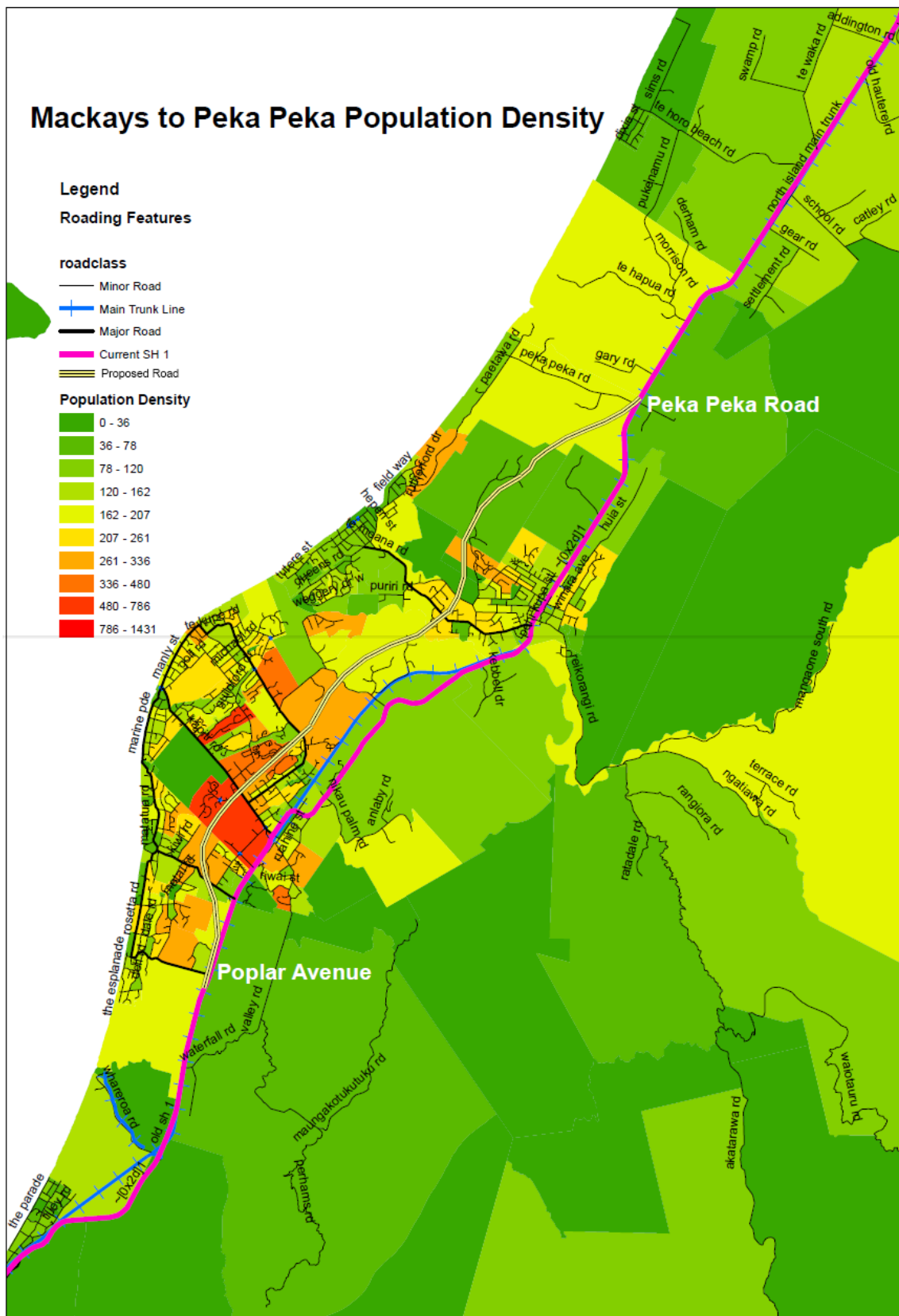


Figure 4. GIS mapping of McKays to PekaPeka population density

Legislation and Process for Building Roads of National Significance

Planning and funding process

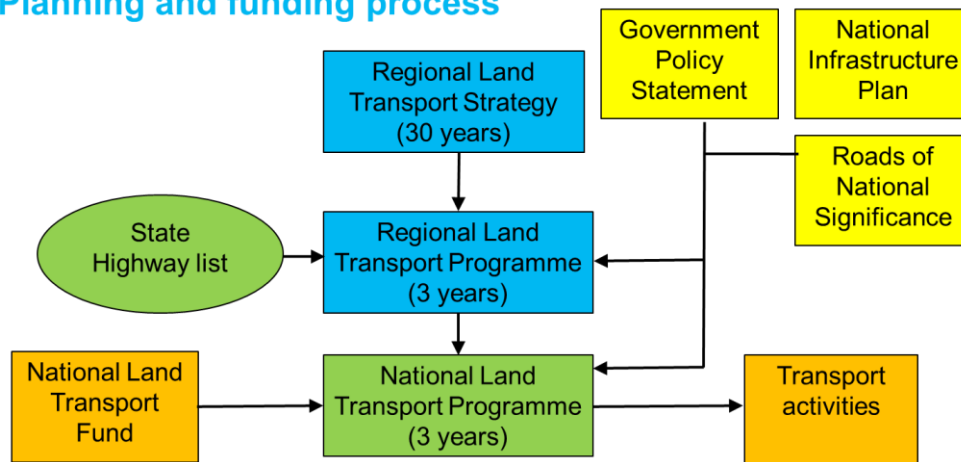


Figure 6. Over view of Transport Infrastructure funding and governance policy. Ministry of Transport, March 2009

Land Transport Management Act 2003

This Act stipulates the creation of a National Land Transport Strategy that covers 30 financial years by the Minister of Transport. As such a strategy has been created under the auspices of this Act.

National Land Transport Strategy

This strategy is required to project needs and costs for the next 30 financial years and is issued under the Land Transport Management Act 2003. The most recent one sets out a strategy until 2040. One is required to be written every 6 years. This is a broad document but ultimately it is concerned with financial planning and prioritisation of transport infrastructure projects.

Government Policy Statement for Land Transport Funding

Issued under the Land Transport Management Act 2003, it is the current government's statement on what it regards as the priorities and important aspects of building and maintaining land transport infrastructure. This most recent GPS (May 2009) introduces the term Roads of National Significance (RoNS) which is a helpful term to use given the 2009 streamlining of the RMA providing a more efficient avenue for tabling projects for ministerial 'call-in'. 'Call-in' requires that it be demonstrated that the proposal be of 'national significance'. The GPS stipulates seven RoNS including the Wellington Northern Corridor.

National Land Transport Programme

The National Land Transport Programme is the action plan to bring into effect the Government Policy Statement for Land Transport Funding (GPS). The NLTP is also a requirement under the LTMA 2003. It lays out the priorities for action according to strategic and economic criteria. The programme aims to enact the government's policy while contributing to the following:

1. economic development
2. safety and personal security
3. access and mobility
4. public health
5. environmental sustainability.

The Crown Entities Act 2004, section 49 requires that “the entity acts in a manner consistent with its objectives, functions, current statement of intent, and output agreement”, thus making the above objectives binding within the legally vague term ‘contributes’.

Resource Management Act 1991

This is an aspirational piece of legislation which requires a full consideration of a project’s impact on the environment before consent can be given. It encompasses aspects of the road environment that directly relate to health, especially air and noise pollution.

Can the Crown circumvent the RMA duties? In effect no, although there are some special provisions under the RMA, there is still nothing to stop the declaration of duties of the Crown under the RMA and then have them enforced by the judicial system which has been shown to be true under case law.

Environment Court

The Environment court is essential for interpretation of the RMA as it relates to applications for resource consent. It has been said that this situation results in “central planning through... tribunal decision making”. Because of this however, the Environment court has no powers to instigate an inquiry or appeal itself but must only take up matters brought before it.

Call-in

This is a power vested in the Minister of the Environment (the minister) applying to matters of national significance. It is to be applied to proposals which have garnered widespread public concern for one. The minister may refer the proposal to either a special board of enquiry headed by an Environment court or straight to the Environment court. It is important to note that the court to date has not entered into any executive planning functions but rather remained as an objective judicial body for appeals and inquiry only.

This underlines the importance of health and environmental impact concerns to be raised early and through the appropriate channels to ensure that these issues are considered. Under a 2009 amendment to the RMA, proposals should be submitted to the Environment Protection Authority (EPA) which would then advise the minister if the matter should be ‘called-in’. If the minister does call-in the proposal then the EPA notifies the decision publicly and asks for submissions.

A board of enquiry must make its decision within 9 months but this can be extended to 18 months at the minister’s discretion where he deems it appropriate. This 9 month time frame does not apply to the Environment court. Any decision reached by the court or board of enquiry may only be appealed to the high court and only on a matter of law, i.e. not on disagreement with the health impacts for instance.

All sections yet to be completed in the Wellington Northern Corridor project will be subject to ministerial call-in which means that there will be or has been a public request for submissions relating to the relevant section of the corridor.

Thus despite all statements with the national land transport strategy and programme, the only legal avenue for consideration of health impacts of RoNS is through submission to either a board of enquiry or the Environment court as determined by the minister under ‘call-in’.

Current Situation

Airport to Mt Victoria Tunnel

Currently, the best time to begin construction is being considered and estimation of the length of time it would take to complete construction is underway.

Basin Reserve

The Basin Reserve road network is a critical part of the Wellington Road of National Significance (RoNS), the State Highway 1 corridor between Levin and Wellington Airport. As it is in the urban area, the following investigations are being currently carried out:

- NZTA collaborated with the Ministry for Culture and Heritage to minimise or avoid impacts on the Basin cricket ground and surrounding heritage area which includes the National War Memorial and planned Memorial Park Project on Buckle Street.
- Conducted the The Ngauranga to Airport Study to investigate alternatives which Wellington's transport systems could be improved to accommodate the anticipated population growth. Results showed that transport improvements where SH1 intersects with Kent/Cambridge Terrace and Adelaide Road at the Basin Reserve should be given the highest priority.
- NZTA working alongside acoustic and air quality specialists to estimate future noise and air quality levels and recommend ways the design can avoid or minimise effects.
- Investigating the safety issues of nearby schools by developing design solutions that maintain secure and reliable access.
- NZTA is intending to engage in public consultation on options for transport improvements around Basin Reserve.

Terrace Tunnel Duplication

It is currently under construction for next nine months from 10pm to 6am daily. NZTA found this schedule for construction times to have the least impact on traffic flow around the area.

Ngauranga to Aotea Quay

Currently, NZTA is investigating options to improve the Ngauranga to Aotea Quay section of the Wellington Northern Corridor, following its awarding of the contract for the project. Issues concerning rising travel demand, improving passenger transport, and enhancing access and safety for pedestrians and cyclists have all been identified and addressed.

Transmission Gully

The 27-km four-lane (two in each direction) Transmission Gully route runs from MacKays Crossing to Linden. Since the Transmission Gully project requires a number of stream crossings and diversions (including reclamation), NZTA has lodged a request on 6 September 2010 to the Environmental Protection Authority (EPA) for a change to the Regional

Freshwater Plan. Currently, NZTA is gathering information needed for possible future lodging of regulatory consent for the project, scheduled to be in mid 2011.

Mackays to Peka-Peka

Currently,

- Construction of a new road between the southern end of Emerald Glen Road and the northern side of the MacKays Crossing roundabout which joins State Highway 1, approximately one kilometre south of Paparaumu on the Kapiti Coast is under way. With regards to being culturally sensitive to the reclaimed land around the Emerald Glen Road, an iwi blessing was carried out prior to construction.
- A local area movement survey is carried out to understand the routes and ways people move about on foot, by bike or scooter within their community as well as around and across the expressway route: Waikanae and Waikanae Beach, and Raumati and Paparaumu.
- A public consultation has been performed and the public consultation brochure has been produced and posted on the NZTA website (2).

Peka-peka to Otaki

Currently, a public consultation has been done to obtain feedback from the community on the proposed plans for the expressway. Open days regarding the project were also held to provide an opportunity for people to meet the project team, learn more about the proposals, ask questions and provide feedback in person. The team is also producing the Land of Requirement Plans to clearly indicate which properties will be directly affected by the expressway.

Otaki to Levin SH1

Currently, NZTA is investigating options to improve State Highway 1 (SH1) from Otaki north to north of Levin which includes looking at costs, timings, geotechnical, environmental, ecological, traffic, social and business effects, and landscape assessment on the project. NZTA also intends to seek public input on this matter.

At this stage, majority of the work on Wellington Northern Corridor is focused on detailed investigations to find ways to improve safety and reduce congestion by identifying potential options that requires the most minimal impacts on the environment, and heritage land. Maori participation is also ensured as NZTA is committed to the principles of Treaty of Waitangi and abides by statutory responsibilities under the Land Transport Management Act and Resource Management Act to seek consultation with iwi on appropriate matters. However, there seemed to be no assessment on health impacts of proposed roads being done at this point yet except for the Basin Reserve Project.

The construction of improvements will fall into three distinct phases:

Phase 1:

Construct Aotea Quay to Ngauranga and Basin Reserve within Wellington and progress the Peka Peka to Otaki section, followed by the Mackays to Peka Peka section.

Phase 2:

Linden to Mackays crossing (Transmission Gully)

Phase 3:

Construct the remaining projects as follows:

- Mount Victoria Tunnel duplication and Ruahine St widening;*
- Otaki to Levin;*
- Terrace Tunnel duplication*

Scoping: Surveys and Interviews

Surveys and interviews were conducted to determine particular areas of interest or concerns of particular groups of interest. The groups were chosen specifically to achieve multiple perspectives of the impacts of Wellington Northern Corridor on the health of children. The results of the surveys and interviews contributed to the areas researched in the literature review discussed later. The groups surveyed and interviewed were:

1. The general public
2. General practitioners (GP) in the Kapiti area
3. Principals in the Kapiti area

General public

Two surveys were carried out of the general public. The first was at the Wellington train station on a Friday evening at 4.00-5.30pm. Commuters travelling on the Porirua and Kapiti lines were approached and invited to fill out a questionnaire. Some responses were excluded as they were missing demographic data which left a total of 40 completed surveys.

There were 32 positive comments and 27 negative comments. The majority of the positive responses were that the road would provide a 'faster commute' with 'improved traffic flow' [21]. Seven people made specific reference to the benefit of an 'alternative route into Wellington' which is perhaps unsurprising given the recent earthquake in Christchurch. In addition 33 of the commuters said they were 'unlikely' or 'very unlikely' to change their mode of transport after the Northern Corridor is completed. Some of the negative comments included increased air or noise pollution [6], increased cost to society [5], and environmental impact or damage. Due to this response and the time constraints of the project, public transport alternatives to the road development were not investigated although this might be an important area to focus on in future research.

One person commented that there would be less accidents; this HIA discusses the validity of such a statement. Finally there were 13 comments regarding concerns about the health of children. These were mainly about the effects of noise and pollution. This is also an important area which is addressed in this HIA.

The second survey was conducted at Paraparaumu mall on a Saturday afternoon where 49 completed surveys were generated. There were 31 positive and 20 negative comments. The positive responses were mainly about better traffic flow and a faster drive to town [16]. The majority of negative responses were about the loss of homes [7]. One person commented on the issues with the Urupa which is discussed later in this report. There were some specific concerns regarding children's health, namely air pollution [1] and faster cars around schools [2]. However one respondent noted that 'roads are being upgraded and put in all the time and this doesn't have any impact on kids'. Another felt that there would be 'less fumes from cars as less stop starting'. There were also a number of benefits cited such as better access to hospitals. Finally, a large number said they wished construction would start as they felt the planning stage had gone on for too long. Some felt this was causing further stress.

General Practitioners

Another survey was carried out of GP's who practised in the Kapiti area. Despite efforts to contact most of the GP's in the area, only three responses were obtained due to busy practice schedules.

The first response was from a GP who has lived in the Otaki Region for the past three years. She anticipated no effects of the Northern Corridor construction on the health of children. In respect to the long term effects on child health she commented 'with the new highway in place, bypassing the village, we'll have less pollution and that'll reflect in a decrease of mainly respiratory conditions. Especially all the heavy transport that now drives right through the village which is responsible for a lot of pollution'. This GP estimates a decrease in the incidence of respiratory illness, acute and chronic asthma, coughs and irritation of the nose and throat. There were some benefits foreseen in both the short and long term. The short term benefits were decreased pollution and the long term benefits being that 'hopefully more people will pick up their bikes if authorities are so smart to make things safer for cyclists and pedestrians'.

The second response was from a GP of 20 years who works in the Levin area. This particular GP lived in an area where construction had not yet started. The GP does not anticipate any change in the trend of childhood illnesses during the development of the Northern Corridor or after it is completed. There were potential benefits due to 'improved access to Palmerston North and Wellington Hospital'.

The last GP interviewed was Dr Chris Lane who practises in Paraparaumu. He did not anticipate any health effects on children due to the construction of the road or after construction was completed. However he did feel the new expressway would reduce the number of motor vehicle traffic crashes. As the founder of the Kapiti Emergency Medical Service, Dr Lane claimed to have attended 50 deaths along an 8km stretch of centennial highway, many of which were attributed to head on collisions. He believes that the road toll will drop due to the median barrier and separated north and south lanes in the new expressway. In addition he anticipated that the expressway would bring the Kapiti coast 'geographically closer to base hospital facilities'. However he did acknowledge that the major changes in roading could cause problems for the elderly when driving as they are used to the current local roads.

Principals

Nine principals were interviewed over the phone from schools based in Otaki, Te Horo and Paraparaumu. There were a number of concerns about the current highway:

- the exit from Raumati Road onto highway – too dangerous
- the exit from Poplar Avenue onto highway – too dangerous
- college level students driving on the highway to get to and from school

Some principals also had concerns about the proposed new road:

- increased noise and pollution
- division of the community particularly between the town and beach
- stress for families who have to relocate which may impact negatively on their children
- possible closure of some schools
- concern with how students travelling south will exit the highway

Many of these principals supported an upgrade of State Highway One instead of a new road.

Four principals had no major concerns about the current highway and two said the new highway would not impact on their school. Another two felt there would be improved accessibility to Waikanae Beach and also Otaki where a bottleneck of traffic forms.

Scope

The surveys and interviews highlighted three main health issues that pertained to child health. These are mental health, air pollution and accidents. A literature review was undertaken of these issues and the findings were collated which are listed in more detail below. In addition, given the New Zealand setting and the current health inequalities between Maori and non-Maori, the effect on Maori within each of these areas was considered. The last section of the analysis deals with a particular concern to Maori health which was disruption of the Urupa.

However it is important to acknowledge that a number of possible benefits and harms were identified by the surveys which were outside the scope of this HIA. These included:

- better access to hospitals
- provision of an alternative route into Wellington which might have particular use in a natural disaster
- public transport alternatives to the proposed road
- loss of homes
- faster cars around schools
- Environmental health and degradation
- Loss of local connectivity and social cohesion

Appraisal, Reporting and Evaluation

Traffic Crashes

Motor vehicle crashes are the highest cause of unintentional fatalities in New Zealand. There were 8800 traffic crash injuries between 2000 and 2001 and 3043 injuries to pedal cyclists (8). This demonstrates the importance of safe cycle ways in modern roading projects. On average road injuries are the most expensive ACC claims, averaging at \$11,360 each (8). In the greater Wellington region in 2006 there were 32 fatal crashes, 199 serious crashes, and 1024 minor crashes. Incidents on state highways in the region involving pedestrians resulted in 9 deaths, 26 serious injuries and 63 minor injuries. For cyclists there were 4 deaths, 88 serious and 91 minor injuries. For motorcyclists there were 6 deaths, 84 serious and 191 minor crashes(9).

Porirua City

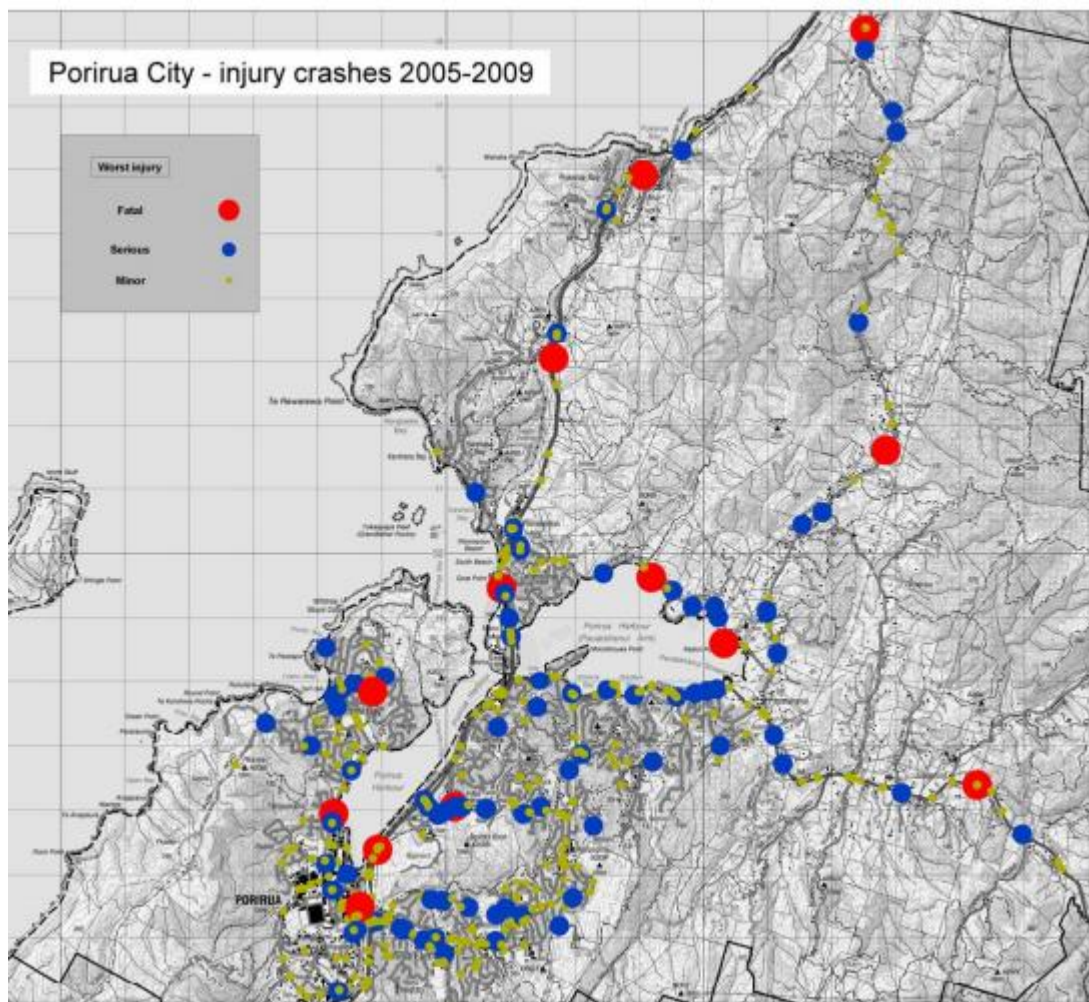


Figure 7. Fatal, serious and minor injury crashes in Porirua City, 2005-2009

There were 4 deaths, 7 serious injuries and 85 minor injuries on the state highway from 2005-2009 in Porirua City. It was deemed that road factors were at play in 20% of all these casualties. Notably nearly half of all crashes occurred on a wet road. There were only 3 minor injuries involving pedestrians from 2005-2009 on the State Highway. Overall the majority of

crash injury burden in Porirua City currently is from local roads; however the mortality burden is equally shared between local roads and the State Highway (10).

Kapiti

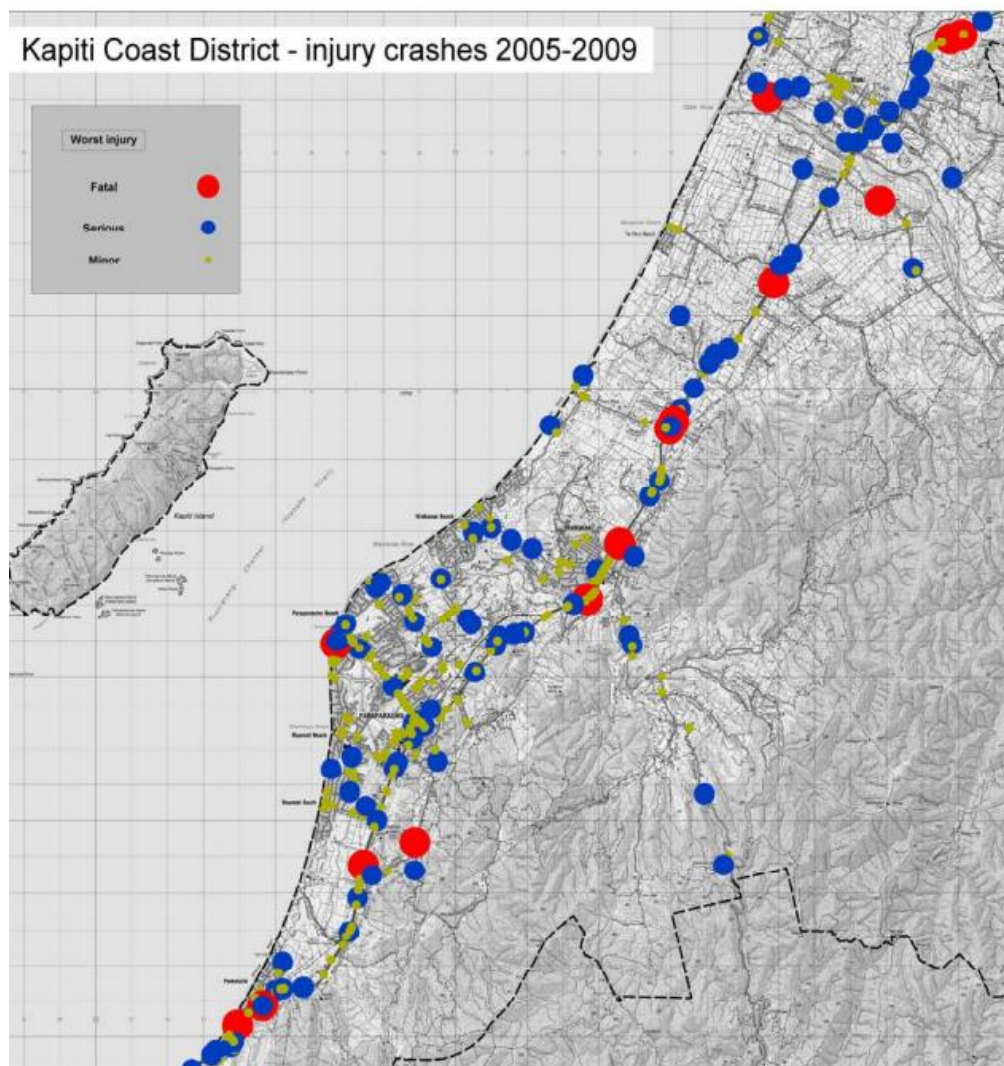


Figure 8. Fatal, serious and minor crash injuries in the Kapiti Coast District

There were 104 road traumas including 4 deaths in Kapiti in 2009. The estimated social cost of these was \$30.79M and of that \$19.18M was attributable to injuries on State Highway One (SH1). Notably, the LTNZ assessment of high priority concerns mentions 'safe roads and roadsides' along with reducing driving under the influence and safer driving speeds. There were 21 injury crashes per 100 million vehicle kilometres travelled in Kapiti which is lower than the national average (11). While only 37% of the loss of control crashes occurred on SH1, they accounted for about 75% of the fatalities, of those two thirds occurred at bends in the road where the driver commonly ran off the road and hit a roadside object.

The maxim 'speed kills' seems to hold true here and can be seen with even a casual glance at the map above. Also of note is that two thirds of loss of control crashes involved only one vehicle. Safer roads seem to be an important factor in reducing the social and health costs of traffic crashes in the region. Since the new proposed express way is intended to be a straighter one, there should be fewer crashes and a lower fatality rate. There were 2 pedestrian casualties in 2009 down from a peak of 12 in 2005. For 2005-2009 there were 4

pedestrian casualties aged between 4 and 9 years. There were 8 over 70 years. The pedestrian casualty data shows the 4-9 year olds have similar casualty rates as those between 35 and 50 (11, 12).

Children

The literature also indicates that motor vehicle accidents are a major cause of mortality and morbidity in children. One study looked at unintentional deaths in children up to the age of 14 (13). Motor vehicle accidents were the leading cause of unintentional death for all children. The main cause of unintentional death in 5-9 year olds and 10-14 year olds was also motor vehicle accidents. They were the second most common cause of unintentional death in children up to age 4. Hospital records were investigated to determine morbidity to children. Motor vehicle accidents featured 6th out of the most common causes of unintentional injury hospitalisations in children.

Maori

Sargent et al investigated the epidemiology of both fatal and non-fatal motor vehicle traffic crashes involving Maori during the years 1980-1994. This was done by linking the New Zealand Police traffic crash reports with New Zealand health information services hospital inpatient and mortality files. During 1980-1994 there were 8178 MVT crashes reported in New Zealand. This led to 9288 Maori casualties. 13% of these casualties were fatally injured.

From here on, the statistics discussed are in regards to Maori. Of the total number of fatal and non-fatal casualties, 82% were under the age of 34 years. The largest age group affected were the 15-24 year olds, with an alarming 45.1% of MVT crash fatalities and 38.5% of non-fatal MVT crashes occurring in this age group. The fatal casualties were mainly drivers (37%), followed by passengers 31%. Almost 70% of fatal crashes involved men. In 2004, at the time of the study, rangatahi (young adults) made up 21% of the Maori population, which meant that MVT presented a significant and preventable burden on the health of young Maori. The loss of rangatahi resulted in a loss of the benefits that come from having competent, healthy and skilled whanau workers.

Those living in higher deprivation areas had a higher proportion of crashes, 43.1% of MVT crashes that occurred involved Maori living in an area with an NZDep91 score of 9-10. The environmental epidemiology shows that the majority of the crashes occurred on two-way, sealed roads that were either in a city or on the outskirts of the city. 40% of all Maori MVT crashes were due to loss of control, 27% of these were while cornering and 13% while on a straight road. Approximately 11% were due to head on collisions. The long-term disability resulting from injuries not only impacts on the individuals but the whole whanau (14).

The study investigated the significance of injury as a cause of death in Maori. Between 1984-1993, 13,330 Maori died from all causes. Approximately 12 % of these deaths were due to injury. Motor vehicle traffic crashes accounted for approximately half of all deaths due to injury (796/1632). This was the leading mechanism of injury leading to death in all age groups, except those under one year where suffocation was the leading cause (15).

Under reporting of accidents

In addition to the statistics on crashes occurring in the Kapiti area, there is likely to be significant under reporting of accidents. Alsop and Langley compared data on hospital admissions with police reports (16).

Out of 5003 hospital records of seriously injured MVT crash victims, only 63% (CI 61.5-64.2) were linked to police reports. This may be because it is the responsibility of the driver to report a crash to the police. Lower reporting rates were associated with certain characteristics:

- under 20 year olds were less likely to report accidents than over 20 year olds
- crashes involving injury to children (up to 14 years old) were less likely to be reported
- Maori had lower reporting rates than non-Maori

However Wellington reporting rates were significantly higher than the national average. This study only included serious accidents and excluded non-collision accidents. This suggests that under reporting of all accidents might be even worse. In addition, the study indicates that the impact of traffic crashes on children and Maori may be further under estimated.

So there is significant mortality and morbidity associated with the current SH1 route which is likely under estimated due to under reporting of crashes. Children and Maori make up a large proportion of the victims (16).

Waikato Expressway

A similar situation in Waikato suggests that upgrading the route might reduce the number of accidents and the social cost to society. The main road in Waikato was also a winding road with high rates of accidents and fatalities. The Waikato Expressway was a project to improve the road and reduce the number of accidents. Table 1. shows the number of accidents occurring on various stretches of road before and after the Expressway was built.

Ohinewai Bypass had a reduction from 16 fatalities in 9 years to 2 fatalities in 6 years. Given that there were 4 deaths on Kapiti roads in 2009 alone, the data from the Waikato Expressway suggests that a safer road may significantly reduce fatalities in Kapiti as well.

Figure 9. below shows the social cost per kilometre year in several sections of the road both before and after the upgrade. The Waikato expressway suggests that improving the safety of the current SH1 route to Levin will reduce the impact of injuries and deaths from motor vehicle accidents.

Recommendations

1. Reduce the number of high speed intersections.
2. Built a straighter road.
3. Include a median barrier.

Project	Study Period	Period	Fatal	Serious	Minor
Pokeno Bypass	1991-1995	Before	2	9	14
	1999-2009	After		3	10
Pokeno-Mercer	1991-1995	Before	2	1	16
	1999-2009	After		2	11
Mercer-Longswamp	2000-2004	Before	8	5	23
	Jun 07-Dec 09	After	1	2	12
Ohinewai Bypass	Dec 92-Nov 01	Before	16	21	39
	Dec 03-Nov 09	After	2	2	17
Rangiriri	2000-May 2003	Before	4	3	17
	Jun 06-Dec 09	After		3	12
SH 2 - Mangatawhiri	2007-2008	Before	3	1	13
	2009	After			2

Table 1. Number of crashes on different roads before and after completion of the Waikato Expressway

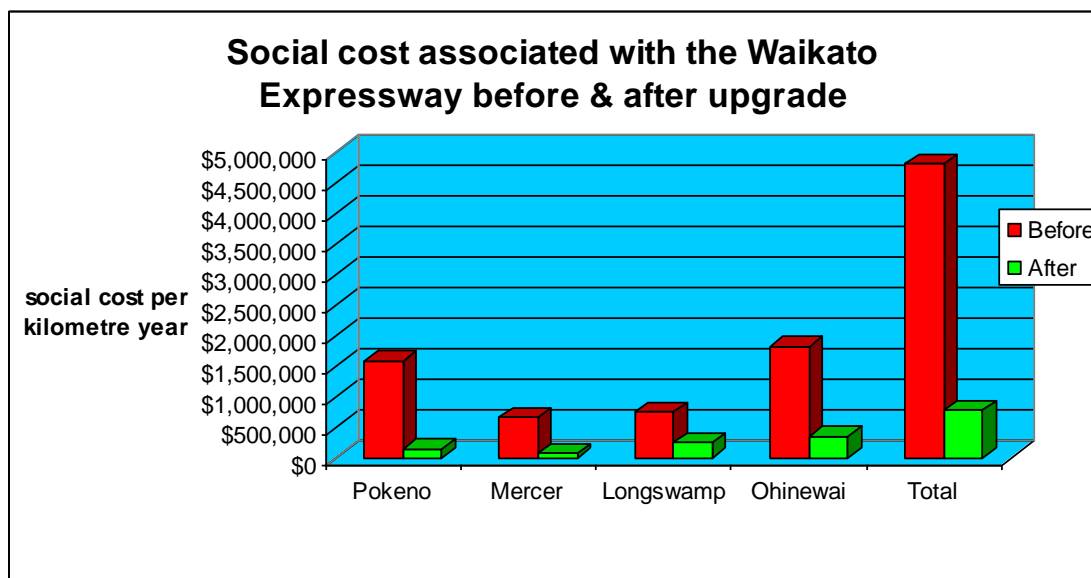


Figure 9. Graph showing social cost associated with Waikato Expressway before and after upgrade

Air pollution and its effect on child health

Building a major road raises concerns around the amount of air pollution generated from traffic. Numerous studies have shown that air pollution has adverse effects on the health of children. The planned Northern Corridor as part of the Roads of National Significance project has the potential to divert traffic closer to population dense areas. For example, the MacKay's to PekaPeka section will pass through residential areas and be located closer to school sites. We reviewed the literature on air pollution and children's health in order to comprehensively assess the potential health impact the Northern Corridor will have on children living in the surrounding areas.

According to the WHO (17) air pollution is defined as consisting of particulate matter (PM), ozone (a major constituent of photochemical smog), nitrogen dioxide (NO₂), and sulphur dioxide (SO₂). PM is a mixture of solid and liquid particles of organic and inorganic substances suspended in the air. The particles are identified according to their aerodynamic diameter, as either PM₁₀ (particles with an aerodynamic diameter smaller than 10 µm) or PM_{2.5} (aerodynamic diameter smaller than 2.5 µm). Air pollutants have the capability to cause serious health problems. In New Zealand each year there is a total of 1,921,000 restricted activity days i.e. that is the number of days lost due to people being exposed to air pollution. Exposure to pollutants is largely beyond the control of the individual and so different ways to control exposure need to be considered in the planning and implementation of a major road. Children are especially vulnerable to the effects of air pollution as their lungs and immune system are still developing (18). Outdoor play means that they spend more time in the polluted environment. They are also more likely to have respiratory infections and thus increasing their susceptibility to air pollution exacerbating their symptoms.

From the literature reviewed, several trends were noticed. The first trend seen was the closer the distance to the motorway, the higher the concentration of air pollutants. This intuitively makes sense as the closer you are to the source of the pollution, the higher your exposure will be. As the proposed motorway is going to be situated through the main residential area of Kapiti, this will mean children previously living in low traffic areas will now have their homes, schools and playgrounds located closer to the motorway. Children will have an uncontrollable increase in exposure to the air pollutants generated. The evidence for the distance-concentration relation was quite clear in the studies found. In 2003, Janssen et al showed that PM_{2.5} levels are 20% higher at 50 metres from a highway compared to 400 metres. Soot was 50% higher at 50 metres compared to 400 metres (19). In a study by Rijnders et al in 2001, they found an increase of 46% in personal exposure to NO₂ for the children from the school located near the busiest highway (169,637 cars/24 h) compared to the children attending the school located near the relatively non-busy highway (45,129 cars/24 h). The school outdoor NO₂ was increased by 41% and the home outdoor NO₂ concentration was increased by 28%. While the estimate of traffic movement through the Northern Corridor is uncertain, the large increase in exposure to NO₂ shown by Rijnders is evidence that the negative impact of NO₂ may manifest in the health of the children in the Kapiti area. High NO₂ is associated with suppression of the immune system and therefore children may be more susceptible to respiratory infections. If children have to take time off school to recover from respiratory illness, this will impact on their amount of learning time in the classroom and may have serious future implications for their education; especially if the respiratory illness becomes a chronic occurrence (20).

Distance from a motorway and its relationship to health outcomes was a focal point of much research. Multiple studies concluded that asthma, wheeze, cough, runny nose, hay fever and

eczema increased in prevalence the closer the children lived to the motorway (this was usually less than 100 metres away) (21-23). The data was not always statistically significant, but was consistent throughout studies looking at air pollution on child health. This is a difficult problem to tackle as with population and economic growth, governments may resort to building larger and improved motorways as seen in the National party's policy to improve the Roads of National Significance. The effect of the air pollution generated by motorways is one that will continue to contribute to child morbidity.

The second trend seen in the research was the higher the concentration of pollutants, the worse the health outcomes in children. There has been a correlation seen between the different types of air pollutants and their adverse effects on child health; in particular respiratory health. Particulate matter and NO₂ seem to be of particular concern in terms of adversely affecting respiratory health. Weinmayr et al in 2010 found that PM₁₀ has statistically significant effect on cough and asthma. A significant decrease in peak expiratory flow was recorded in the children studied (24). Hrubá et al in 2001 found an increase in respiratory illness (especially symptoms of asthma, pneumonia and bronchitis) and hospitalisation in children aged 7-10 was associated with an increase in total suspended particulate (64% PM₁₀, 46% PM_{2.5}) (25). Pe'nard-Morand et al in 2005 showed a positive relationship between long-term background concentrations of SO₂, PM₁₀ with an increased prevalence of asthma and exercise-induced bronchial reactivity. Also increased atopy (shown by positive skin prick testing) was associated with increased O₃ exposure in school children (26). Janssen et al also found elevated total IgE (an allergy related immunoglobulin REF (27)) was significantly associated with soot and NO₂ (19). Skin prick test (SPT) reactivity to any allergen and to indoor allergens were both significantly associated with NO₂, whereas SPT reactivity to outdoor allergens was significantly associated with truck traffic and PM_{2.5}. In terms of air pollution and its affect on mortality, a 2005 pilot study in Christchurch found that a 10microgram increase in 24hr PM₁₀ was associated with a 1% increase in all cause mortality, 4% increase in respiratory mortality and a 3% increase in hospital respiratory admissions of adults and children. In a 2002 public health advisory committee, Kjellstrom and Hill showed that lifetime exposure to PM₁₀ increases total mortality by 1.6% (28).

O' Connor et al's study in 2007 showed some of the negative health effects of NO₂ on respiratory health. Increasing NO₂ concentration was significantly related to a decrease in FEV₁ of more than 10% below personal best. There was also an association between increased NO₂ and increased occurrence of respiratory symptoms: days with wheeze, tightness in chest, cough, nights where child woke up because of asthma, days child slowed down or stopped play, number of school days missed. This study shows the importance that poor respiratory health has on the overall functioning of children, as it can affect sleep, play and education. If these areas are affected by air pollution, then we are putting our children's development at risk if we expose them to increasing amounts of pollutants. While the studies we found showed that there was a correlation between air pollution concentration and adverse health outcomes, several did not reach statistical significance. However they all showed a correlation, so we can predict that air pollution does have a negative effect on the health of children but by exactly how much we cannot say (29).

Generation of PM₁₀ can also come from the natural environment. The background levels are from PM₁₀ generated by natural sources, such as windblown dust or sea spray (30). This natural background PM₁₀ can potentially cause the same respiratory effects seen in the road traffic studies. It should also be noted that the Kapiti area is nestled along the coastline, and so if measurements were to be taken from the proposed new motorway site, it would be difficult to categorise the PM₁₀ produced by the coastal environment from the PM₁₀ from

the road. Interestingly, Wellington and the surrounding areas have PM10 levels with a mean already above the level shown to have a negative effect on respiratory health. This was deduced to be 12.55 microgram/m³ by Lin et al (31). In the Kapiti area, the building of a motorway near a residential area may increase the PM of the environment significantly enough to cause more harm than is already present in the general child population. A GIS map could be drawn for the Kapiti area in relation to the number of children who will be living within 100 metres of the proposed road as it runs through the residential area. This would be a good way to see how many more children will be exposed to air pollutants comparative to alternative/current routes. Unfortunately due to time constraints, this could not be completed for inclusion into this report.

Wind direction is a factor that would alter children's exposure to air pollutants, with winds blowing from the motorway towards the residential housing exposing more children to the pollutants generated. This is an environmental factor that we have no control over. As the actual route of the proposed motorway is not yet finalised, the population who would have an increased risk of exposure to air pollutants with the wind is unknown.

The effect of air pollution on lung development is another health concern to be considered. In a report by the WHO on effect of air pollution on child health (18), they found that NO₂ and O₃ caused oxidative damage to developing lung tissue. O₃ was especially damaging to the epithelium of the airways, initiating inflammation and impairing future healing processes in the lung. Gauderman et al in 2007 found from their study that over a period of 8 years, 10-18 year olds had reduced lung development if they were living within 500m of a motorway compared to those not living near a motorway (32). This was seen by an average decrease in FEV1 of 81ml ($p=0.01$ [95% CI -143 to -18]). Reduced lung development could lead to a whole lot of problems, such as reduced exercise tolerance and poor respiratory function. For children, their early development is critical for setting their future health outcome, so early lung damage can have detrimental consequences as they mature. A study by Brugge et al (also in 2007) reported elevated risk for asthma for children who moved next to the highway before they were 2 years of age (33). This suggests that early childhood exposure to air pollutants may be key in the development of respiratory problems like asthma, bronchitis, etc. It also emphasises that early developmental environment is important in child health outcomes. The study by Brugge also concluded that girls were found to be at greater risk than boys for asthma, other respiratory conditions and allergy resulting from highway exposure. The reason for this difference is unclear. Air pollution also has the potential capability to affect unborn children (33). de Medeiros et al in 2009 reported that neonatal death risk increased if the mother lived closer to a main road (34). However, this effect of air pollution needs further investigation.

One factor affecting the concentration of air pollutants is the type of traffic e.g. truck versus car traffic. Janssen et al in 2003 found truck traffic increases indoor and outdoor PM_{2.5} concentrations and soot, more so than car traffic) (19) while Ciccone et al in 1998 found average NO₂ concentrations were higher in streets where lorries often pass than in streets where lorries were reported not or seldom to pass (35). The Northern Corridor is part of State Highway 1 which is the main highway running from the top of the North Island, all the way to the bottom of the South Island. Therefore, it is a major thoroughfare for heavy transportation vehicles such as lorries and goods trucks as they transport freight all over New Zealand. This means that there is guaranteed to be a high volume of heavy air pollutant producing vehicles passing along the motorway that is to be situated near residential housing. Ciccone also found that the high frequency of trucks was associated with an increased risk of

respiratory problems, with strong associations with increased bronchitis, bronchiolitis, pneumonia and wheeze.

Another factor in the production of air pollution is the type of traffic movement. Ryan et al in 2005 sampled for PM_{2.5} and black carbon in traffic and found that during stop-and-go traffic, levels of air pollutants increased significantly (36). 21 other studies they looked at also found that traffic that was not travelling at a constant speed (i.e. constantly accelerating and decelerating) was associated with higher emissions of air pollutants compared to steady-speed traffic. This could mean that the air pollution released from traffic generated in the Northern Corridor may decrease, as the motorway will encourage constant speed traffic flow, without the stopping and starting currently seen in the roads at Kapiti. However, if the population that is exposed to the air pollutants increases as the road passes through residential areas, we may see more children suffering from respiratory illness to a less severe degree.

From our literature review, it seems that the closer the proximity of the highway and the greater the increase in concentration of pollutants exposed to children, the more adverse effects on their health. Factors such as traffic type, vehicle movement, wind and environmental factors all play a part in the air pollution exposure and generation. Respiratory illnesses such as asthma, bronchitis, wheezing and cough as well as allergic reactivity seem to be associated with increased air pollution. The correlation of particulate matter and NO₂ with respiratory illness seems to be the strongest. Lung development occurs during childhood so if it is adversely affected by air pollution, there can be flow on effects to adulthood. However we cannot estimate how big an effect air pollution will have on the children's health in the Kapiti region as the data from research found was not all statistically significant. Regardless, it is important to consider the placement of the roads so to lessen the potential impact on respiratory and overall child health. As well as the health concerns raised, there are benefits of a major road improvement and these need to be carefully weighed against the harms.

Recommendations

Further studies could be done in the New Zealand setting to see how air pollution affects child health in relation to already existing motorways. New ways to mitigate air pollution also need to be investigated.. In a broader scope, better car development and improved engineering could help reduce the initial production of the air pollutants and minimise the human contribution to the environment.

Mental Health

The implementation of the Northern Wellington Corridor could have significant effects on the mental health of children and Maori population who are in close proximity to it, particularly in the Kapiti region which would have the proposed road built directly through it. There are many factors about an expressway that can contribute to mental health morbidities. However due to time and resource constraints, this HIA focuses on road traffic noise pollution and their effects on mental health.

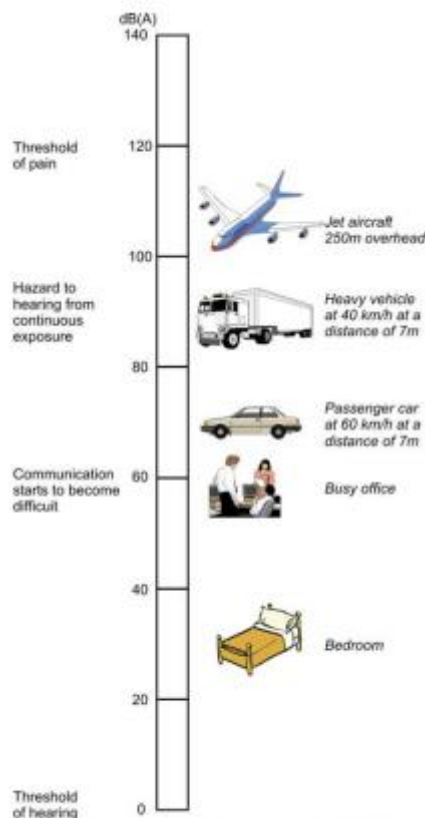


Figure 2.1 The Level of Common Sounds on the dB(A) Scale

Road traffic noise is the aggregation of the noise from the individual vehicles in the traffic stream and is considered to be a line source if the density of the traffic is high enough as distinct from a point source. It is produced by a combination of noise from the engine, transmission, braking system, interaction of tyres and road pavement surface, body and load rattles, and movement of air around the vehicle. For this report, studies involving the use of LAeq level as the environmental noise index to assess road traffic noise were chosen. LAeq is the equivalent energy level, which over a period of time contains the same amount of sound energy as the varying levels of the road traffic noise(37).

Effects of Traffic Noise

Highways can produce a large amount of noise due to large traffic volumes and the high frequency of vehicles moving up and down the highways. There are many modalities by which traffic noise exposure can lead to decreased quality of mental health of children.

One of the main effects is stress. There were many studies that have found that increased systolic and diastolic blood pressure in children exposed to traffic noises long term (38-40). It has been proposed that the increase in blood pressure is secondary to stress caused by road traffic noise (40).

In addition, road traffic noise can produce annoyance and behavioural disturbances in children. Annoyance is a subjective experience that is defined as “a feeling of displeasure or a negative attitude associated with exposure to an unwanted sound” (41). Studies show that increased traffic noise exposure leads to higher levels of annoyance (39, 41-44). Behavioural disturbance, which is correlated with annoyance, was more strongly correlated with increased road traffic noise than annoyance. Increased behavioural disturbance leads to behaviour changes in the form of closing windows, raising ones voice, or altering one’s scheduled activities as a consequence of traffic noise(41). Although, these studies are not specific to children, they suggest that road traffic noise may directly or indirectly affect children’s mental health.

Road traffic noises can also affect sleep of children. Sleep is widely known to not only be important for daily cognitive function and wellbeing, but also an important contributor to neural development in children. There is evidence that shows reduce sleep quality in children when exposed to road traffic noise. Some of the effects of noise on sleep include reduced perceived sleep quality, day time sleepiness, increased motility during sleep, increased sleep latency, increased sleep awakenings, and reduced length of deep and REM sleep (39, 45-47).

Exposure to road traffic noise has been shown to have negative effects on children’s learning and mood. Among these effects are decreased recall and recognition of text, decreased effort and motivation in school, poorer auditory discrimination and reading level (43, 48, 49). A

study suggested that acute exposure to traffic noise affects recall and recognition by affecting the encoding, ensuing storage and retrieval of information, while chronic exposure of traffic noise either generally hampers information intake or by blocking out efficient storage of information (48). Negative changes in mood may be due to increased annoyance levels, behavioural disturbances and stress levels caused by increased traffic noise exposure.

The evidence for the effect of road traffic noise on psychological symptoms is mixed. One study found that there is a dose-response relationship between ambient noise levels (rail, highway, road) and mental health indices such as depression, anxiety and conduct disorders in children (50). Other studies showed that there is little to no correlation between exposure to road noises and psychological symptoms (51, 52). Overall the current studies are not enough to disprove the association of noise exposure and psychological symptoms and further research is indicated (52).

All these mental health impacts have special implications for Maori children. Statistics show that Maori suffer from more mental health morbidities than Non-Maori (53) and the impacts produced from road traffic noises may have carry on effects when Maori children grow up. In addition, noise impacts on learning may have some contribution to lower literacy, numeracy and science achievements in school, increased suspensions, exclusions, expulsions, truancy and early leaving of school (54).

It is unclear how much the effects of road traffic noise on mental health contribute to the disparities of mental health and education between Maori and non-Maori. Further research may be indicated. However, it is important to consider all possible factors in order to improve the health and well being of Maori.

Recommendations

Traffic noises may have multiple impacts on children's mental health and methods to reduce noise exposure can provide many benefits in terms of reducing stress, annoyance, behavioural disturbances, improve quality of sleep and reduce negative effects on child learning. Some of the possible methods are:

- Provide funding for insulation such as double and triple glazing of windows (40)
- Implementing sound barriers along the highway
- Improve traffic flow along the highway - to prevent congestion and sudden acceleration of vehicles, which leads to noise peaks that may be perceived as more annoying than vehicles travelling at a constant cruising speed (42)
- Improve and maintain low noise producing road surfaces (55)
- Build roads away from urban areas

Maori

New Zealand portrays itself as a multicultural country by using the haka, pounamu and other well known Maori symbols to attract international interest. Yet Maori have poorer health outcomes which exist in addition to those caused by inequalities in income distribution. This is despite the declaration in The Treaty of Waitangi that British colonisers will protect Maori health. On a global level the World Health Organisation demands international action on social and health inequalities in The Ottawa Charter (56). Thus as major new infrastructure is

being planned we need to seriously consider ways we could use it to promote Maori health and lessen the disparity.

Maori as the tangata whenua (guardians of the land) have an intimate and protective relationship with the land. This includes all aspects of the land, from the sea to the sky. In this section of the report we have taken one example of how the RoNS proposal can impact upon Maori health but we acknowledge that the subject is broad and a full appraisal is beyond the capabilities of this review.

The Takamore Urupa (burial ground) in Waikanae has been used for Maori burials from the early 1800s. One of the proposed routes of the Northern Corridor development passed through this site. One reason why Maori opposed this route was to do with their strong spiritual beliefs about the Urupa. Paul Ropata, Chairman of the Whakarongotai Marae Kaumatua committee, explained these views from a Maori perspective. Once the body has been returned to Papatūānuku (Earth Mother) the person's spirit leaves and begins its ascension through the twelve heavens to its final resting place in the thirteenth heaven where the God Io Matua resides. The ground associated with the burial is now deemed to have been consecrated with a lasting sacredness. It would be a gross transgression to disturb the remains. The spiritual wishes and thoughts of the people present are also buried with the body. Therefore any disturbance is not only disrespectful to the deceased but also to the people who have gathered to farewell their family member or friend. Disturbance to the burial site can result in poor health, illness, and even death for people connected to the deceased or those who unwittingly cause disturbance to the site. So the Maori opposition to the proposed route was based on a spiritual belief that disruption to the Urupa would cause illness.

There was a variety of evidence which supported the idea that Maori spiritual beliefs are an important part of health and need to be respected. They included The Treaty of Waitangi, Durie's three principles and Te Whare Tapa Wha which are discussed below in more detail.

The strongest evidence in support of the Maori view is The Treaty of Waitangi. This is sometimes referred to as the founding document of New Zealand and it formalises the agreement between the indigenous Maori and the colonising British. The Treaty links Maori spiritual beliefs to our duty to enable Maori autonomy and equity. Article Two protects Maori autonomy by allowing them to retain their spiritual and cultural property such as the Urupa and Article Four gives Maori the right to practise their own spiritual beliefs. So the Treaty principles imply that we should avoid disturbing the Urupa and respect Maori spiritual beliefs about the area.

The Treaty principle of autonomy is supported by Durie (2007). Professor Mason Durie set up a framework to address indigenous health issues. He developed three principles which are indigeneity, dual competence and human dignity (57). Durie writes that indigeneity is the determination of an indigenous person to retain their own distinctive cultural identity, avoid assimilation and exercise a degree of autonomy (57). This supports the view that as an indigenous population, Maori have a right to retain their spiritual beliefs about the Urupa.

But does spirituality have anything to do with health directly? Te Whare Tapa Wha (a Maori model of health) indicates that spirituality is an integral part of health for Maori. The model consists of four elements or foundations which are all necessary for health. These are taha tinana (physical health), taha whanau (family health), taha hinengaro (mental health) and taha wairua (spiritual health). The model is based on the idea that if any one of the four dimensions is missing or damaged the person becomes 'unbalanced' and unwell. It

demonstrates that spiritual health is an essential part of overall wellbeing from a Maori cultural perspective.

This reasoning was supported by Mr Ropata as he felt that Maori religious beliefs impact on many areas of life. Maori have a responsibility to maintain a clearly defined balance between the spiritual and material worlds. In upholding the beliefs associated with burial they show respect not only to the deceased person and their family but also to the Maori Gods. This belief is also practised in services like health clinics and educational facilities.

The interface between Pakeha and Maori worlds does not have to be a point of contest (58) and compromise is the only way forward for New Zealand. This compromise will remain in limbo until a Treaty claim from December 2010, which challenges the defined borders of the Urupa, is heard and resolved. At this point, the one thing that is certain is that Maori do not wish to have sacred land disturbed. More discussions are required with the possibility that neither option one nor two are appropriate solutions for ensuring the obligations set out under the Treaty of Waitangi. In that case a new solution will need to be developed which promotes Maori health and works to reduce the disparities that exist.



SACRED PLACE: "We can't move bodies," says Paul Ropata of Whakarongotai Marae, at his grandparents' grave at the iwi's cemetery.

Image from PHIL REID/The Dominion Post

Recommendations

1. Continue open and frank discussion with local iwi.
2. Reassess Urupa boundaries in light of the recent Treaty claim.
3. Be open to the possibility that option one and two may not be appropriate in light of the Treaty claim.

Conclusion

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