Achieving Urban Sustainability: The consideration of sustainable transport in strategic spatial planning.

A case study of Porirua city's Northern Growth Area Structure Plan 2014

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Abstract

In recent decades there has been growing recognition of the adverse effects that dispersed urban form has on the environment and wellbeing of urban residents. In response to growing urban populations and a global call for urban sustainability, spatial planning has shifted away from the case by case method of regulating urban development which facilitated sprawl, toward a long term strategic approach to planning future land use. Under this approach, a more sustainable vision of a city's future layout is developed by local councils and implemented through a strategic spatial plan. However if strategic planning is to increase urban sustainability, it must address the most significant issue of sprawling cities; vehicle dependant urban transport systems, which result in high CO2 emissions among other impacts. Integrating transport and urban form elements is argued to be a key approach to address these issues. Planning urban form to increase density, destination accessibility, and diversity, reduce distance to public transport, and design (coined as the 5Ds of sustainable urban form by R Ewing, Bartholomew, Winkelman, Walters, and Chen (2007) all function to reduce travel demand and induce a shift to alternative modes of transport. This reduces vehicle kilometres travelled by people in urban areas and its associated impacts. If strategic spatial planning aims to increase urban sustainability then, it needs to integrate transport and urban form through incorporating and considering these five urban form elements.

In 2014, Porirua City Council, carried out a strategic spatial planning exercise to envision a future housing development scenario in its northern periphery over the next 30 years. The plan aimed to ensure sustainable, integrated, and coordinated urban and rural development. This thesis took the form of a case study to assess the extent to which the process integrated urban form and transport in its quest to achieve urban sustainability, using the incorporation of the 5Ds as a benchmark. While opportunities to support more sustainable transport modes were identified early on in the process, the planning process did not integrate transport into decisions about urban form in a way that maximised these. This was due to a range

of factors including: the lack of transport related objectives; perceptions of increased density; funding issues; and resource capacity issues within the local council.

Acknowledgements

My first and most heartfelt thanks go to my supervisor Ralph Chapman for his never ending encouragement, three o'clock coffee discussions, and inspiring passion for urban sustainability. I am eternally grateful for your faith in me Ralph, and for the support you've given me on this path of academic and personal growth over the last few years. Thank you to the Porirua City Council for granting me permission to write my thesis on your planning process over 2014. Special thanks to Peter Matich from Porirua City Council, for making my involvement with the planning process possible, and taking the time and energy out of a busy schedule to keep me in the loop, as well as sharing your knowledge and expertise with me. To Marc Baily and the team of facilitators from Boffa Miskell and Aurecon Ltd, thank you for allowing me to sit in on the stakeholder workshops and answering my stream of questions and queries. To the stakeholders involved, thank you for your patience as I observed your planning discussions like a fly on the wall. To the lovely Nadine, thank you for taking your time to help me! To my Beautiful Brains of 4 Wai ti ata Rd, Tui Arona, Sam Morris, and Jerome Cameron: it is to you three that I owe a significant portion of my happiness and sanity (and procrastination time). To have gained such fantastic, funny, and caring friends through this process has been the biggest blessing. To my mother Teresa, for always supporting me in my life decisions. This wouldn't have been possible without you. Similar thanks to Jesse, I would never have got where I am today without your motivation and support. I wish you the best always. To the people I lost along the road, Caroline and Peter. Your life and loss were so intertwined with mine during this process, it would feel strange to leave you unacknowledged.

Contents

Chapter 1: Introduction

Badly designed cities are linked to a wide range of negative impacts on the environment and wellbeing of urban residents. Some of the most significant are those derived from urban transport systems. Arguably the most far reaching impact of urban transport is the level of greenhouse gas (GHG) emissions resulting from private vehicle use. Other negative impacts include: air and noise pollution; high levels of energy consumption; road congestion; vulnerability to fuel costs; high infrastructure costs; inefficient land allocation; loss of ecologically and agriculturally important land; health effects; loss of community cohesion and social capital; and car related accidents (Jenks, Burton, & Williams, 1996; Williams, 2005; Giles-Corti, 2011; Petersen, 2004; Calthorpe, 2011; Bart, 2010; Cavill, Kahlmeier, Rutter, Racioppi, & Oja, 2008). In light of these issues, many experts have called for a shift away from car-dominated urban transport as part of a wider transition toward a low carbon future. Altering urban form is a key approach to achieve this shift. The focal question of many experts writing about urban planning in the age of climate change is therefore: how can urban form be altered to reduce car use, or at least halt increased car demand (Barrett, 1996)? Models of sustainable urban form suggest the solution lies in prioritising five features of spatial layout that can induce this reduction; density, destination accessibility, distance to public transport, diversity, and design. Urban spatial planning and land use decisions should incorporate and consider these elements if they hope to address unsustainable urban transport and urban form patterns, and create sustainable and resilient cities in future.

Defining urban sustainability

Urban sustainability is a broad concept which encompasses many topics (see figure 1.1 below). Attempting to evaluate the sustainability of a plan such as the Northern Growth Area Structure plan (NGA Structure plan), which manages the environmental impacts in many of the areas listed in figure 1.1, is outside the scope of this study. Based on widely accepted definitions of sustainability such as that espoused by the

The United Nations World Commission on Environment and Development (1987), a sustainable urban system can be defined as one that allows the present community to provide for their social, economic, and cultural wellbeing, while minimising negative environmental effects. This is too general to inform studies that aim to evaluate the success of specific urban management projects.

More specifically then, urban form is defined as the spatial structure of an urban system and its component parts: its buildings, transport, and other networks. Based on definitions of sustainable urban form literature, specifically R Ewing et al. (2007) sustainable urban form can be defined as one which supports levels of density, destination accessibility, distance to public transport, diversity (mixed uses), and design (known as the 5Ds) high enough to reduce negative environmental effects while allowing people to provide for their wellbeing.

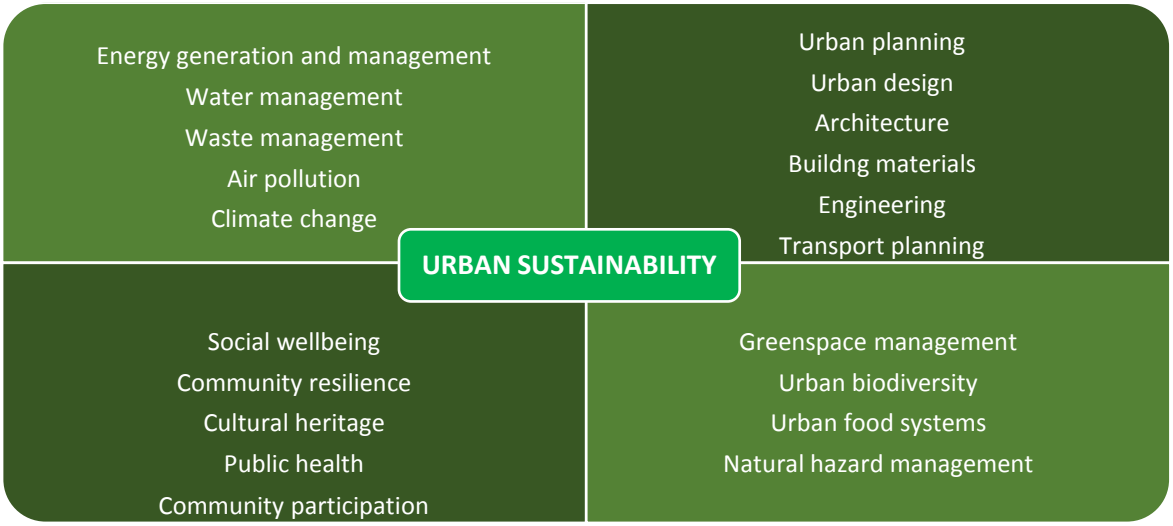

Figure 1.1 Topics related to urban sustainability.

While there is a large body of literature about the role spatial planning can play in inducing sustainable transport, there are few studies which assess how well planning processes work to achieve this in the real world. Studies that do look at the integration of transport in spatial planning often focus on the integration of transport policy, such as (Kulmer, Koland, Steininger, Furst, & Kafer, 2014) rather than the inclusion of planning instruments themselves. In New Zealand, Tonkin and Taylor

(2008) concluded that there is a lack of studies which review the inclusion of sustainable transport in local spatial planning. Such assessments would serve as an example of the role planning plays in creating more sustainable urban futures, and provide an example for spatial planning over the coming decades.

This study aims to examine the extent to which strategic spatial planning in New Zealand considers sustainable transport issues in decision making, through a case study of the NGA structure planning process in Porirua, New Zealand. To achieve this, the study poses the key research question:

To what extent does decision making in the strategic spatial planning process in Porirua support the inclusion and consideration of sustainable transport in order to increase urban sustainability?

To answer this, four questions are posed:

1. *How well are urban form elements that induce sustainable transport outcomes incorporated in the process?*
2. *How are these elements framed in the process?*
3. *How well are these elements then considered by stakeholders?*
4. *What factors drive or constrain stakeholder consideration of these elements?*

This case study will use the 5D elements as a benchmark to evaluate how well the planning process incorporates sustainable urban form for good transport outcomes, in order to answer the research questions above. It is hoped that this study will contribute an insight into the extent to which the strategic spatial planning framework in New Zealand gives consideration to sustainable urban form elements and transport, and the factors that drive or constrain it. This research also aims to inform improved integration of sustainable transport considerations into future strategic planning.

Methodology

This project will take the form of a single case study, using multiple qualitative methods. This approach is informed by the research setting itself, which is suited to a case study design for the reasons explained below.

The NGA Structure Plan process is a real-life phenomenon, which this study aims to understand in depth. Specifically it looks to understand how the framing of urban form, and inputs by stakeholders throughout the decision making process, informs the sustainability of the end decision. This planning phenomenon is inextricable from its real life context: the planning framework and the theories of sustainability that inform it, the socio-economic context of Porirua, the values and priorities of the stakeholder organisations, and the wider needs of the current and future community. Yin (2009, p. 18) defines a case study as:

"an empirical inquiry that investigates a contemporary phenomenon in-depth and within its real-life context; especially when the boundaries between phenomenon and context are not clearly evident."

The NGA planning process is therefore suited to a case study approach.

Case study techniques are also suited to research questions which look to understand 'how' a phenomenon works. This study aims to understand 'how' sustainable urban form elements are valued within the planning process, and 'how' this affects the sustainability of the outcome. A case study analysis is highly suitable to investigate these questions in depth.

As case studies attempt to understand a phenomenon in depth and within its wider context, a variety of data collection techniques are used to gain the fullest picture. Drawing on multiple forms of data allows the phenomenon to be seen from multiple vantage points, and suits the complexity of real world processes where many factors influence the events or processes or outcomes in question. This helps to address the information gaps found in each single set of data collection, and provide validity to the researchers' analysis and conclusions.

This case study will combine three different qualitative methods of data collection in order to develop a more complete picture of the factors which influenced the decision making process. This includes an analysis of planning documents, passive observation of planning meetings, and an interview with a key stakeholder. These three methods are described in more detail below:

- Critical analysis of planning documents relevant to the NGA planning process including:
    - central government transport legislation, planning legislation, and reports on New Zealand transport and urban form;
    - Greater Wellington Regional Council policy statements, strategies and plans;
    - Porirua City Council district plan, transportation strategy, and development frameworks;
    - Internal council planning documents created during the NGA planning process including technical reports produced throughout the decision making process, workshop agendas, power point presentations, evaluation methodology documents, draft and proposed plans.

  These documents direct the content of the NGA plan, as the plan is legally required to be consistent with, or give consideration to, many of the documents above. They also provide a rich source of information on the context in which decisions are made during the process, and the factors that constrained or drove the outcomes. Furthermore, they provide the purpose and mandate of organisations which influence the inputs of those organisations representatives in the planning process.

- Passive observation of:
    - Two stakeholder workshops;
    - Two public consultation meetings;
    - and a hearing panel.

Permission to observe these meetings was granted by council planners and workshop facilitators. Attendees were offered the opportunity to object to the researcher's observation and note taking. Participants at the stakeholder workshops are listed in Appendix 3. The researcher sat with stakeholders during the workshops and listened to the discussions of transport related stakeholders as they evaluated management options (the planning process will be explained in chapter 5 from page 59). Notes and written quotes were taken at these workshops and used to inform analysis in this thesis.

Passive observation of the workshops and meetings provide a rich understanding of the local factors that influence decisions during the evaluation process. They also provide insight into the drivers for a local decision, or barriers to making a certain decision, that are not recorded in planning documents and reports. Observations as a research method are therefore valuable where a study aims to understand the factors influencing a real life phenomenon, such as a planning decision.

- Personal communication with stakeholders and facilitators present at the stakeholder workshops before and after the workshops, and members of the public at the public workshops. These communications provided an enriched understanding of the observations and planning documents by providing context.

- One interview with a key stakeholder. This stakeholder was interviewed due to their broad overview of the planning context, which enabled them to provide background rationale for the information gathered through planning documents and passive observations. The interview was recorded and notes also taken during the interview.

Chapter 2: The problem of urban transport

Climate change

The Intergovernmental Panel on Climate Change (IPCC) scenarios predict that by 2100, temperature rises will be in the range of 1.1 degrees Celsius to 6.4 degrees Celsius (C), with the most likely range being 1.8 - 4.0C. The IPCC 5th assessment report stresses however that GHG levels must be stabilised at 450 ppm by 2050, with a maximum temperature rise of 2C, if we are to prevent a "dangerous anthropogenic interference with the climate system" (IPCC Fifth Assesment Report Working Group III et al., 2014). In order to achieve climate stabilisation at 2C, it is widely agreed that industrialised countries must reduce their GHG emissions by between 60-80% relative to 1990 levels by 2050 (R. H. Ewing & Anderson, 2008).

Mitigation of climate emissions is thus a key focus for international and domestic policy makers in the coming decades. Most relevantly, the IPCC 5th assessment report highlights the role that local governments' must play in mitigating and adapting their jurisdictions to climate change, given their responsibility for the wellbeing of their communities and local environments, their understanding of local climate change impacts, and power to manage infrastructure and land use in a way that responds to this local context (IPCC Fifth Assesment Report Working Group III et al., 2014). The importance of taking responsibility for climate change at the local level highlights the need for spatial planning to address sustainable transport concerns and reduce local car dependence.

New Zealand's emissions

New Zealand has one of the highest rates of car ownership among OECD countries. As a result of this, combined with low population and low population density,

domestic transport emissions per capita are high compared to other developed countries (Ministry for the Environment, 2014).

The effect of these trends is reflected in New Zealand's rising emissions profile: between 1990-2012 New Zealand's GHG emissions increased by 25%.[1] Road transport is one of the largest contributors to this increase, emitting 20% of the countries CO2-e annually (Ministry for the Environment, 2014). It is responsible for around 40% of the energy sectors emissions, whose emissions have increased the most since 1990 (see figure 2.1). Thus while the agriculture sector still emits the most, its proportional emissions have actually reduced as a result of increases in road transport emissions.

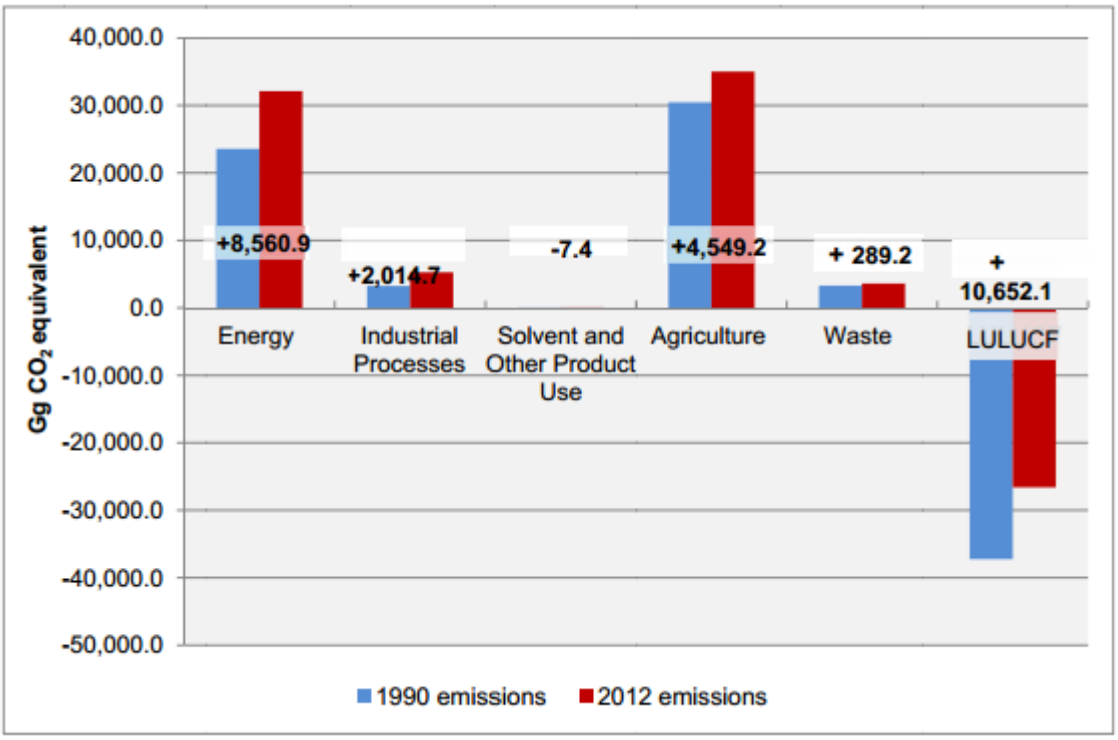

Figure 2.1 Change in New Zealand's emissions from 1990-2012 by sector (taken from Ministry for the Environment, 2014).

[1] Gross emissions consist of emissions from the energy (transport and electricity), industrial processes, solvent and other product use, agriculture and waste sectors. The gross emissions figure excludes emissions from the LULUCF (land use, land-use change and forestry) sector. In the same period, net emissions (including emissions and removals of GHGs from the LULUCF sector) were 111.4%. This is largely attributed to harvesting of forestry plantations between 2009-2012.

Transport related CO2 emissions and its impact on climate change

Carbon emissions from road transport are one of the most far reaching environmental impacts of cities worldwide. In New Zealand, road transport is the largest source of total CO2 emissions. In 2012, road transportation made up 36.9% of total CO2 emissions, with public electricity and heating contributing the next highest amount at 18.9%. Road transport has substantially contributed to the 37.5% increase in total CO2 emissions in the country since 1990 (Ministry for the Environment, 2014).

However it is harder to ascertain how much of this is derived from urban transport. In the USA, transport within urban areas is responsible for 75% of the country's total Vehicle Kilometres Travelled (VKT), which is a common measure for vehicle C02 emissions. Transport between urban areas makes up the remaining 25%. However urban transport consists predominantly of light vehicles, which produce four times less CO2 than heavy vehicles, dominant in rural areas. Allowing for this, urban areas still represent around 62% of total VKTs in the USA, a percentage that continues to increase as urban populations grow (R Ewing et al., 2007). In New Zealand 87% of the population lives in urban areas. While urban road transport emissions are not reported on specifically, approximately 65.2% of road transport emissions is generated by light vehicles (Ministry of Transport, 2014a). According to the Ministry of Transport, vehicle kilometres travelled in major urban centres makes up 47% of the national total (Ministry of Transport, 2014b). This number does not include all urban areas, and the number is likely higher.

Either way, it can be extrapolated that reducing car dependence in urban areas will make a substantial contribution to CO2 emissions reductions in New Zealand. Any attempt to plan for urban sustainability must therefore aim to reduce transport related emissions if it is to succeed.

Chapter 3: Achieving urban sustainability: the role of urban form and transport integration

The relationship between urban form and transport

Urban form can be defined as:

> *The patterns and spatial arrangements of land use, transportation systems, and urban design elements, including physical urban extent, layout of streets and buildings, as well as the internal configuration of settlements* (IPCC 5th Assessment report 2014).

Land use patterns are a critical determinant of urban transport patterns, and vice versa. Altering the structure of urban form can therefore play an important role in increasing the sustainability not only of land use, but transport systems too. This is recognised by urban sustainability authors such as Kenworthy (2006) who highlight the need to integrate land use and transport systems if urban sustainability is to be achieved.

Urban sprawl, defined as a highly dispersed layout of activities (residences, places of employment, amenities and shops) is characterised by low scores in the 5Ds of urban form, particularly density (Ewing et al. 2007). Similar studies that attempt to characterise cities based on their level of dispersal also define a sprawling city as one which scores low on measurements of continuity, concentration, clustering, centrality, nuclearity, proximity, and accessibility to the street network (R Ewing, Pendall, & Chen, 2002; Galster et al., 2001). Most importantly, dispersed land use patterns are associated with high rates of private vehicle use. Arguably the most far reaching impact of this is the level of greenhouse gas (GHG) emissions. Other negative impacts include: air and noise pollution; high levels of energy consumption;

road congestion; vulnerability to fuel costs; high infrastructure costs; inefficient land allocation; loss of ecologically and agriculturally important land; health effects; loss of community cohesion and social capital; and car related accidents (Jenks et al. 1996; Williams, 2005; Giles-Corti, 2011; Petersen, 2004; Calthorpe, 2011; Bart, 2010; Cavill et al., 2008).

Sustainable transport and its value for achieving urban sustainability

A focus on transport is based on the proposition that urban transport systems are unsustainable in their current form, and that this is a key driver of the negative environmental effects of cities; (D. Banister, 2005; Curtis, 2007). What then, is a sustainable urban transport system? It is one which provides for people's daily travel needs while minimising impacts on the environment and on social wellbeing. This translates to low CO2 emissions and air pollution, high energy efficiency, human scale transport (public space that is designed for use by pedestrians rather than vehicles) allowing spaces for community interaction, and active transport (cycling, running, walking) that addresses health concerns. In practical terms, a sustainable transport system would differ from city to city, depending on local contextual factors such as existing infrastructure and urban form among other things.

An overview of approaches to addressing the impacts of urban transport systems

The unsustainability of urban transport presents a complex problem. Based on the influence that urban land use patterns have on those of transport, altering the layout of cities is argued by many to be a key instrument with which to address unsustainable transport patterns (see Curtis 2007 as an example). The sustainable mobility approach for example recommends "actions to reduce the need to travel (less trips), to encourage modal shift, to reduce trip lengths and to encourage greater efficiency in the transport system" (David Banister, 2008, p. 75). Implementing these actions requires changes to the layout of land use. However, the most effective approach to addressing the unsustainable transport is subject to debate, and it is

clear that a range of instruments must be implemented if emissions reductions targets are to be met in time. So why then, does this thesis focus on urban form solutions alone?

Broadly speaking there are three approaches for reducing the negative impacts of urban transport: demand management; operations management (traffic control); and vehicle/fuel technology improvements (figure 3.1). All three aim to reduce CO2 emissions. However, vehicle and fuel technology improvements, particularly gains in efficiency have received the most attention from national policy makers and the media (R. H. Ewing & Anderson, 2008). In the US, the Clean Air Act (1970) and the Alternative Motor Fuels Act (1988) set efficiency standards for new vehicles to address CO2 emissions from transport (Environmental Protection Agency, 2015). They also encourage the use of biofuels. The European Union sets mandatory emissions reduction targets for all new cars entering the market (European Commission). In New Zealand, the Energy Efficiency and Conservation Strategy 2011-2016 also aims to improve the efficiency of new vehicles (relative to 2010 levels). Proponents of these measures argue that efficiency improvements are best placed to reduce transport emissions, because the technology is already viable and is ready to be implemented within a short timeframe. The International Energy Agency (IEA), for example, argues that fuel efficiency gains could stabilise global transport emissions, even if the amount of vehicles doubled, by 2050 (International Energy Agency, 2012). A USA based study estimated that a 1.5% annual increase in fuel efficiency alone would result in a 35% reduction in transport related GHGs by 2040 (Transportation Research Board 1997, as quoted in (Deakin, 2001). The short term solution that fuel efficiency presents is important given the closing window for addressing climate change: The IPCC has set a global emissions reduction target of 40-70% (relative to 2010 levels) by 2050 if we hope to stabilise CO2 levels (IPCC Fifth Assesment Report Working Group III et al., 2014).

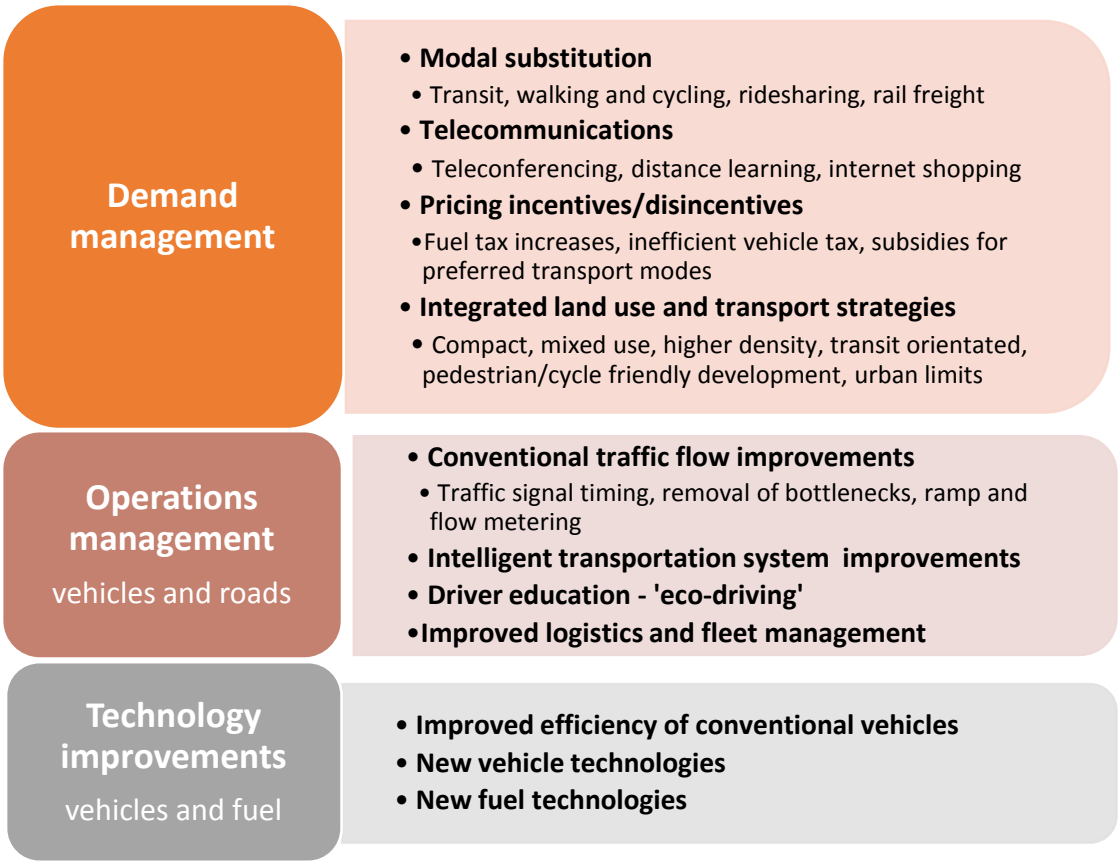

Figure 3.1. Three key approaches to inducing sustainable urban transport (adapted from Deakin 2001, 8).

However, relying solely on technological improvements to reduce transport emissions is problematic. Firstly, fuel and vehicle efficiency may not be able to achieve the level of emissions reductions predicted above. These predictions are reliant on a high rate of improvements in efficiency, and high investment in these improvements by vehicle manufacturers (IPCC Fifth Assesment Report Working Group III et al., 2014, p. Chapter 8). Currently, manufacturers are not investing fast enough. Regulatory attempts to incentivise uptake indicates that there may be barriers to the supply and spread of these technologies. This undermines the strength of the approach, and its ability to achieve stabilisation of global transport emissions by 2050. Secondly, the predictions do not consider factors which may offset efficiency gains, such as the effect of population growth on transport demand, or the rebound effect. People's behavioural response to gains in fuel or vehicle efficiency is to increase their car use (Greening, Greene, & Difiglio, 2000). Both these

factors will lessen the reductions gained in energy related emissions. The rebound effect is also relevant to operations management, where reduced congestion makes travelling by road more time efficient, resulting in increased impetus to travel by car and increased distances travelled (R Ewing et al., 2007). In the case of both operational and technology improvements then, the rebound effect undermines the ability of the instruments to achieve significant emissions reductions.

Even if the technological or operations approaches could achieve the short term reductions predicted, a reliance on these instruments fails to address the automobile use that is the root cause of the problem. While the IEA argues that increased efficiency can decouple rising vehicle use and resulting transport emissions enough to halt increases in CO2, decoupling is insufficient to create the drastic reductions necessary. Reliance on technological improvements to vehicles reinforces the idea that private vehicles are the best form of transport, and reinforces path dependence: the continued growth of vehicle and road based transport systems that have contributed to a significant proportion of global emissions, even when better alternatives exist (IPCC Fifth Assesment Report Working Group III et al., 2014, p. Chapter 8; Low & Astle, 2009). This desire to decouple vehicle use from emissions is driven by the economic importance of car based transport (D Banister, Pucher, & Lee-Gosselin, 2007; Williams, 2005). Operations management also does this. Not only does decoupling ignore the need to decrease emissions, but it also ignores other negative externalities of a private vehicle based transport system: noise; air pollution; congestion; increased allocation of land to roads and parking. For this reason, technological improvements and operations management should not be solely relied on to reduce the negative effects of urban transport. They may act to distract policy makers from implementing the instruments required to create the long term systematic change needed to ensure resilient and sustainable transport futures.

Demand management: A more holistic approach to unsustainable transport

Policy makers have largely focused on increased vehicle and fuel efficiency and other technological solutions as a method to reduce emissions from urban transport.

However on page 22, it was argued that this may be insufficient to reduce urban emissions to the recommended levels by 2050. Most importantly, technological solutions entrench vehicle dependence, which is the key driver of transport emissions and other negative effects. Reducing car use must therefore be the main focus of actions to address vehicle emissions. Altering people's travel behaviour through urban and transport policy changes is the key to achieving this reduction.

Pricing as a demand management tool

Altering people's travel behaviour to overcome car dependence can be achieved through the implementation of both push and pull policy instruments that move travel demand away from cars. Higher fuel pricing is a push mechanism that discourages car use, inducing greater use of alternative transport choices (Barrett, 1996; Newman, 2009). Fuel pricing can have a direct influence on travel choices. However the effect that increasing fuel price has on reducing car use is undermined by a low elasticity of demand to price rises in the short term. In the longer run, greater adjustments to levels of car use can occur.

Non-price factors that influence travel demand

Many other factors influence people's transport choices, both directly and indirectly. Socio economic and demographic factors exert the largest influence on trip rates (Ewing et al. 2007). However, controlling for these, altering urban form reduces trip rates through reduced distances and the increased convenience of other transport modes (Ewing et al. 2007). For this reason, modal substitution is widely acknowledged as a key means of reducing car trip demand. Indirectly, the locational choices of people and businesses also influence people's transport choices (Schwanen & Mokhtarian, 2005). These factors make it difficult to quantify the effect that urban form alone has on people's travel choices.

Overcoming car demand and dependence: the role of urban form and alternative transport policies

Fuel pricing alone has a limited ability to overcome car dependence in the long term as it does not increase the viability of alternative transport modes. The IPCC 5th assessment report (2014; chapters 8 and 12) instead argues that a shifting demand toward more sustainable transport must be centred on two other instruments: altering the structure of our urban forms, and re-prioritising alternative transport modes. Together, these two instruments create a strong pull mechanism to move people's travel behaviour away from car use. Both are an important step toward reversing existing car dependence.

The value of the urban form approach is that addressing transport emissions through urban planning is within the reach of city level decision makers. Urban form and infrastructure policies strike the best balance between emissions reductions, and the power decision makers have to implement them.

Given that urban form locks in existing transport patterns and related energy consumption, the IPCC 5th Assessment (2014) argues that urban form policies can have the largest impact on a cities GHG emissions. The relationship between urban form and transport is complex. As can be seen below in figure 3.2, transport patterns influence the locational behaviours of households and firms. These spatial patterns in turn influence people's travel behaviours. Alterations to urban form thus have a critical influence on people's travel behaviour (Williams, Burton, & Jenks, 2000). To make the most of this relationship, land use planning should 'include measures to reduce the need for movement, and provide favourable conditions for energy efficient and environmentally forms of transport'(Jabareen, 2006, p. 40). The strengths of altering urban form lie in the reduction of: travel

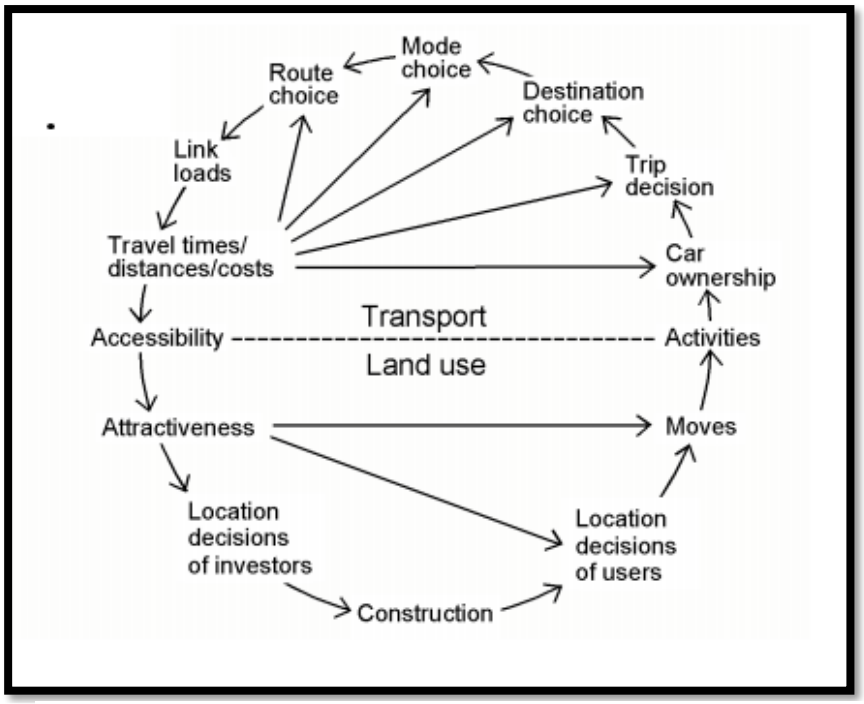

Figure 3.2 The Land-Transport Feedback Cycle (taken from M. Wegener and Furst (1999).

distances, trip times, travel demand, most specifically, car demand. One estimate is that altering urban form has the potential to reduce VKT per capita by 20-40% relative to more sprawling urban form (R Ewing et al., 2007; R. H. Ewing & Anderson, 2008).

Defining a sustainable urban form

As outlined at the beginning of this chapter, sprawling urban areas are defined by low levels of density, mixed land use activities, centrality and accessibility to key destinations and public transport stops. These factors combine to lock in car dependant travel behaviour, and are linked to many negative effects. In response to this, a variety of models of sustainable urban form have emerged. All pose a range of alternative and more holistically designed configurations of urban buildings, transport, infrastructure and amenities, with the aim of creating more sustainable and successful cities. These models include smart growth, new urbanism, compact urban form, and transit orientated development.

David Banister (2008, p. 73) provides an example of a sustainable city, as one which:

"(has a population) over 25,000 population (preferably over 50,000), with medium densities (over 40 persons per hectare), with mixed use developments, and with preference given to developments in public transport accessible corridors and near to highly public transport accessible interchanges… Settlements of this scale would also be linked together to form agglomerations of polycentric cities, with clear hierarchies that would allow a close proximity of everyday facilities and high levels of accessibility to higher order activities."

In real life however, the options available to urban planners are dependent on the local context. The existing topography, urban layout, urban size, level of development, infrastructure, and local environmental factors all dictate which changes are possible and which are ideal for the area in question (IPCC Fifth Assesment Report Working Group III et al., 2014). Other factors such as the political environment, funding, institutional capacity, market forces, and community values also influence the suitability of an option.

With this in mind, and while all models of sustainable urban form differ in their use of terminology and in their key objectives, all incorporate five elements of urban form that urban planners can implement to create more sustainable outcomes (D Banister & Anable, 2009; R Ewing et al., 2007; Jabareen, 2006; Petersen, 2004; Williams, 2005). Most succinctly known as the Five Ds (shortened to 5Ds), these elements are acknowledged to have the strongest influence on the sustainability of people's travel behaviour. The extent to which they are embodied in a city's development patterns therefore acts as a measure of the sustainability of a city's urban form and transport. Ewing et al. (2007) estimate that CO-2 reduction is equal to 95% of VKT reductions in compact developments. Thus, if a cities VKTs were reduced by 30%, there would be corresponding CO-2 savings of 28% (R Ewing et al., 2007).

Introducing the 5Ds

Density

Density refers to the population size of a given urban area. It can measured in a variety of ways, however the most common are people or dwellings per unit area. Density exerts the strongest influence on travel behaviour and energy consumption in the transport sector (P. Newman & Kenworthy, 1989). While there is some debate about the exact magnitude, it is agreed that density has a significant inverse relationship with VKT per capita (P. Newman & Kenworthy, 1989). One estimate is that 82% of the difference in global car use rates can be attributed to differences in density (J. Kenworthy & Laube, 2001). Controlling for all other variables, a higher density can generate up to 40% less VKT per capita than one on the lower end of the scale. A 50% increase in density can reduce VKTs by 25-30% (Reid. Ewing, 1997). Density also has a significant inverse relationship with vehicle ownership rates, traffic fatalities, and maximum ozone levels.

This relationship is the product of multiple factors. Firstly, increased density reduces travel distances between destinations, directly reducing energy consumption and transport emissions from car trips. Given that there is almost a 1:1 ratio of carbon savings for each VKT, these direct savings are significant.

More importantly however, increased density enables people to make more sustainable transport mode decisions, reducing the modal share of cars. It has the most significant positive relationship with modal share of both public transport and walking. This can be attributed to two factors:

Firstly, the reduced travel times that come with reduced distances between destinations, increases the ease with which destinations can be reached by walking, cycling or public transport. This helps close the ‘convenience gap’ that people perceive between travelling by car and by alternative transport modes, particularly walking/cycling, making sustainable transport more feasible. The increased ease with

which people can travel by sustainable modes induces a behavioural shift away from car use, and away from car ownership as mentioned above (Talen, 2011).

Secondly, density is the most important factor in increasing public transport use. The higher the density in areas near to public transport stops, the higher ridership levels are. As population size in a given area therefore determines the level of demand for a transport service, density is a key consideration of transport providers when calculating the quantity of public transport to provide (Newman, 2009). If the population cannot sustain a demand that ensures the companies' margins, the service will not be provided. Arguably then, if spatial planning is to support an increased modal share of public transport and a reduction in car dependence, it should support higher densities.

It is important to note that there is debate about whether the influence that density has on travel behaviour is due to density itself, or factors that co-exist with increased density, such as increased public transport, or the disincentive of limited parking (Ewing et al., 2007).

What densities are optimal?

The optimal density for new development is highly dependent on the existing urban context. High densities often fail to gain political support, especially in smaller cities as it is often perceived to be inconsistent with the existing areas character, or the preferences of buyers in the local housing market (Robert Cervero & Guerra, 2011). As such, the choice of density must be informed by the wishes of the community.

In saying this, densities must be high enough to induce significant VKT reductions if they are to contribute to sustainable urban outcomes. Planning the density of new development must therefore ensure a balance between what is in-keeping with existing urban form and what is necessary for sustainable transport. Exactly what minimum density is required to achieve this is subject to uncertainty, in part due to inconsistent measurement of density across the literature: residential, population,

and activity density are all used, and density is also reported in both gross and net. Authors such as Newman (2007) state that 35 or more people and jobs per hectare (Ha) in local neighbourhood centres is necessary to induce a rapid decrease in VKT per capita (see figure 3.3 below). Other studies argue that net density anywhere between 15-50 households/Ha can achieve significant reductions (Steuteville, Langdon, & Contributors, 2006). Household measures are confounded by the differences in average household size across regions, making it harder to apply.

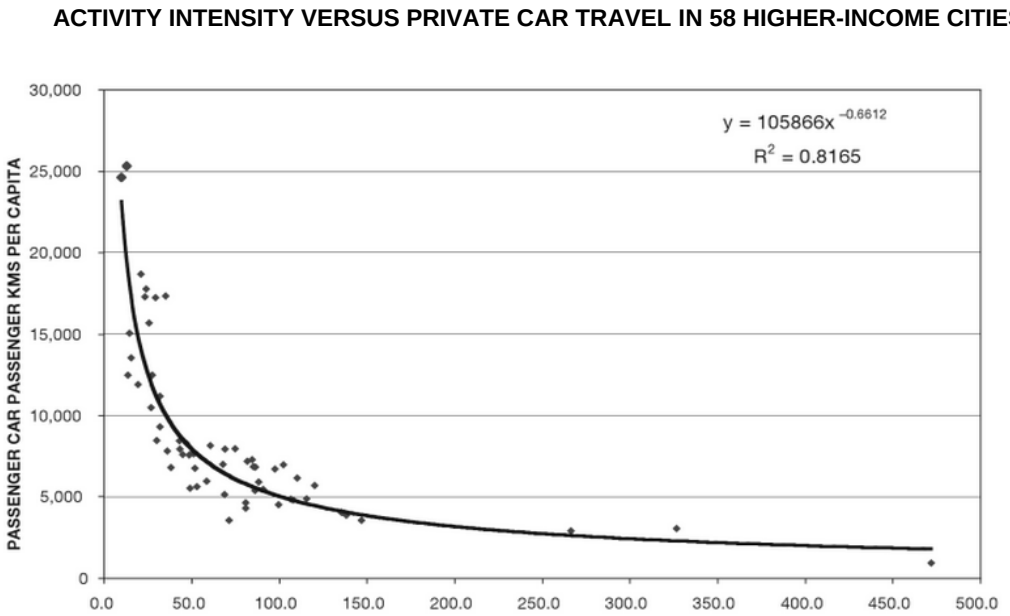

Figure 3.3 Activity intensity versus passenger car use in 58 higher-income cities. Taken from Newman (2007).

In order to support the viability of public transport services, it has been argued that densities should be 35 people/Ha, or 6-7 dwellings per acre at minimum (requiring 13 dwellings/Ha at New Zealand's average household size of 2.7 people)(R Ewing et al., 2002; Newman, 2007). This density also supports small neighbourhood shops and schools. Auckland Regional Council found that to support a public bus route, a gross residential density of 20 households per hectare (HH/Ha) within 800m (10 minute walk) of public transport is necessary (Auckland Regional Council, 1999, p. Appendix H). This is roughly equivalent to 50 people/Ha. To support a light rail system, Robert Cervero and Guerra (2011) found that 30 people per acre (74 people/Ha) around railway stations were required.

However it is often perceived that increased density means uniformly multi storey apartment style developments. This is not the case. Density is not synonymous with housing typology, and models of sustainable urban form such as compact development highlight the importance of mixed housing types to achieve 'higher average blended density' (R Ewing et al., 2007). Vancouver for example, has implemented approaches such as invisible (additional dwellings within an existing house), hidden (additional dwellings on a single unit title), and gentle densities (new townhouses, apartments in existing commercial buildings for example) to increase overall density within existing urban and suburban areas, without altering existing amenity and character values (Johns, 2013).

Diversity

Ensuring that a diverse mix of land use activities such as retail, services, education, employment, and residential are all provided within closer proximity of each other can significantly reduce VKT. This is based on the premise that people like to maximise the amount of activities available to them within a given travel time. There are three interlinked mechanisms through which mixed use areas reduce travel: by providing activities at closer and more convenient locations, which captures people who may otherwise travel further to access that activity; by reducing travel distance and duration between origin and destination points; and by inducing people to use alterative transport modes (Robert Cervero & Duncan, 2006). The reduction in trip lengths between activities reduces VKT. Shorter distances can also increase the modal share of walking up to and above 20%, and encourage cycling, reducing VKTs further (R Ewing et al., 2007). The level of mix in a given area also has the largest influence (after density) on public transport ridership levels, and car ownership levels. Creating diversity at both ends of people's daily trips i.e. in both residential areas and activity centres is therefore crucial to inducing more sustainable transport choices.

Diversity can be separated into two categories: job-housing balance, and retail-housing mix (Robert Cervero & Duncan, 2006). This separates two key reasons behind

most daily trips (work, and buying goods), and their different effects on VKT. Increasing the amount of shopping (such as grocery stores) and other services in residential areas can reduce the use of cars for shopping by over 25%, through reduced travel distance, and increased accessibility by foot, cycle or public transport. The presence of shops within 90m of residences may also be linked to an increase in commuting by foot, cycle, or public transport.[2] Increasing the 'job-housing balance' has a larger influence on VKT however, because commuting makes up the majority of people's daily travel distance. Increasing job-housing balance primarily means creating higher proximity between jobs and housing. This creates shorter commute distances and reduced VKTs. Shorter distances also induce modal shifts. As seen below in figure 3.4 the probability that people will commute by walking or cycling increases as distance decreases. Another aspect of job-housing balance is increasing the ratio between people and jobs within a given area, to curb the number of people commuting further out for work. Both these factors ensure a reduction in people's commuting distances and car use, and can reduce VKT by more than 15% (Robert Cervero & Duncan, 2006). Optimally, jobs and housing should be within 4 miles (around 6.5 km) of each other to achieve this (Robert Cervero & Duncan, 2006).

[2] If shops are more than 90m away, Cervero argues that people chose to commute by car, and combine activities by shopping on the way to or from home (trip chaining)(R. Cervero, 1996).

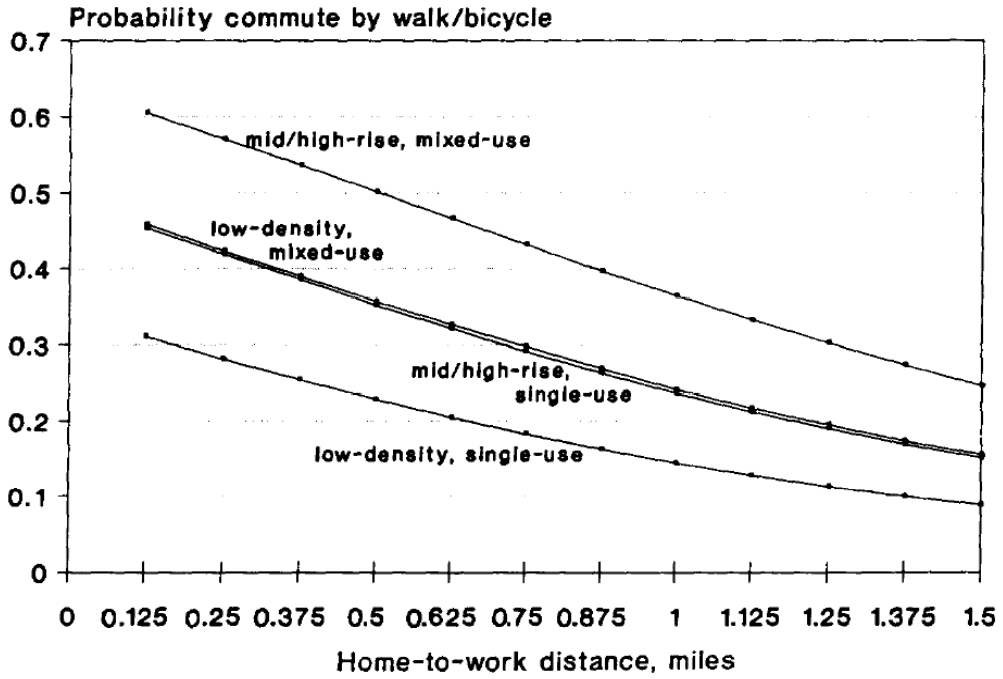

Figure 3.4. Probability of commuting by walking or bicycling for four land-use scenarios, as a function of commute distance. Taken from Cervero (1996)

Design

The design of street networks influences people's travel behaviour and patterns. Within the context of sustainable transport, good design is measured by the interconnectedness of roads, and by the extent to which the transport network is pedestrian and cycle orientated. This is measured using a range of variables such as pedestrian crossings, footpath covers, and the presence of trees (R. H. Ewing & Anderson, 2008).

Destination accessibility

The concept of accessibility is multi-faceted, and its meaning diverges across different fields of study.[3] In its basic form, it consists of two different aspects:

[3] Traditional transport planning for example views accessibility as a factor of congestion and speed in the road network. Easing congestion and increasing travel speeds are prescribed to increase accessibility. Urban planning on the other hand considers accessibility to be a factor of the spatial distribution of destinations. Social studies consider the impacts of urban layouts on people with

1. Destination accessibility: the *number of opportunities* (jobs, education, shops, healthcare etc.) that can be reached within a given travel time

2. Origin/user accessibility: *the ease of reaching* a range of opportunities within a given travel time. (R Ewing et al., 2007; Halden, 2002)

Both aspects; the accessibility *of* a destination, and ease of access *to* a destination, are important to achieving accessibility. When quantifying the concept, the two are measured separately but are equally relevant to the overall level of accessibility an urban system presents. Both are encompassed under the definition of destination accessibility in this thesis.

The aim of accessibility is therefore to maximise the amount of opportunities available within a given travel time from people's homes, and within a given travel time between other destinations. Achieving this is factor of the three elements of accessibility: opportunity demand, opportunity supply; and the supply of transport that links opportunities (Halden, 2002). By manipulating both the location of residences and opportunities and the spatial arrangement of transport routes that connect them, planning can increase accessibility to meet people's opportunity demand.

Enhancing destination accessibility should arguably be the overarching objective when planning for urban sustainability. It has the strongest potential of all the 5Ds to integrate urban form and transport, and enhance sustainable transport behaviour. The other four Ds and integration can almost be considered a means to the end goal of accessibility.

Accessibility then, aims to reduce average travel time, based on the idea that people's access to opportunities is limited by this factor. However, theories of fixed

limited mobility. See (Geurs & Van Wee, 2004) for an overview of different understandings of accessibility.

travel time budgets, such as Zahavi's hypothesis or Marchetti's Constant, may undermine the influence that reducing travel time will have on people's behaviour. Zahavi argued that people's travel decisions are driven not by a desire to minimize travel time (and cost), but to maximize the opportunities available to them within a fixed time and cost budget of around one hour (Michael Wegener, 2004). Thus, as travel speed increases, a person will respond by travelling further (under a desire to maximize their opportunities) rather than reducing their travel time. This suggests that reducing travel time may not induce people to travel less by car. On the other hand, some authors including Newman (2007) argue that fixed time budgets are compatible with reduced car travel, by ensuring accessing opportunities using alternative modes such as rail and buses is time competitive with cars.

Reducing distances between opportunities through increased density and proximity of opportunities would further contribute to this effect. However fixed travel time budgets present a highly homogenised picture of people's travel behaviour. Some authors have argued that when disaggregated to more local levels (Zahavi's findings were based on a global average), travel time is highly variable, responding to activity type and socio economic factors (Iragaël., 2004) Arguably, people's decisions about travel time are also influenced by a wide range of factors that differ from person to person. While the concept of fixed travel-time budgets may give some insight into planning for accessibility, it has limited applicability when predicting people's behavioural responses to increased accessibility.

Accessibility and sustainability

It is important to note that increasing accessibility does not lead to sustainable outcomes by default. Under traditional transport planning, accessibility is viewed as a factor of capacity and travel speed in the road network. Easing congestion and increasing travel speeds are therefore prescribed to increase accessibility to dispersed destinations, ensuring they can be reached within a reduced travel time. Under this paradigm, while accessibility is increased and meets demand, it also

increases VKT, emissions, and land consumption: in other words, it produces unsustainable outcomes.

In the context of urban sustainability then, accessibility must maximise ease of access, while ensuring the negative effects of transport: high energy use, VKT, emissions, and land consumption, are minimised. Accessibility as a sustainable planning objective could thus be defined as:

The ease with which people can reach a variety of opportunities within a given travel time using more sustainable modes such as public transport, walking, or cycling.[4]

Sustainable accessibility is therefore best achieved through increasing the supply of public transport, walking and cycling infrastructure and services to connect a range of destinations. This allows people to access activities easily while reducing the modal share of private vehicles, and related GHG emissions. Routes from residences to destinations and between destinations must be well linked using alternative modes to ensure each stage of a trip is viable without the use of a car. The level of accessibility from residences to activities influences the destinations people choose, the mode of travel they choose to take, and the frequency of trips taken from home to destinations (R Ewing et al., 2007) Increased accessibility between destinations allows people to meet multiple needs on single trips (trip chaining). This reduces the distance travelled and travel time. Ensuring accessibility in both these stages of the journey thus creates more sustainable travel behaviour. Altering transport particularly increases origin or user accessibility.

While altering the transport system is critical to inducing more sustainable travel behaviour, the 5Ds demonstrate that transport changes can only succeed if the layout of land uses is also altered (Halden, 2002). Referring back to the definition of

[4] This definition is the authors own, and is also based on the definitions of: The Councillor's Guide to Urban Design, CABE, 2004 (https://www.selwyn.govt.nz/__data/assets/pdf_file/0008/9836/Appendices.pdf); Dittmar and Ohland 2003 referenced in Talen 2011; Bertolini et al. 2005; Geurs and van Wee 2004.

accessibility, a key aspect is maximising the amount of destinations available within a given travel time. This increases the supply of opportunities. If the spatial distribution of opportunities remains sprawling while being increasingly connected by alternative transport modes, travel times between activities will increase. This fails to meet the key criteria of accessibility: 'within a given travel time'. To address this, the proximity, concentration, and mix of opportunities within a given spatial area must be increased to make travel between them by alternative modes time-competitive with cars. Altering the spatial distribution of opportunities particularly supports destination accessibility.

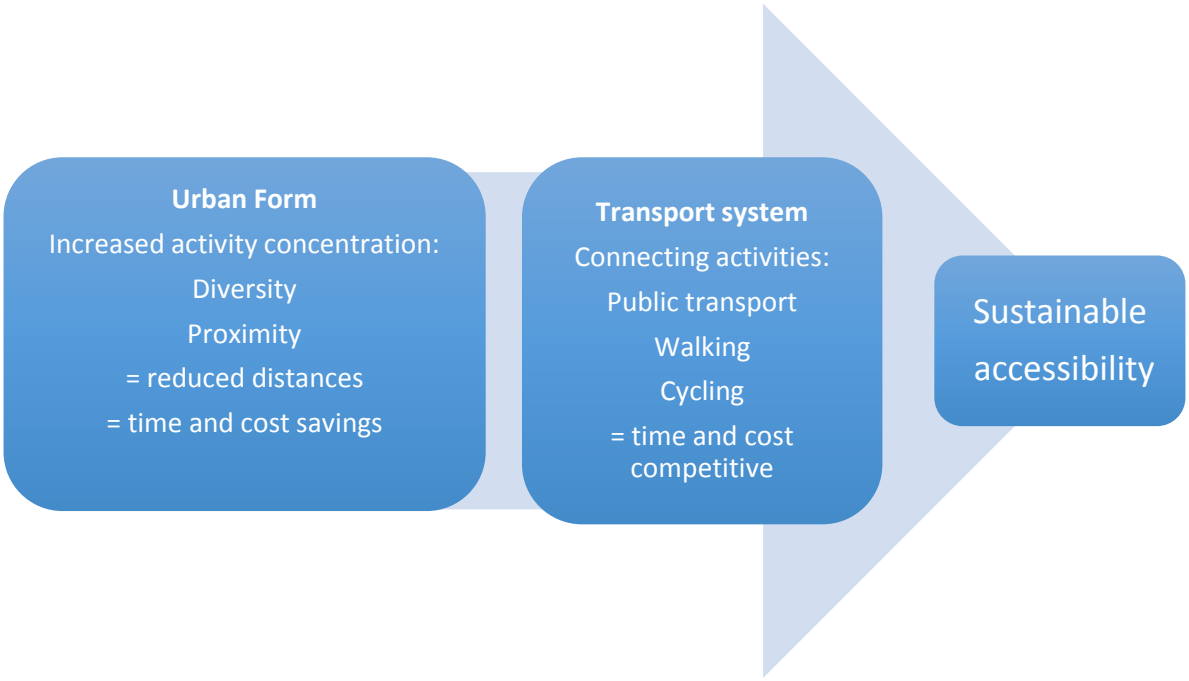

Figure 3.5 Elements of urban form and transport that increase sustainable accessibility

Distance to transit

As outlined above, altering urban form to increase accessibility will not reduce car use or energy consumption unless alternative transport modes are also easily accessible and are time competitive with cars. The distance from home or work to rail stations and bus stops therefore has a strong influence on the likelihood of public transport use. Ensuring public transport stops are within a walkable distance from both home and workplaces is necessary to shift people away from car use. Distance

to transit is measured as the distance from home or work to the nearest station, using the shortest street route. Studies have found that the maximum distances are between 400-800m (around 10-20 minutes) after which people become less willing to walk, discouraging use of public transport (Abeles Phillips Preiss & Shapiro Inc, 2002).

Good public transport in turn influence people's residential location. Studies have found that when people work in central activity areas which are well serviced by public transport routes, they are likely to choose residential locations which enable them to take that public transport to work. This has strong implications for the location of future residential development in urban areas, as it indicates that there is demand for locations close to public transport stops. In Wellington, 30% of workers commute from peripheral urban areas of Porirua, Kapiti, and the Hutt into central Wellington City, a location that is well serviced by public transport. Locating new residential development in these areas near public transport stops will build on the existing demand for public transport.

Tying it together

Each element of the 5Ds influences different aspects of transport patterns, and in turn influence the success of each other. It is therefore important to incorporate all five elements in development patterns, to ensure sustainable transport outcomes are achievable.

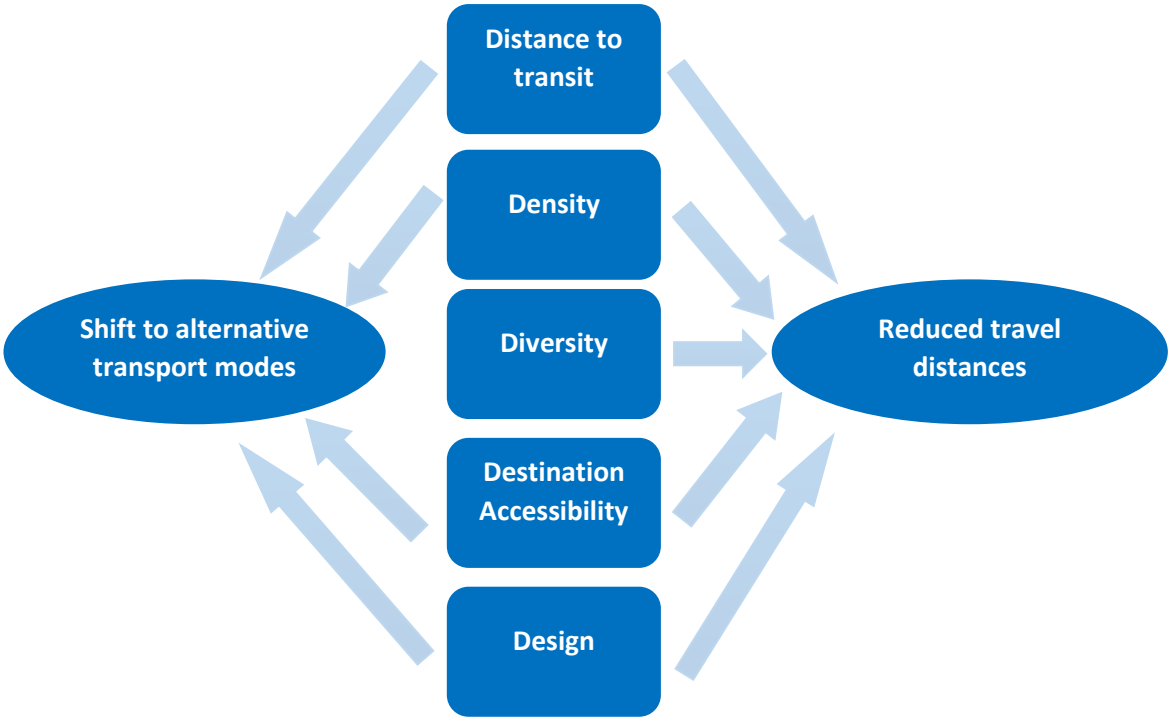

Figure 3.6 The mechanisms by which the 5Ds induce more sustainable travel

Critical elements of a sustainable transport system

While we have previously discussed the impact of urban form on travel, transport infrastructure is a driver of both transport behaviour and urban form. The development of transport infrastructure, especially additional roading, increases travel demand, car use, and associated emissions. A doubling of transport infrastructure capacity leads to a minimum increase of 10-20% of VKTs in the short term (IPCC Fifth Assesment Report Working Group III et al., 2014, p. 38 of Chapter 12). In the long term, additional roading can increase VKTs by 80-100%, as the additional capacity influences people's locational decisions. This locks in the rising travel demand and emissions (IPCC Fifth Assesment Report Working Group III et al., 2014, p. 38 of Chapter 12). In order to achieve sustainable outcomes, transport infrastructure must be re-structured to reduce travel distances and car demand. This will occur through the prioritisation of public transport and walking and cycling infrastructure over roading, which acts as a pull mechanism, providing people with alternatives to driving and inducing them switch. These transport policy approaches must occur alongside re-structuring of urban form to reduce travel distances. Longer

distances encourage car use and will continue to act as a barrier to walking and cycling, and public transport.

Summary

Increasing the sustainability of transport is one of the most important aspects of achieving greater urban sustainability and resilience. While there are a range of approaches to create more sustainable urban transport, implementing the 5Ds of sustainable urban form in spatial planning is one of the best long term solutions. The 5D elements exert a strong influence on people's travel behaviour within urban environments by reducing distances and the need to travel by car, and inducing a shift to alternative transport modes. Arguably then, urban planning in New Zealand should incorporate and consider the 5Ds when assessing development approaches for the coming decades.

Chapter 4: The evolving approach to spatial planning in New Zealand

Since 1991, planning of land use and development in New Zealand has occurred under the Resource Management Act 1991 (the RMA 1991). The main purpose of the RMA is to promote the sustainable management of natural and physical resources through regulating the potential adverse environmental effects of proposed development activities in order to avoid, remedy or mitigate its adverse effects (RMA 1991: Part 2, Section 5). This effects-based planning approach was considered by policy makers as the best way to manage the interconnected and complex nature of the potential environmental effects of a development proposal. Furthermore, it was considered more suitable than a development-based approach to regulating environmental effects, as controlling the nature of physical developments directly may have constrained market based innovations and approaches to development (N.J. Eriksen, Berke, Crawford, & Dixon, 2003). The RMA can therefore be seen as a permissive piece of legislation, which allows an activity to occur as long as it does not exceed set environmental limits.

However the ability of the RMA to manage environmental effects holistically is limited under this permissive approach. In particular, case by case decision making about resource consents at the local and regional levels makes it difficult to plan for development patterns holistically, or assess the long term effects that development will have on the environment. What results is fragmented patterns of land use and infrastructure that create negative environmental externalities and make integrated management difficult. Urban sprawl is a classic example of the impact that case by case decision making can have on the environment over time.

In recognition of the impact that sprawling urban development patterns are having on the environment, and the recognition that growing urban populations will place increased demand on urban development in the coming decades, policy makers and

planners began to look to alternative, more long term focused models of urban planning in the 1990s (Albrechts 2004). Strategic spatial planning aims to create a strategic vision of future urban form, which informs development over several decades. It is defined as 'a high level plan that shows the arrangement of land-use types, and identifies public infrastructure, such as streets, schools, rail, reservoirs, and natural features' (Boffa Miskell 2014b). By nature then, it is integrated, aiming to consider all elements of urban form alongside each other. By creating a high level blueprint of future urban layout based on community and stakeholder consultation, strategic planning attempts to avoid the effects of case by case decision making made under existing planning regimes. Strategic planning therefore provides an opportunity for cities to plan for future transport layouts alongside housing development in order to reduce car dependence and support a more sustainable urban form.

Chapter 5: A case study of the Porirua city Northern Growth Area Structure Plan 2014 - the urban context and the planning process

Introduction

As seen in the previous chapter, strategic spatial planning provides a strong forum in which to ensure urban form supports sustainable transport. In 2014, the council of Porirua city, a satellite town located to the north of Wellington, New Zealand adopted a strategic approach to urban planning, and developed a strategic spatial plan to manage urban growth over the next thirty years in consultation with expert stakeholders and the wider public the plan aimed to ensure new housing development within the cities Northern Growth Area (NGA) was 'sustainable, coordinated, and integrated'. In order to achieve this, the plan set out guidance on the location, nature, and density of development. Given the goal of sustainability and the extent to which housing location and density influences transport choices, the decisions made in the planning process will influence the sustainability of local transport behaviour within the NGA in future. By way of context, this chapter describes Porirua's existing urban form before outlining the planning process methodology.

Porirua: the urban context

Historic urban development patterns in Porirua

Porirua, population size 54,100[5], is one of four cities that make up the Wellington region in the lower North Island. Following historic patterns of urban development in the area, Porirua has become a classic example of car based urban form. The development of the railway line linking Porirua to Wellington in the 1880s signaled an outward migration of people from the capital city to the area, first as a rural holiday destination, and later as a permanent place of residence over the later decades of the 19th century. Early on, settlement in the area was dispersed around the Porirua harbour. Following the rise of car travel in the 1920s and 1930s, the creation of sealed roads connected these settlements, allowing Porirua's urban development to become further dispersed.

The most substantial growth, however, occurred in the 1950s and 1960s. Post war housing shortages in Wellington city during the late 1940s spurred the first Labour government to develop Porirua as a dormitory city.[6] Central government created a detailed blueprint for the development based on Ebenezer Howard's Garden City model and the related New Town model of urban form. In response to the perceived moral decay that was resulting from inner city life, both models advocated the creation of low density towns on the outskirts of larger cities. In Porirua this took the form of a retail based town centre at the southern end of Porirua harbour, commercial and industrial zones to provide employment for new residents, and large low density suburbs of state housing in the hills surrounding this centre, as seen in Figure 5.1 below.[7] This new satellite city was linked to Wellington by a new motorway alongside the rail line, to allow for commuting by car. While early development in Porirua was therefore located around the railway, from the 1920s the rise of cheap car travel and roading led to widely dispersed and low density development patterns.

[5]http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/SubnationalPopulationEstimates_HOTPAt30Jun14.aspx

[6] http://www.pcc.govt.nz/About-Porirua/Porirua-s-heritage/Porirua-s-suburbs/Porirua-City-Centre--Elsdon-and-Takapuwahia/History-of-Porirua-City-Centre

[7] http://www.teara.govt.nz/en/city-planning/page-2; http://www.tandfonline.com/doi/pdf/10.1080/026654399364193

Figure 5.1 Aerial photograph of Porirua City Centre development May 5th 1962. Town centre in middle, low density suburb of Elsdon on the left, and Mungavin on the right. The motorway and railway run down the right side of the harbour and town centre, connecting Porirua to Wellington to the south. (Photo from Pataka Museum Collection at Porirua Library. Taken from Porirua City Council website)

Development of new suburbs has occurred in more recent decades on the eastern and northern hills, which are separated from the town centre and the western suburbs by the motorway and train line. This separation makes it difficult to travel directly between east and west suburbs in the city. The large distances across which the suburbs are spread, and the distances between the key retail centres and residential areas also hinders connections. Travel within the city is therefore largely car based. As a result of historic development patterns, Porirua is now a low density

[8] : (http://www.pcc.govt.nz/About-Porirua/Porirua-s-heritage/Porirua-s-suburbs/Porirua-City-Centre--Elsdon-and-Takapuwahia/Historic-Photos-of-Porirua-City-Centre).

dispersed city and fits within the literature's model of car dependent urban form (Newman and Kenworthy, 1989).

Existing urban form in the study area: opportunities for and constraints on implementing sustainable urban form elements

In recent years Porirua City Council has developed structure plans for several suburbs across the city in an attempt to coordinate urban development. The NGA Structure Plan covers the largest tract of land so far: as seen in Figure 2, the area consists of three suburbs – Mana, Plimmerton, and Camborne to the south, and peripheral land in Pukerua Bay in the north, with a large tract of rural land between. Urban form varies from suburb to suburb as a result of historical development patterns and varying topography across the area.

Porirua has an average population density of 266.1 people/km2, far higher than the national average of 14.9 people/km2.[9] However, it has an average population density of 2.96 people/Ha, far below that required to reduce VKTs or increase public transport ridership levels.[10] In the Northern Growth Area suburbs, Cambourne/Mana suburbs have a combined population density of 16.86 people/Ha. This equates to 5.4 households/Ha. Plimmerton suburb has a population density of 9.1 people/Ha, or 2.9 households/Ha.[11] These are also far below densities required for reduced car use and public ridership. These existing densities may present a constraint to density increases in future, due to the difficulties of constructing within existing suburbs.

Mana

[9] file:///C:/Users/reidp1/Downloads/Quarterly%20Report%20March%202008.pdf : 13
[10] http://profile.idnz.co.nz/porirua
[11] Based on authors own estimated density calculations using population statistics from http://profile.idnz.co.nz/porirua/about/?WebID=230, and hand drawn meshblocks from http://www.freemaptools.com/area-calculator.htm.

As seen in Figure 5.2, Mana is situated on the narrow and predominantly flat strip of land between Porirua Harbour and Pauatahanui inlet. The highest elevation point in the suburb is around 50m above sea level.

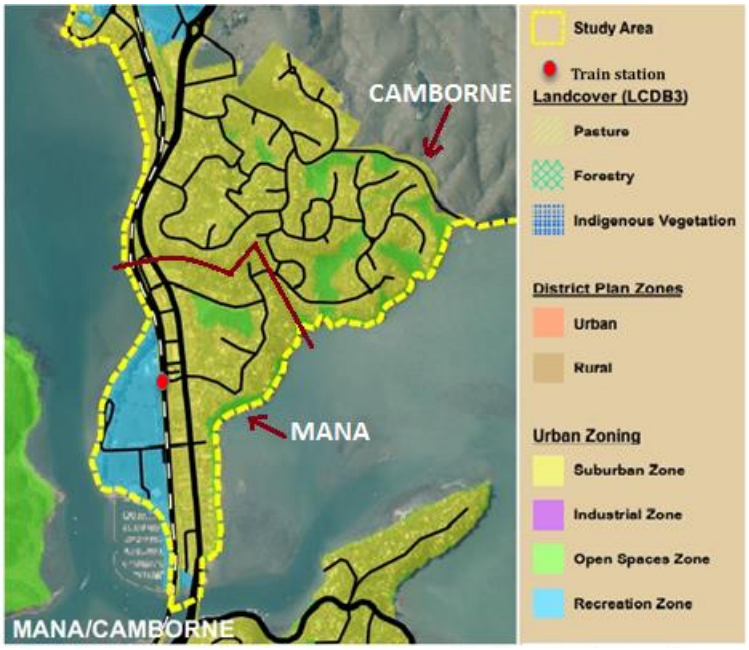

Figure 5.2. The suburbs of Mana and Camborne situated at the southern end of the NGA (map adapted from Boffa Miskell 2014).

Development is situated down either side of a main road, and is mainly residential. A commercial centre (seen in figure 3) is located on the west side of SH1. It includes a supermarket, restaurants and retail stores. A railway line runs down the west side of Mana, parallel to the main road. A train station is located on the southern outskirts of the commercial centre.

Figure 5.3. Shopping area zone in Mana (map adapted from PCC GIS maps

Of the four suburbs in the NGA, Mana performs the best against the 5D criteria. As can be seen in Table 5.1 below, the longest distance from within the suburb to the train station is just over 800m.[12] This is on the upper limit of the 800m/10 minute distance required to encourage public transport ridership. Similarly, destination accessibility in Mana is good. The shopping zone is within 800m of the suburb's outer border. Except for the main road, most of Mana's land use is only residential. In this sense it does not have highly diverse land uses. However along the whole length of the main road there is a mix of residential, commercial, and retail land uses even outside the shopping zone. Furthermore there are many recreation zones

[12] Measured from the top of Mana View Road (the furthest point from the train station) to the train station, following the street.

within walking distance of residences in Mana: as well as the official recreation space seen in figure 5.2, the inlet and marina areas are popular for swimming and other activities. Mana is therefore within the parameters recommended in the literature to induce more sustainable transport behaviour. Density, however, presents a challenge. Based on the figures in table 5.1 for Mana/Camborne, density is below that suggested for reduced VKT and public transport use. However the accuracy of this calculation is made difficult by the combined population count for the two suburbs, as well as the inclusion of open land within the suburb boundaries which lowers the density count. As Mana is more built up and has a wider range of housing types, it has a higher operative density than Camborne.

Given Mana's performance against the 5D criteria, locating new housing in this suburb would induce more sustainable transport outcomes through increased density, proximity to the train station, and proximity to amenities and recreation which would reduce the need to drive. However development in Mana is subject to physical constraints. Much of it is at risk of high ground shaking during an earthquake. The area covering the Ngatitoa Domain and the east side of the main road in Mana is below 2m above average sea level and is therefore at risk of 'worst case' storm surges and tsunamis. These factors may limit development potential in closest proximity to the train station and shopping zone.

Table 5.1. 5D statistics for Mana

Urban form statistics	Mana	5D criteria*
Population size *Mana/Camborne combined* (2013)	2,553	n/a
Land area	0.630 km^2	n/a

Mana/Camborne combined (estimate)		
Population density *Mana/Camborne combined* (people/ha)	16.86 (or approx. 5 households/ha)	To reduce VKT: 35 To ensure public transport viability: 20 households/ha within 800m of PT stop
Diversity of land use	high	high
Distance to a public transport stop	823m from furthest point	<800m walking distance
Destination accessibility	<800m to shopping centre	<800m/10 minute walk to amenities

Camborne

Camborne is situated on the hill to the north and east of Mana, with Plimmerton to its north. It covers almost twice the area of Mana, and its land use is entirely zoned as a suburb. Housing is standalone residential. There no commercial, retail, or public amenities in the suburb apart from open space reserves. There are also no public transport routes in the suburb. In order to access amenities and public transport stops, residents travel to either Mana or Plimmerton.

Table 5.2. 5D statistics for Camborne

Urban form statistics	Camborne	5D criteria
Population size *Mana/Camborne combined* (2013)	2, 553	n/a
Land area	0.960 km^2	n/a

Mana/Camborne combined (estimate)		
Population density *Mana/Camborne combined* (people/ha)	16.86	To reduce VKT: 35 To ensure public transport viability: 20 households/Ha within 800m of PT stop
Diversity of land use	low	high
Distance to a public transport stop	unknown	<800m walking distance
Destination accessibility	unknown	<800m/10minute walk to amenities

Camborne therefore performs worse against the 5D criteria, as can be seen in table 5.2. Distance to transport is above 800m. Distance to amenities also exceeds that which induces walking and cycling. Further to this, the slope of Camborne is a constraint on walking and cycling uphill. As a result of these factors, Camborne's current urban form does not induce sustainable transport choices.

Plimmerton

Plimmerton is a long and narrow coastal suburb, fenced in by steep hills behind. It consists of standalone housing, and a small town centre. Plimmerton's largest phase of residential growth occurred as a result of the opening of the Wellington-Manawatu railway line in the 1880s. As a result of this development pattern, its town centre is based next to the train station. It consists of food outlets, a school, and other retail. Due to the proximity of the station to residences in the suburb, Plimmerton also has the highest train ridership rate in Porirua. More than half of the Plimmerton population travel outside Porirua for work.

Table 5.3. 5D statistics for Plimmerton

Urban form statistics	Plimmerton	5D criteria
Population size *Plimmerton* (2013)	2,115	n/a
Land area *Mana/Camborne combined* (estimate)	0.960 km2	n/a
Population density *Mana/Camborne combined* (people/ha)	16.86	To reduce VKT: 35 To ensure public transport viability: 20 households/Ha within 800m of PT stop
Diversity of land use	medium	high
Distance to a public transport stop	furthest point	<800m walking distance
Destination accessibility	to shopping centre	<800m/10minute walk to amenities

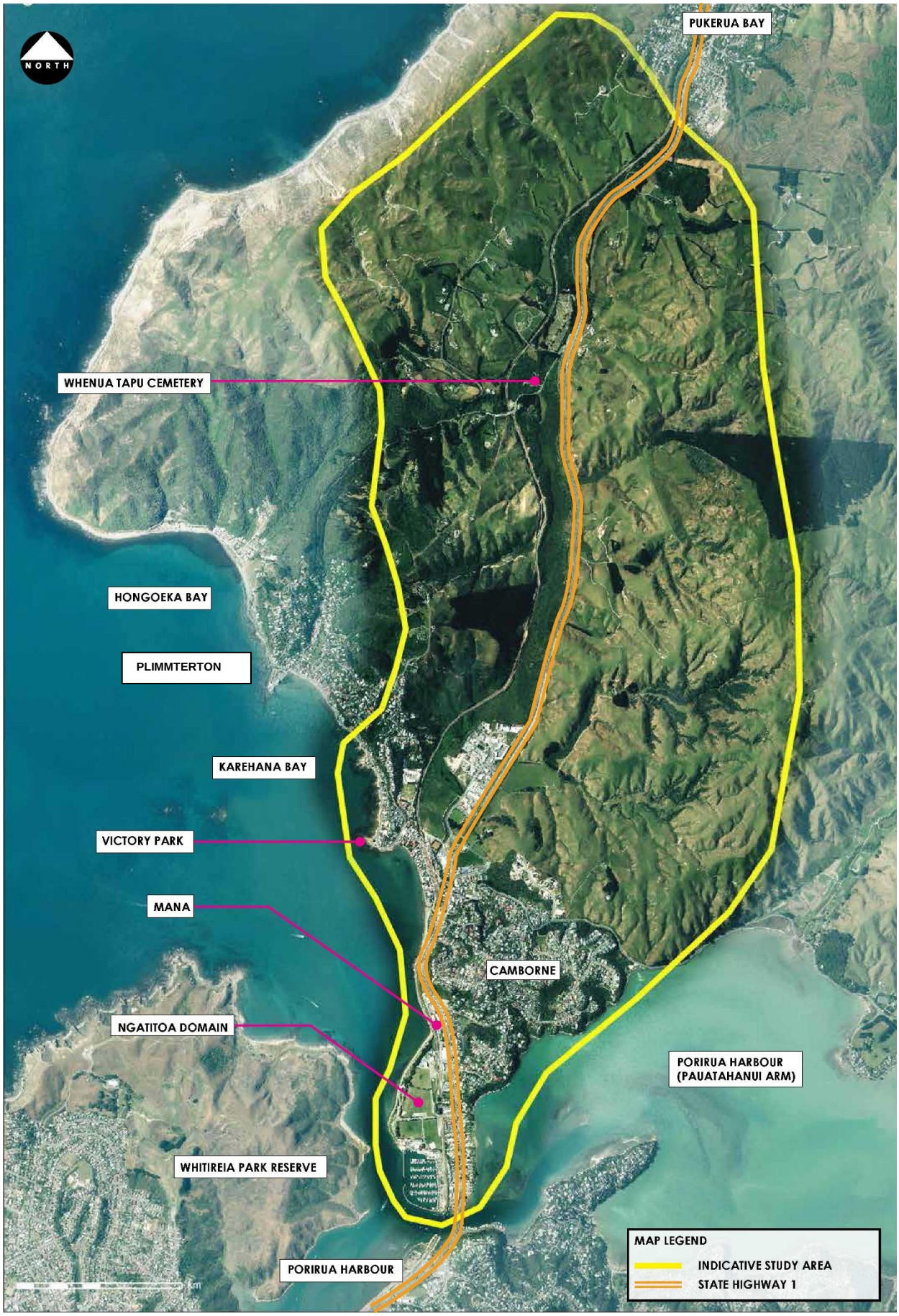

Figure 5.4 The Northern Growth Area. Note the location of Mana, Plimmerton, Camborne and Pukerua Bay relative to the road (orange) and railway (west of road) networks

Transport opportunities

There are several opportunities within the existing transport system to encourage more sustainable travel patterns. Presently, the NGA's transport network consists of a central spine running from north to south through the middle of the area, as can be seen in figure 5.5 below. Residential areas are located on either side of the spine. As well as the four lane state highway 1, the spine consists of an electric railway line with regular passenger services up and down the region, and a walking/cycling track. All three run parallel to each other. The railway is serviced by three stations at Mana, Plimmerton and Pukerua Bay. Branching off the central road spine are collector roads which provide access to the local residential streets. These collector roads and local streets have footpaths but no designated cycle lanes.

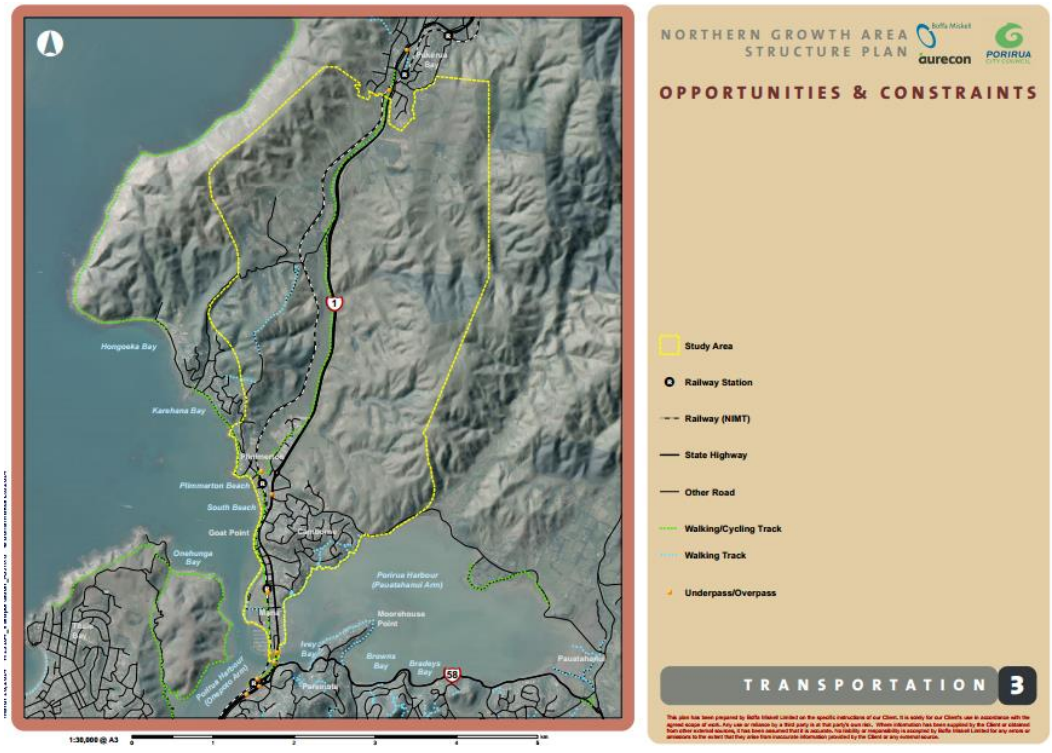

Figure 5.5 The transportation network in the NGA

Public transport

The central railway presents a major opportunity to increase sustainable travel behaviour in the NGA. Train ridership levels in the NGA suburbs are already the highest in Porirua City; around 20% of residents commute by train (Boffa Miskell Ltd & Aurecon Ltd, 2014). This high ridership is primarily attributed to the proximity of residential areas to the three train stations. However, good park and ride facilities also allow for people living further than walking distance to access the train easily, supporting high ridership levels. Lastly, traffic congestion and distance to Wellington are likely both factors in people's decision to commute by train. While ridership levels are high in the NGA, the Greater Wellington Regional Council identified that there is still sufficient capacity in the train service to provide for additional population growth in the area. Park and ride services would need to be increased. This presents an opportunity to ensure future development supports increased train ridership. Given the role that proximity has played in existing ridership levels, locating new development within walking or cycling distance of the three train stations would allow new residents to utilise the train service in the area, while minimizing additional pressure on the road network.

THE TRANSMISSION GULLY PROJECT

Transmission Gully 2014-2020 is one of eight major roading projects along the Northern Road Corridor in Greater Wellington region. Together they are designed to streamline traffic flow and reduce travel time between the key urban centres. These projects are part of the wider Roads of National Significance (RoNS) programme being implemented by NZTA, under which state highways are being streamlined to reduce congestion, increase safety, and reduce travel times between major urban centres.

There is no bus service in the NGA. The viability of bus services is determined by the customer base, defined by population size, density and distance from bus stations. The current population size and densities and distances in the NGA suburbs do not support a bus route.

The lack of a bus service in the NGA constrains people's' access to existing public transport stops, and could be an issue for servicing future development areas.

The road system

The current road system presents a challenge for future urban development. State Highway 1 which runs through the central spine of the NGA, is New Zealand's main national road. As such it has a high traffic count: the NGA's northern SH1 section from Pukerua to Mana currently carries around 24,000 vehicles per day, while the south section running through Mana carries around 35,000. The additional 11,000 vehicles through the Mana section is likely generated by local traffic travelling between Camborne/Mana and Porirua/Wellington. This level of traffic places a significant amount of pressure on the NGA's transport system. Intersections of the SH1 and collector roads are busy, particularly during peak hours. As a result, some NZTA stakeholders have argued that the increased traffic flows generated by population growth in the area may exceed the safe capacity of SH1 intersections, particularly those which turn off into the main suburban collector roads.

The presence of SH1 presents a further challenge to planning urban development, as rules governing designated state highways state that no roads can be directly connected to a state highway. While much of the NGA area is bare land on either side of the motorway and is therefore open for investigation, it cannot be viably developed as long as the SH1 has its current status, unless the area developed is first linked by collector road to a SH1 access point, such as the roundabout at south-eastern Plimmerton.

Transmission Gully 2014-2020: implications for planning in the NGA

While SH1 in its current form presents issues for future urban development in the NGA, it is currently being rerouted around Porirua under the Transmission Gully project 2014-2020, as can be seen in figure 5.6 . The rerouting of externally generated traffic will have major implications for transport and urban development planning in the NGA. In fact, Transmission Gully was a key factor in the council's decision to

encourage new development in the NGA. Transmission Gully will have three key effects on the NGA's transport system.

Firstly, it is estimated that traffic flow on the NGA section of SH1 will decrease by as much as 60% after the opening of Transmission Gully in 2021. On the Pukerua to Mana stretch, traffic flow may decrease from 24,000 to around 6,000 vehicles per day (Boffa Miskell Ltd & Aurecon Ltd, 2014). Along the southern Mana stretch where additional traffic is generated locally, traffic is estimated to fall from 35,000 to 20,500 vehicles per day. Importantly, the additional capacity this reduction is expected to create along the road provides an opportunity for local urban development and the associated increased local traffic volumes. This allows for efficient use of the existing transport infrastructure. Reduced traffic flow from outside (and bypassing) the NGA will also allow transport systems to be planned for the needs of local traffic, and to be flexible to local urban planning decisions.

However it is important to note that these estimates are based on the assumption that the Transmission Gully motorway will not be tolled. If it were tolled, the new motorway would attract less traffic, and it is estimated that traffic through the NGA may fall by as little as 10-20%, limiting the additional capacity available in the roading system for new local traffic.[13] As of 25th March 2015, NZTA had not released a decision on whether the road would or would not be tolled. The lack of certainty regarding traffic flow presents a major challenge for planning urban development in the NGA. It makes it difficult to predict the effect that urban development may have on the capacity of transport infrastructure.

[13] Observation of stakeholder discussions at the phase 2 workshop April 2014

Figure 5.6. Existing SH1 route through Porirua, and the new Transmission Gully route (note that Transmission Gully bypasses the NGA)
http://www.nzta.govt.nz/network/projects/wellington-northern-corridor/

As noted, the current SH1 will revert to a local road after the opening of Transmission Gully in 2021. As such its administration will pass from NZTA which is responsible for managing state highways, to Porirua City Council (PCC). Reversion to a local arterial road would provide more flexibility regarding the location of development within the NGA. More access points for local traffic into the main road may also reduce congestion at existing intersections.

Further, a local road designation combined with a major reduction in traffic flow would present an opportunity to revert the road from four to two lanes, and reallocate existing road space for other transport modes. This was recognised in part in an early NGA planning report, which stated that "a 2 lane option would allow

duplication of the walkway/cycleway on either side of the road and could allow development on portions of the existing road alignment."[14] Beyond cycle lanes, this space could theoretically be allocated as a bus lane, providing a transfer service from NGA suburbs to and from train stations.

However the transfer of management also means the transfer of funding responsibility from NZTA to the PCC. Decisions about the location of development will therefore be subject to the ability of the council to fund required changes or additions to the transport network. The PCC is facing several financial challenges: it has few profitable assets; it relies on rates from a constituency whose income is less than the New Zealand average for an increasing portion of its revenue; it is facing a significant decrease in its non-rate revenues related to reduced development and financial contributions and fee collection; and it is already allocating transport funds for connection roads to Transmission Gully. As a result the PCC is already struggling to provide current levels of service to the community. They are not in a strong position to increase funding for transport in the NGA.[15]

Conclusion

The NGA presents two key opportunities for integrating development with transport networks in order to induce more sustainable transport choices. First and foremost, the electric train line servicing the NGA has a high level of demand, which has been attributed to the proximity of the three train stations to residences and town centres. The train service also has enough capacity to absorb increased ridership over the next 20-30 years. The opportunity this presents for servicing new housing was recognised early on in the NGA planning process, but requires land development to be close to stations.

[14] Boffa Miskell. 2014: 19.
[15] Porirua City Council. 2014. Porirua City Council Annual Plan 2014-2015. Accessed online 26/03/2015. file:///C:/Users/Pattern/Downloads/PCC%20Annual%20Plan%202014-15.pdf.

Secondly, the reversion of SH1 to a local road allowed for increased connector roads and therefore land development. This presents opportunities for transport infrastructure decisions to be flexible to local needs.

Given these opportunities to integrate transport and urban form to induce more sustainable transport behaviour in the NGA, the structure planning process provided a perfect forum in which to support this through the incorporation and consideration of sustainable urban form elements, and the prioritisation of alternative transport infrastructure.

The Northern Growth Area Strategic Planning process: a description

The planning context

The need for local councils in Wellington to strategically plan urban development was identified in the non-statutory Wellington Regional Strategy (WRS) 2007. The strategy identified the need to ensure good regional urban form, and tasked local councils to develop 'centre development visions' (city wide visions of future form) and strategic structure plans with a focus on integrating land use and infrastructure planning in order to achieve this. While the focus on regional urban form was removed from the WRS during its revision in 2012, the NGA process is still informed by the content of the older version.

In Porirua, this led to the development of the Porirua Development Framework 2009. In response to increased rates of population growth in the city and concerns that this would lead to haphazard urban development on Porirua's periphery, the council opted to proactively manage the location and form of future development. In particular, there was concern that haphazard development could negatively affect infrastructure networks in the area. Not only were the council concerned about development exceeding capacity of the aging wastewater network, but also rising infrastructure and service provision costs for the council resulting from inefficient development patterns. As well as being economically inefficient, spread out

infrastructure networks also increase the risk of resource losses, for example water leaks from broken pipes. There were also concerns that haphazard development could lead to negative environmental impacts. In a bid to avoid the unwanted effects of haphazard development, the council decided to implement strategic planning to 'set out the location, nature, and density of development for the Northern Growth Area'.[16]

The content of the NGA plan was also informed by a range of other planning documents, the key ones of which are laid out above.

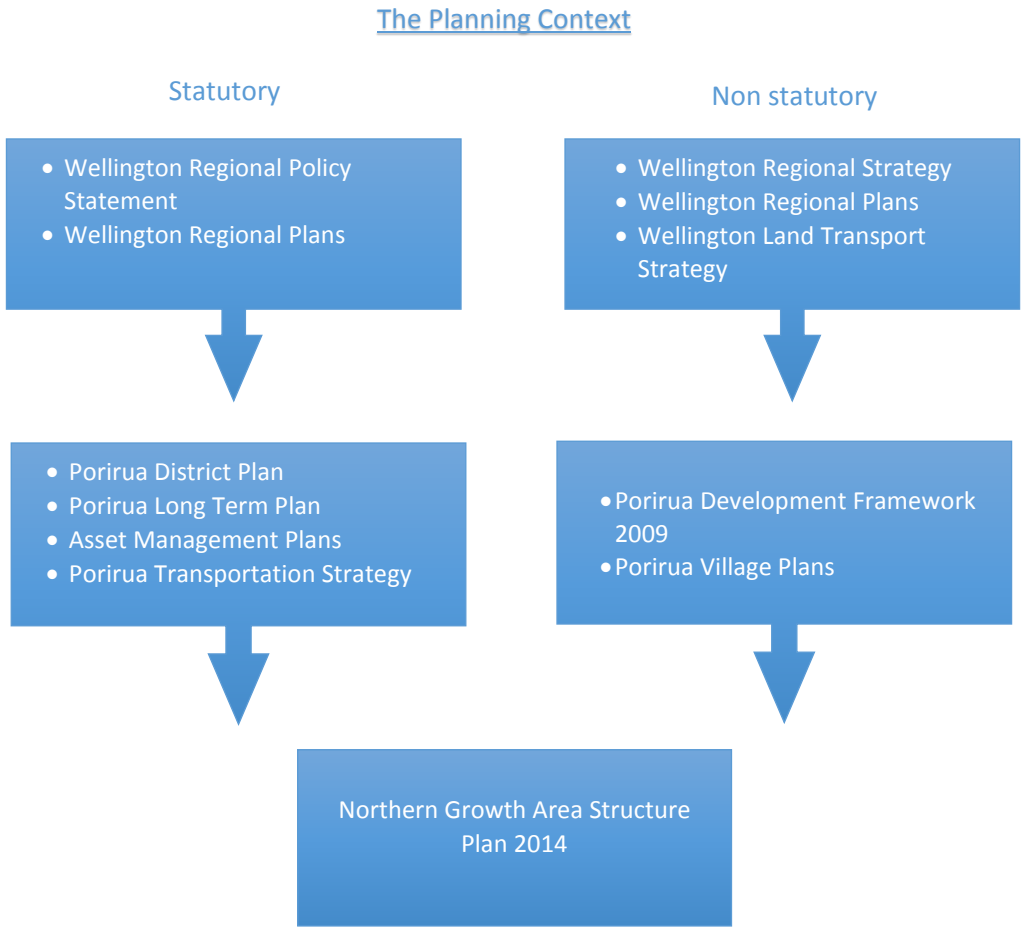

Figure 5.7. Planning documents informing the NGA Structure Plan (note: these documents are those recognised in an early NGA planning report).

The Northern Growth Area Structure Plan process occurred over the course of one year from December 2013 to December 2014. It aimed to guide urban development

[16] Boffa Miskell. 2014. Issues, Opportunities and Constraints report': 36.

to the north of Porirua over a 30 year time period, based on population growth predictions. The current population of the NGA is 7,791 people, around 15% of Porirua City's total population. Based on average natural population growth rates in Porirua over the last 15 years, it is estimated that the NGA will have an extra 2,800-4,600 people within the next 20 years. Porirua City Council has calculated that this growth rate would require around 1,200-2,000 new dwellings to be built in the NGA over that time period.[17] These estimates form the basis of decisions made about the need for, but not the exact location and form of, future housing.

Structure Plans are non-statutory. The NGA plan will not therefore regulate development directly. Rather the decisions it lays out regarding location and form will be incorporated into the statutory Porirua District Plan during its rolling review occurring from 2002-2016/17.[18] In this way the Structure Plan is a high level blueprint of how the council envisions the area will look in 30 years, which is then implemented through planning rules in the district plan.

Overview of the planning process

The process occurred over four phases, as summarized in Figure 5.8

[17] This calculation was based on: population projections; average household size in Porirua; and expected rate of construction per annum based on resource consent rates. For more information on how these numbers were calculated see Issues and Opportunities report 31 March 2014.
[18] Porirua City Council. "Porirua City District Plan: Rolling review of District Plan." Accessed online 20/02/2015. http://www.pcc.govt.nz/Publications/District-Plan.

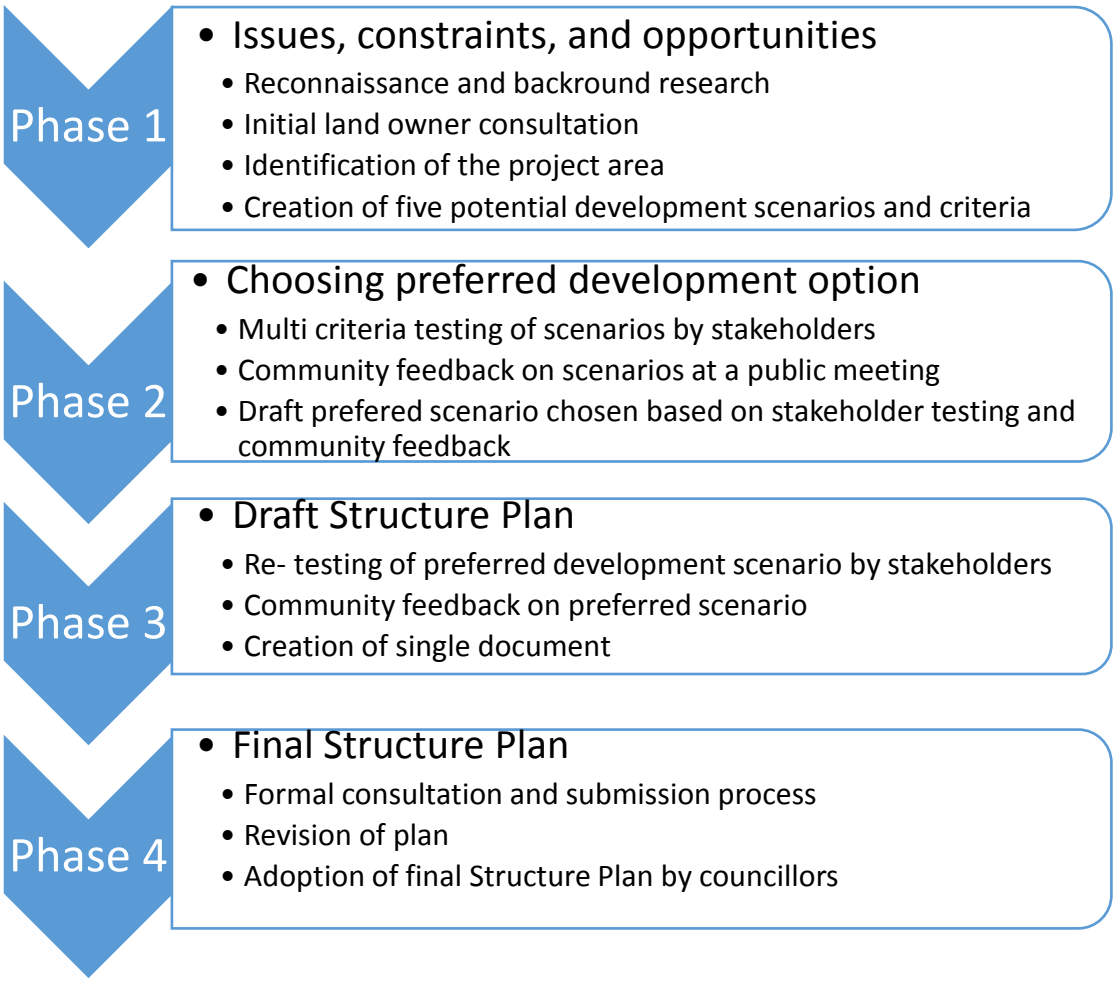

Figure 5.8. The four phases of the NGA planning process

Aims and objectives of the NGA process

Following from concerns raised in regional and local planning documents, and consistent with the purpose of the RMA 1991, the overarching objective of the planning process was to '*ensure sustainable, integrated, and coordinated urban and rural development*' in order to meet the economic, environmental, social and cultural needs of the community (both present and future).[19]

[19] Boffa Miskell. 2014. *Porirua Northern Growth Area Structure Plan: Issues, Opportunities and Constraints Report.* Prepared for Porirua City Council 31 March 2014.

Six more detailed objectives were also proposed in order to meet this goal, as can be seen in the Box below.

DETAILED PLANNING OBJECTIVES IN THE NGA

1. *Integrated land use and infrastructure development patterns with a network of connections for vehicles, cycles and pedestrians, and ensuring that links to the wider network are efficiently and safely developed.*

2. *Scale, form and intensity of development responds to the supporting capacity of the natural and physical resources, including infrastructure, landscape and ecological values.*

3. *Future development complements the existing urban areas and does not detract from their special qualities or degrade their infrastructure.*

4. *Protection of the sensitive receiving environment, including Taupo Swamp, Pauatahanui Inlet and coastal marine areas.*

5. *Efficient planning of services to meet the likely long term needs of housing and industry within the area.*

6. *Support for development that is affordable and economic in the short and long term for both Council and the community.*

Phase 1: Issues and opportunities

As outlined in figure 5.7, the first phase involved an investigation of the potential opportunities and constraints influencing development in the NGA (see appendix 1). These were collected from mapping exercises, planning documents, and consultation with relevant organisations and landowners.

In simplified form, the investigation first mapped physical constraints and opportunities in the area. Constraints included slope, underlying geology, earthquake and flooding hazards, important natural features, hydrology, ecology,

heritage and archaeological sites. These constraints were then overlaid to identify areas of minor, moderate, major, and significant constraint. Land with a major or significant level of constraint was then ruled out for development, while the remaining land was considered suitable for further investigation. Mapping of opportunities related mainly to the location of suitable land, community facilities and transport routes.

The mapping exercise, therefore had an important influence on the form of the potential development scenarios which took place in phase 2. The location and form of the scenarios were dictated primarily by the physical constraints identified, and secondarily by opportunities.

Secondly, phase 1 identified a range of statutory and non-statutory planning documents that had to be taken into account during the planning process. Issues relevant to the NGA context informed the creation of the development scenarios, but were primarily included as criteria against which scenarios were assessed. In this way they were a considerable part of the decision making process.

Porirua Development Framework 2009

The Porirua Development Framework (PDF) 2009 had a direct influence on the proposed location and form of development in the NGA. The PDF was created to guide future development city wide, and as such laid much of the investigative groundwork regarding physical constraints and opportunities for development across the city. Mapping undertaken for the PDF resulted in the identification of potential areas for intensification and for urban growth, as seen below in figure 5.9. This had a strong influence on scenario development within the NGA planning phase 2, as will be seen in the next section.

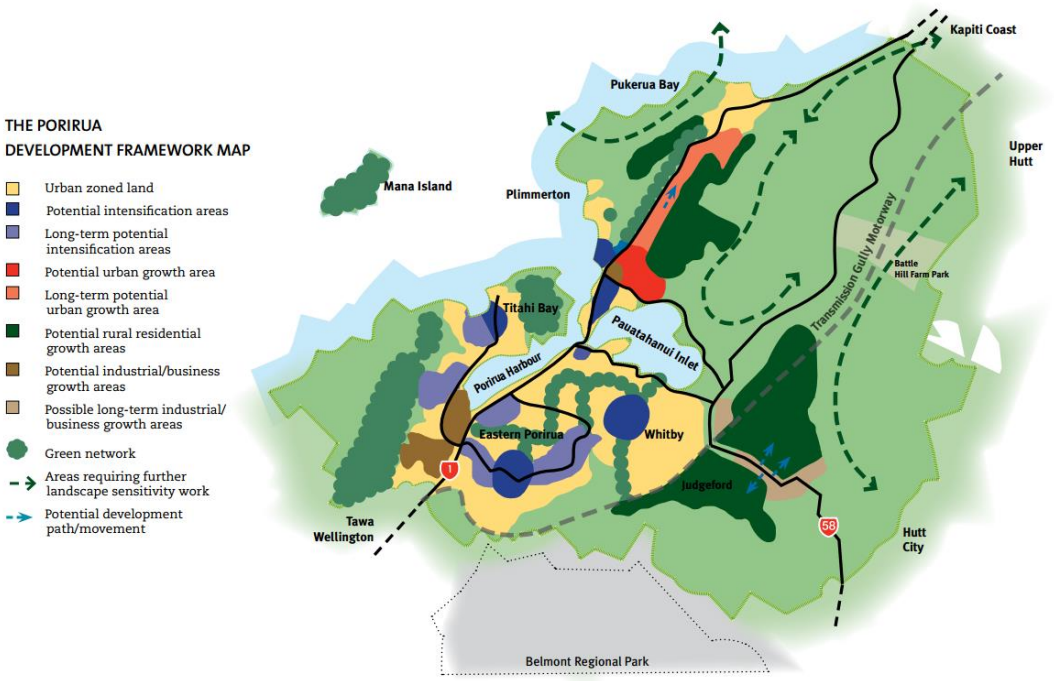

Figure 5.9. The Porirua Development Framework Map. Note the location of potential intensification areas and urban growth areas in the NGA. (Map taken from Porirua City Council. August 2009. Porirua Development Framework.

Thirdly, consultation with relevant organizations and major NGA landowners was undertaken to identify other issues or opportunities within the area, such as infrastructure capacity issues, potential development projects and land available for sale and development.

Phase 2: Choosing a preferred development option

Phase 2 was the key decision making stage of the process. Based on the constraints identified in phase 1, planning facilitators created a series of development scenarios. These scenarios were then tested against a set of criteria by stakeholders (listed in appendix 3) in a two day workshop, before being set out at a public meeting for wider community feedback. Based on this process, one preferred development scenario was chosen to form the core of the draft Structure Plan.

Scenarios

Planning facilitators created five potential development scenarios as seen in figure 5.10 plus an additional commercial zone scenario. Scenarios were intended to be *'representative of different approaches to urban form',* and as such, each proposed a different location, spread, and density for development.[20] As can be seen from figure 5.9, scenarios 1-4 all propose development of undeveloped land in the NGA. Scenario 1 proposed development across all available land at a very low density of 0.35 dwellings per hectare (d/ha). Scenario 2 proposed a new village in the middle of the NGA, separate from the existing urban area. Both scenarios 3 and 4 extended the current urban periphery: scenario 3 entailed greenfield development on the periphery of Camborne and Pukerua Bay at a density of 10 dwellings per hectare, while scenario 4 would see development spread further at a slightly lower density of 6 d/ha. Scenario 5 was the only option for intensification within the existing urban boundary, at a density of 40 d/ha. While these scenarios seem specific, it was stressed by facilitators that they were indicative only, and stakeholders were able to alter them during the assessment process if they desired.

[20] Porirua NGA technical report July 2014:15.

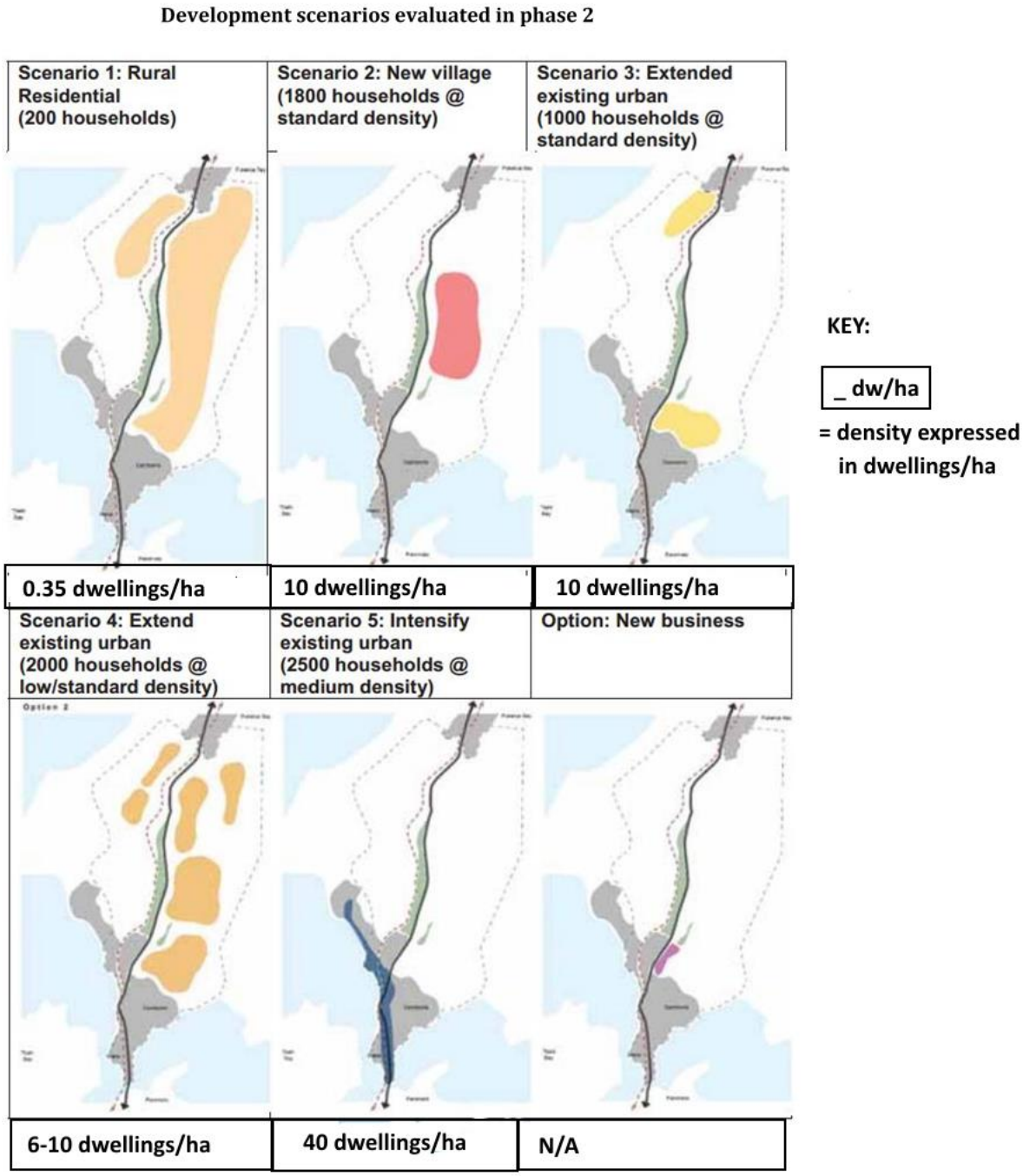

Figure 5.10. Development scenarios and proposed densities. Figure taken from Boffa Miskell. 2014. Northern Growth Area Structure Plan Technical Report, 22nd July 2014.

Multi Criteria Analysis

These 5 scenarios were then considered by the range of stakeholders (identified above) over a two day workshop. A multi criteria analysis methodology was used to systematically compare the scenarios relative to one another, and choose the one

that best ensured sustainable development.[21] The criteria that were chosen therefore '*cover(ed) the four factors underpinning sustainable management, being economic, social, cultural, and environment, as reflected in the Local Government Act 2002 and Resource Management Act 1991.' (*Boffa Miskell July 2014: *17).* Local issues and opportunities identified in phase one also informed what was included as criteria, as did the criteria previously used for similar planning projects in Porirua (Boffa Miskell July 2014).

Fifty one criteria (see appendix 2) were categorised under nine headings:

1. Regional/city context
2. Economic
3. Identity
4. Transportation and movement
5. Services infrastructure
6. Environment
7. Heritage
8. Open space
9. Social

The criteria were not weighted. Each in theory had an equal influence on the chosen scenario.

In the workshops, stakeholders were grouped based on their area of expertise, and evaluated the scenarios against one category each. The transportation and movement category was assessed by stakeholders from NZTA, and Greater Wellington Regional Council.

Scenarios were assessed against the criteria, being given a rating under the traffic light system for each criteria:

[21] Boffa Miskell. 2014. Technical report July 2014: 17

Green	Urban form scenario acceptable due to positive benefits, or no known constraints.
Orange	Urban form scenario less acceptable due to minor constraints (may require further investigation, incur additional costs, or require careful management of the scale and density). *Should be avoided if possible*
Red	Scenario undesirable due to major constraints (significant risk, environmental effect, or economic burden). *Should not occur.*

Each category was then given an average overall rating of green, orange, or red by the group assessing it, based on the majority colour. The results for each category were then collated, as seen in figure 5.11 below. The scenario with fewest (0-1) red ratings across all categories was considered the preferred option overall.

Public consultation

Phase two also consisted of a public consultation meeting in which the scenarios were presented to the community for initial feedback. This feedback was then considered during further testing of the preferred option in phase 3.

Result of Phase 2: the preferred scenario

Scenarios 2 and 3 (new village and extension of existing area) received no red ratings. Scenario 5 (intensification) received only one red rating. Scenarios 2 and 3 were therefore both chosen for further testing and inclusion in the draft Structure Plan, while Scenario 5 was rejected.

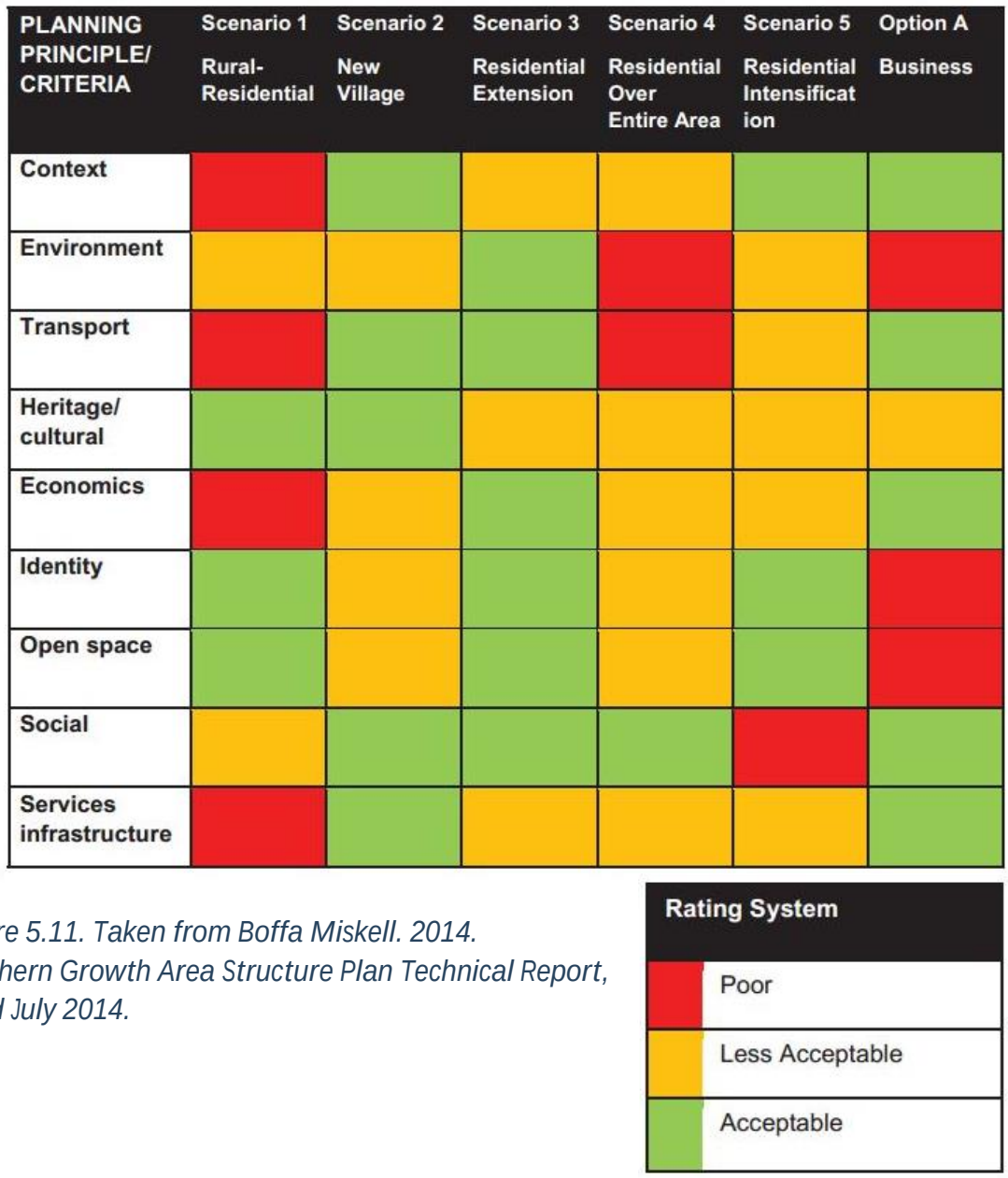

Figure 5.11. Taken from Boffa Miskell. 2014. Northern Growth Area Structure Plan Technical Report, 22nd July 2014.

Phase 3

Phase 3 consisted of another stakeholder workshop in which the preferred option was retested against the criteria to ensure no issues or opportunities had been missed. The layout of the preferred option was then brainstormed by mixed stakeholder groups.

Phase 4

A draft structure plan was created based on the preferred scenario option, which was then publically notified for formal submissions. A submission hearing was held at which feedback on the plan was given by members of the public, with the chance that it could inform alterations to the plan before it was finalized. Scenarios 2 and 3 remained the preferred option throughout phase 3 and 4 and formed the basis of the final notified plan.

Summary

This chapter provided an outline of the planning process, within the context of Porirua's existing urban form, which framed the potential development paths able to be taken by planners. The historical development patterns in Porirua have created a car dependent, dispersed urban form. The existing layout of housing and transport infrastructure constrains the potential development paths that can be taken in future, and makes it difficult to realise the benefits that could be gained from implementing the 5Ds. However there were transport opportunities present in the NGA that could have been maximised through support of the 5Ds to induce more sustainable travel behaviour.

This chapter also described the planning process which led to the choosing of a preferred scenario. An assessment of how well the process incorporated and considered the 5Ds, and how well the decision made supported a sustainable transport outcome, will follow in the next chapter.

Chapter 6: Findings and Interpretation - An assessment of the incorporation and consideration of sustainable urban elements in the NGA planning process

Introduction

The NGA planning process provided a forum in which sustainable transport considerations could be incorporated into urban form decision making. This chapter aims to assess how well this occurred. It will explore how well the 5Ds of sustainable urban form and transport were incorporated and framed in the planning process; and how the 5D elements were then considered by stakeholders in the decision making process, in order to answer the key research question:

'To what extent does decision making in the NGA Structure Plan process support the integration of transport and urban form in a way that enables a sustainable urban outcome'?

This chapter will first provide a comparative assessment of how well the scenarios incorporated the 5Ds. Based on this comparison it will then assess whether the scenario chosen by decision makers was best suited to induce more sustainable transport behavior by residents in the area. These scenarios were designed by facilitators to conceptualise and compare a range of approaches to urban development, and were the instrument around which decision making was centred. The extent to which these scenarios incorporated the 5Ds therefore directly influenced how much the resulting plan would support sustainable transport.

Through this assessment I argue that decision makers did not choose the scenario which best supported sustainable transport outcomes.

Based on this conclusion, this chapter will then explore the factors which influenced decision makers to reject this scenario. Firstly it will look at the extent to which the 5Ds were included in the criteria used to test the scenarios. It will then assess how well the 5Ds were included in planning objectives, issues, and opportunities in phase 1 and 2, in order to understand whether this influenced the integration of transport in the process. Based on workshop observations and interviews, it will then explore how the 5Ds were considered by stakeholders during the multi criteria assessment workshops, and identify the factors that drove or constrained stakeholders to support sustainable transport and urban form options.

Phase 1: Aims and objectives: considerations of the 5Ds

Each planning phase presented an opportunity for the incorporation and consideration of the 5Ds of sustainable urban form. This section will assess the extent to which each phase incorporated the 5Ds, and the role that this played in ensuring their consideration by decision makers. It will focus on the scenarios and the multi criteria analysis which formed the core of decisions regarding development in the area.

Aims and objectives

A plan's purpose and objectives play an important role in determining its outcomes. The overall purpose frames the discourse throughout a planning process, determines which issues are considered important, and which factors and solutions will be explored to address them. In this way, objectives function to ensure decision making does not stray from the problem at hand, but works toward the desired end result. Having strong and unambiguous objectives is therefore imperative to good planning, as it ensures that the outcome is consistent with desired goals.

If urban planning is to ensure that urban form and transport are integrated for sustainable development, this needs to be identified as a planning objective. On an initial reading, the NGA planning objectives seemed to achieve this. The inclusion of the terms 'sustainable and integrated' in the plans overarching goal to *'ensure sustainable, integrated and coordinated urban and rural development'* gave a positive indication that the process would consider the integration of different elements of the urban system (of which transport is key) in order to improve the sustainability of development patterns. Given the emphasis placed on integration of urban form and transport in all urban sustainability literature, the inclusion of this term gives the impression that these would be considered by decision makers.

Ensuring internal consistency between the purpose, objectives, issues discussed, analysis methods, and solutions is therefore recognised as a criteria for 'good' planning in planning evaluation literature (Alexander and Faludi, 1989). Planning inconsistency means the issue at hand is not fixed. [22] In relation to the NGA objectives, the aim was sustainable, coordinated, and integrated development. This aim and the objectives that stemmed from it should have framed all decision making and should have ensured stakeholders considered a range of tools and solutions to optimize this outcome.

Six sub-objectives were also identified in the NGA process. Of particular relevance to sustainable transport was the aim to create:

"Integrated land use and infrastructure development patterns with a network of connections for vehicles, cycles and pedestrians, and ensuring that links to the wider network are efficiently and safely developed'

[22] See Alexander, E.R., and A. Faludi. 1989. 'Planning and Plan Implementation: Notes on evaluation criteria'. *Environment and Planning V: Planning and Design 16:* 127-140 for discussion criteria for successful plans. Of note are rationality criteria which plans should meet, including consistency: 'are the provisions of the plan internally logical, compatible and consistent with its goals, objectives, premises, and analysis?' (p137).

This aim indicated that the council were aware of the need to ensure urban development was integrated with the transport network. This is important as the overarching goal of integration was more general, with anything from integration of social and economic wellbeing to integration of buildings with storm water infrastructure falling under its gambit. Furthermore it indicated that this integration functioned to achieve the higher objective of sustainable integrated and coordinated urban development. Along with the emphasis placed on the train service as a transport opportunity, this gave the impression that new development would enhance the sustainability of transport and indicated that decision makers would give consideration to the methods known to support this outcome. Interpreted this way, the objectives of the NGA process seemed to head the process in planning considerations in the direction of a discussion on integrating urban form and transport with the end goal of sustainability.

However, when read carefully, this sub goal does not give emphasis to alternative transport modes. Rather, it gives equal balance to vehicles alongside walking and cycling, and does not mention an aim to integrate land use with the train service. Therefore, while the wording indicates an awareness of the role that integrated planning can play in ensuring sustainability, it does not in fact direct the discussion to integration with alternative transport modes as is required for a sustainable transport outcome.

So while the objectives indicated sustainable urban form and transport, they did not in fact explicitly state this. As a result, the solutions investigated and the planning discussions had were not focused on optimising this outcome.

Neither do the objectives explicitly state the aim of sustainable transport, or the aim of integrating land use and transport specifically to enhance urban sustainability. The literature on sustainable transport argues that the term ‘sustainable transport’ must be an objective of transport and urban planning if good transport outcomes are to be achieved. While unsustainable transport was identified as an issue, and rail as an opportunity, increasing the sustainability of transport through integration with urban

form was not addressed specifically in the objectives. The lack of sustainable transport as an objective meant that it was not given specific attention or priority in the decision making process.

Furthermore, sustainability as an objective is weak if the term is not defined properly. Many policies which aim to achieve sustainable management arguably fail to do so as there is no working definition of sustainability to inform the implementation of a development or project that on paper, aims to ensure that very thing. Even further, a definition of sustainability arguably needs to include measurement criteria, against which a plan can be tested for how successfully it supports the goal of sustainability. One issue is the changing notion of sustainability based on local contexts and community values. Sustainability may therefore take on a different definition within each place. Regardless of the differing definitions of sustainability across space, there must still be a measure adopted within an individual planning context.

Phase 2: Issues and Opportunities: An assessment of how well sustainable transport and urban form issues were identified in the NGA planning process

The issues identified early on in an urban planning process determine the factors considered in decision making, and therefore determines planning outcomes. If spatial planning is to integrate transport in order to support sustainable transport outcomes, the negative effects of existing transport patterns need to be identified as a planning issue. This did not happen. Failure to identify transport issues constrains the discussion of potential solutions to address them.

Policies that informed the NGA planning

The content of the NGA plan was informed by a range of statutory and non statutory plans and policies at the national, regional and local level, which the plan had to give consideration to (or be consistent with). Assessing the extent to which transport issues were recognized in these documents is therefore important to an assessment

of their inclusion in the NGA plan. To an extent, the informing policies identified transport issues, providing an opportunity for the NGA process to consider integrated urban form and transport solutions as exemplified by the 5Ds.

The Wellington Regional Strategy 2007

The Wellington Regional Strategy 2007 was a non statutory document which informed the development of the structure plan. It identified the need to match transport decisions and land use; integrate transport with urban needs – employment close to where people live, through developing housing near existing commercial centres; ensure efficient use of the transport system, considering the way the development 'fits' with the transport network; and the need for a wider range of housing options, which should be achieved by enabling 'medium and high density development close to centres and transport links while protecting the character of transitional low density housing' (Grow Wellington, 2007, p. 33). This gave councils a framework within which to consider these factors when developing strategic spatial plans.

The Porirua Development Framework 2009

In 2009, the council produced the Porirua Development Framework (PDF), a non statutory document designed to guide future urban development across Porirua city over a 30 year period. It aimed to ensure development aligned with the RMA 1991 goal of sustainable development, while ensuring urban planning responded to local contextual factors such as existing development patterns, issues, and opportunities. The PDF directed the NGA planning process, its objectives, and the factors considered in it. Importantly, the PDF listed the following issues relevant to sustainable transport and urban form outcomes:

Climate Change issues

- emissions and the Kyoto protocol

- energy efficiency and rising energy prices

Transport issues

- peak oil
- 'the need for decreasing dependency on motorized and private vehicles' (p4)
- 'the increased use of public transport, including trains, and non motorized transport such as walking and bicycles' (p4).
- The rerouting of SH1 around Porirua, known as the Transmission Gully project (construction to be undertaken 2015-2021), which will alter transport patterns and management in the NGA.[23]

Integration issues

- The need for integrated planning, defined as planning places that provide for social, economic, cultural, and environmental wellbeing (PDF 2009).

Sustainable urban development issues

- Sustainable housing
- Sustainable urban design

The acknowledgement of these issues within the Porirua Development Framework indicates that the council recognises that there are transport issues within the city, and that spatial planning is an important forum through which to address them. This suggested that some level of integration of transport and urban form would be considered in the NGA planning. Furthermore, it gives a positive indication that these transport issues will inform the development of the NGA plan (given the directing role of the PDF). To what extent this indicates the integration of transport and urban form for sustainable outcomes however is uncertain from the wording. On one hand, the PDFs overarching goal of sustainable development, along with the combination of issues identified: rising emissions, the need for decreased car dependency, increased walking cycling and public transport, and sustainable housing, indicate that

[23] (Issues and Opportunities report p8).

decisions about the location and form of new development aim to support reduced car use and increased walking and cycling. Given that some elements of the 5Ds are necessary to achieve this, the identification of these issues suggests that they will be considered in NGA planning discussions.

Most important was the identification of the need to reduce car use and increase the use of non motorised transport modes. This indicated that the need to reduce car use would be a factor influencing development decisions in the NGA. Furthermore the emphasis placed on opportunities for alternative transport signified that optimising public transport, walking and cycling would have a strong influence on decisions about development location and form.

Further to this, the identification of sustainable housing and sustainable urban design also provides a strong basis for the consideration of higher density housing and other sustainable urban form principles such as compact, pedestrian orientate and mixed use development that have co-benefits for transport sustainability.

Overall, the PDF suggested that sustainable transport would be an influencing factor in the decision making process for development decisions, for example where new development would be located and what form it would take.

While the need for sustainable integration of transport and urban form may therefore be interpreted as implied in the PDF, it is not explicitly recognised as an issue. Integrated planning is instead recognised as a high level concept of considering social, cultural, economic and environmental outcomes within a single planning sphere. As a result, the PDF gave no directive to the NGA planning to consider integration of the two in their decisions.

Transport issues and opportunities identified in the NGA planning process

The identification of physical constraints, including existing transport had an important influence on the form that potential development scenarios took in phase 2. The location and form of the scenarios were subject to existing land use and infrastructure patterns, particularly the location of social facilities and transport routes. They were also subject to a range of physical constraints such as natural hazards and underlying geology. It is important to note then, that consistent with the PDFs identification of the need to reduce car use and increase public transport, the NGA plan highlighted the need to increase non fossil fuel based transport, and increase public transport ridership. It also stated that the train line provided an opportunity to address this.

In particular, distance to public transport and reduced car use were emphasized in the NGA planning documents:

'the proximity of the residential growth areas to existing rail commuter stations, will encourage the community living in these areas to use public transport, reducing the reliance on the use of private vehicles' (Boffa Miskell, 2014b: 36).

Essentially this reiterates Bannisters second objective of sustainable development: reduce levels of car use in urban areas.[24]

The question then is, how well were these issues incorporated for consideration into the decision making process in the Northern Growth Area?

Transport opportunities

As can be seen in the above quotes, public transport was identified as a factor that would influence development decisions. The importance of integrating residential

[24] Bannister, D. 2005. *Unsustainable Transport: City transport in the new century.* Oxfordshire: Routledge:17.

development with public and active transport modes was therefore included in the planning process.

Additionally, after the choosing of the preferred scenario in phase 2 the summary report stated that *'the Structure Plan has been designed to support increased patronage of rail passenger services by locating denser residential development in close proximity to the railway stations.'* Furthermore, it stated that the pedestrian and cycling network in the plan was designed to allow for *'direct and easy access to the railway station'* (Boffa Miskell 2014: 40). These comments indicate that planners considered that the process had resulted in sufficient support for more sustainable transport infrastructure and behaviour.

However, the decisions in the resulting plan did not support existing public transport infrastructure. Firstly, it did not locate development in proximity of stations, nor was it denser. While increasing the existing park and ride facilities was suggested and supported by the GWRC to allow for increased use of the train by locals outside of walking distance of the station, I argue that this was a weaker substitute for locating housing within proximity of the stations where possible.

The planning did consider the future provision of bus infrastructure, allowing space for bus stops to be created when a bus service begins running. However the location of new development will not reduce car use until a bus service begins. Creating new bus services require a significant amount of housing to be built, creating sufficient population densities to support the bus service, before they become viable. However the plan did not consider how it could induce quicker bus provision through its chosen housing development option. The chosen scenario did not does fulfill the plans stated objective of reducing car use or supporting more public transport use. Which factors influenced this shift away from the most sustainable transport option?

The Development Scenarios: A comparative assessment of the inclusion of the 5Ds and sustainable transport modes

As outlined in the previous chapter, five development scenarios formed the basis for the multi criteria assessment of possible development options (see figure 6.1 below). It was stated in planning documents that the scenarios were "representative of different approaches to urban form" ((Boffa Miskell, 2014b, p. 15). In the context of the plans objective to ensure sustainable development, this is interpreted to mean different approaches to ensuring more sustainable urban form. This statement indicates that planners were aware of the concepts put forth in planning literature regarding recommended ways in which urban form elements could be arranged when aiming to achieve a more sustainable development outcome.

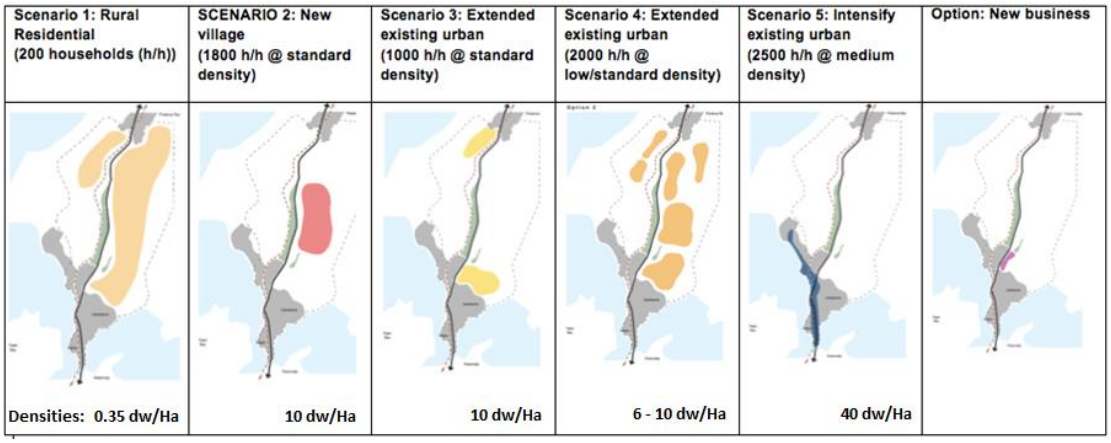

Figure 6.1. Proposed development scenarios

However the scenarios did not represent a good range of sustainable approaches to development. When compared using the 5Ds as a measure of sustainable form, the scenarios are instead seen to present a scale of least to most sustainable urban form. A comparative assessment of the scenarios based on the 5Ds follows below. The fact that the scenarios presented a scale of less to most sustainable was one factor which influenced stakeholders decision to reject scenario 5. The lack of incorporation of the 5Ds within many of the scenarios limited stakeholders ability to compare different, but equally valuable, approaches to developing the NGA sustainably. Instead, the fact that stakeholders were comparing scenarios of varying sustainability ultimately informed the sustainability of the option chosen. This section will assess how well the 5Ds were incorporated into the scenarios in order to make this point.

Limitations of a comparative scenario approach

By way of disclaimer, facilitators stressed that these scenarios were a conceptual tool through which to compare different approaches to development, and that the location and form of development shown in them could be altered during the brainstorming exercise in phase 2 (subject to the existing constraints). However, while scenarios were flexible in theory, I argue that stakeholders' perceptions of the options for development became limited to those presented for assessment. By framing the stakeholder discussion around potential approaches to development, they may have constrained the final decision made regarding urban form in the NGA.

Furthermore, the use of a comparative evaluation methodology to test the scenarios foreclosed the consideration of other approaches conducive to urban sustainability and efficiency. Stakeholders assessed the performance of each scenario relative only to the four others presented to them. Approaches to development that fell outside of those shown in the scenarios, such as those posed in models of sustainable urban form, were therefore not open for consideration by stakeholders. This foreclosed a discussion of other approaches which may have induced more sustainable development of the NGA, and more sustainable transport outcomes. Sustainable transport outcomes were therefore limited to the extent to which the 5Ds were expressed in the scenarios presented.

Limitations were recognized. As planners stated, you can't include everything. However when attempting to understand how well sustainable transport considerations were incorporated into the process, the comparison of limited scenarios may have acted as a constraint to a wider consideration of best practice approaches that suited the planning context.

Assessment of the inclusion of the 5Ds

Of the 5Ds, increased density is arguably the most important element to enact for more sustainable transport, due to the strong inverse relationship between density

and VKTs per capita in urban areas. As described in the previous chapter, densities were included for consideration in the process in the development scenarios (see figure 6.1 above). This presented an opportunity for stakeholders to compare a range of housing densities, their suitability in the NGA context, and the benefits they could have for sustainable and efficient development outcomes.

If the proposed densities were to induce more sustainable transport behavior and reduce VKT in the NGA, they needed to be within the range suggested in sustainable urban form literature. Newman (in Thwaites et al 2007) states that 35 or more people per hectare (ha) are required in local neighborhood centres to induce a rapid decrease in VKT per capita. Based on Porirua's average household size of 3.13 people, this translates to a minimum of 11.2 dwellings per hectare in the NGA local neighbourhood centres. Density above this level also supports the other 5D elements: increased accessibility, diverse land uses, and reduced distance to public transport. Additionally, densities of 35 people p/ha also increase the viability of schools, shops, and public transport services in local centres, ensuring these amenities can be provided within walking or cycling distance of residences. It is suggested that for a public bus route to be viable, there must be at least 20 dwellings/ha within 800m or 10 minutes walk of a bus stop. Clearly, density is a key element for supporting the use of alternative transport modes and reducing VKT.

However, of the five development scenarios presented, only one (the intensification of the existing suburbs of Plimmerton and Mana) proposed a density above the threshold of 35 people/ha recommended for significant reductions in VKT. As seen in figure 5.11, scenario 5 proposed development at a density of 40 dwellings p/ha (around 125 people/ha at Poriruas average household size). This is four times greater than the density recommended for sustainable urban form and transport outcomes. By comparison, the next highest density proposed was 10 dwellings/ha in Scenario 2 and 3. This falls under the threshold recommended for a significant reduction in VKT, and as such would not induce significant sustainable transport outcomes for the NGA. No middle density was proposed between 40 and 10 dwellings p/ha. In meeting

the recommended threshold for density, scenario 5 presented the best solution for inducing more sustainable transport patterns in the area.

While density has the strongest influence on VKT, location is also a significant determinant in VKT reductions. Location of development relative to existing neighbourhood centres and train stops influences the level of destination accessibility and distance to public transport. People are induced to use more sustainable transport modes when housing is within 800m or 10 minutes walk of amenities and public transport stops. Of the development scenarios, only Scenario 5 ensured that all new housing would have been located within 800m of existing amenities and train stations in Mana and Plimmerton. Through ensuring that a greater proportion of NGA residents could access more sustainable transport modes, Scenario 5 therefore presented the most sustainable option.

The extension of Camborne and Pukerua Bay under Scenario 3 would also have allowed some new housing to sit within 800m of existing amenities and train stations. However there were multiple factors that limited the value of extending development into these areas. Firstly, the proposal to develop housing to the northeast of Camborne at a density of only 10 dwellings p/Ha means that housing would spread outside of the recommended 800m distance from shops and stations in Mana or Plimmerton. Secondly, Camborne has very low diversity, as it is solely residential land use, and has no shops or public transport routes of its own to service new development. Thirdly, Camborne is a hilly suburb, making walking and cycling more of a challenge. This may reduce the likelihood that residents will choose to walk and cycle to and from the centres in Mana or Plimmerton. As a result of these factors, while Scenario 3 offers the next best opportunities for sustainable transport outcomes, it does not perform as well as Scenario 5 in density, accessibility, diversity of land use, or distance to public transport.

In comparison, the remaining Scenarios, 1, 2, and 4 offered even more reduced opportunities for sustainable transport behavior. This was mainly a factor of the distance between the proposed location of development and the existing amenities

and train stations, which were significantly further than 800m from existing neighbourhood centres, and more dispersed in the case of 1 and 4. Furthermore, the existing transport connection from these areas is the SH1 road. While there is a paved cycling/walking track running along this route, it is cut off from potential development locations by the railway line to the west and the highway to the east. Accessibility to this track and distance therefore both constrain the convenience of walking and cycling as a form of transport rather than recreation.

Scenario 5 therefore presented the strongest opportunity for increased transport sustainability in the NGA, and the strongest opportunity to achieve the planning goal of sustainable development overall. However, as has been made clear already, this option was not chosen by decision makers. Instead, a combination of Scenario 2 and 3 was chosen for further investigation. Given the opportunities identified for sustainable transport in the NGA and the plans aim to ensure more sustainable development, why was scenario 5 rejected in favour of Scenario 2 and 3?

Critique of the development scenarios

While the 5Ds were included in the development scenarios to an extent, their incorporation was problematic. This influenced the way in which they were considered and discussed by stakeholders in the multi criteria assessment, and ultimately influenced the rejection of Scenario 5 as the preferred option.

Firstly, the fact that only one of the five housing scenarios supported the 5D criteria meant the 5Ds were not incorporated into the scenarios well enough to allow a serious consideration of their benefits by stakeholders. It reduced the likelihood of the scenario being chosen by stakeholders during the multi criteria assessment.

The likelihood of the Scenario 5 being chosen was further reduced during the multi criteria assessment. By comparing the performance of Scenario 5 against the other four scenarios in a range of criteria, the benefits of the scenario were at risk of being traded off in favour of non transport related attributes of the other scenarios. This

again acted to stack the odds against the choosing of the most sustainable transport option.

Furthermore, by placing visual parameters on the physical layout, the scenarios framed stakeholders perceptions of what was possible. The lack of proper inclusion of the 5Ds within the other scenarios meant that stakeholders did not perceive their benefits when considering which scenario was best for sustainable development, or factor the 5Ds into their decision.

However this raises the important question of why only one scenario which met the recommended criteria for sustainable urban form and transport was included, when the purpose of the process was to 'ensure sustainable development'. With this in mind, one would be right to assume that all scenarios would embody an urban form recognized as sustainable in some way. Many of the scenarios however, seemed to contradict this purpose. Scenario 1 and 4 both presented low density housing across the whole area. Both are essentially a 'business as usual' approach to development, as resource consents would continue to be made on a case by case basis, resulting in development patterns that are not coordinated to maximise the sustainable roll out of transport and other infrastructure. The cumulative effects of such development would be difficult to measure or manage. Furthermore, under the current district planning rules people can apply for a plan change to have rural land rezoned to residential if they wish to develop housing in greenfield areas. Effectively, this means that scenario 1 and 4 present development options that would have already occurred without the creation of a strategic plan.

Given that the NGA Structure Plan was done specifically to negate ad hoc development and its effects, the inclusion of two 'business as usual' scenarios must be questioned. While proposing these scenarios may be framed as a tool through which to compare the existing approach against new development strategies, I argue that given the planning goal of sustainable development, their inclusion was not warranted.

The effect that these two scenarios had on the planning process was to shift the options toward the more conservative, unsustainable end of the spectrum. The lack of multiple sustainable options limited the discussion of sustainable urban form by stakeholders. This means that of the five housing scenarios, only three proposed an actual alternative to the existing development trend. Of these, only Scenario 5 included the 5Ds well, and Scenario 3 did so to an extent, as discussed above.

Scenario 2 was proposed as a sustainable alternative: it was to have mixed densities and land uses, with a school and amenities developed there. Given that developing an empty piece of land rather retrofitting an existing layout can allow developments to be designed sustainably, a new village technique is a tempting development option. However, the location of this new village was so far away from existing neighbourhood centres that the distance to public transport and destination accessibility were a deterrent to people using active or public transport instead of cars to travel locally. Residents would have to use their cars to access the train station in Plimmerton for commuting as well. While the process proposed more park and ride facilities to induce higher train ridership, which is a rational way to decrease commuter car use, this approach still did not support better transport choices well compared to Scenario 5. While Scenario 2 proposed building amenities and increasing some housing density as demand allowed, the rate of development on undeveloped land would mean that it would take decades for population in the new suburb to reach levels that would make these viable. Scenario 2 would therefore be in danger of remaining a low density greenfield development for decades before more sustainable development begun to occur. In the mean time, the development would lock in car dependant travel behaviour at a time when reduced emissions are most important if we are to attempt to meet the 2050 reductions targets recommended by the IPCC.

Essentially then, the scenarios presented a false dichotomy of potential approaches to development. They gave the impression that development could be either very high density and concentrated, or it could be the opposite. This was in fact, recognized by facilitators, with one stating that the scenarios were *'not intended to*

be a design concept, but are a way of testing extreme visions to ensure all options are considered.' While the intention of this comment may have been to demonstrate that the process was about considering many options in an iterative way, what stands out is the decision to centre decision making around the extreme approaches. The 40 dw/ha proposed in Scenario 5 was 3 times higher than the minimum density required for a more sustainable transport outcome. It was also 5 times higher than the maximum density within 800m of train stations in Plimmerton and Mana currently. While the higher the density the better in terms of VKT reductions, density must still be responsive to the local context. Given the low existing densities of the NGA suburbs, proposing a density so much higher than required for good transport outcomes seemed out of place, and was unlikely to be supported, especially when conformance with existing densities was included as a criteria. Why then, did the proposed densities jump from 10 dw/ha in Scenarios 3, and 4, to 40 dw/ha in Scenario 5 without any middle ground being proposed? Effectively Scenario 5 was created in the knowledge that it would be at odds with some of the criteria used to assess it.

By presenting scenarios that sat at the opposite ends of the sustainable urban form spectrum, I argue it swayed decision makers away from the sustainable option because it was too extreme, and pushed them into the arms of a less than ideal option because no middle ground was presented to them.

The inclusion of density within the scenarios therefore provided an opportunity for stakeholders to discuss the benefits and impacts of a range of densities within the context of creating sustainable development. However, the benefit of higher density to more sustainable transport choices was not discussed in the assessment stage, and the higher densities proposed in scenario 5 were rejected in favour of less sustainable options.

The Scenarios: A conclusion

The scenarios framed the urban form and transport possibilities that could be considered by stakeholders in the criteria assessment. In doing so they determined how sustainable the transport layout would be. The scenarios provided an opportunity to incorporate the 5Ds and sustainable transport infrastructure into the NGA plan, allowing stakeholders to consider them when choosing the best development option. Arguably however, they did not include enough 5D or sustainable transport elements to ensure a sustainable development option was chosen. Only Scenario 5 included the 5Ds in a way recommended by the literature. The lack of 5Ds presented in the scenarios constrained the ability of stakeholders to consider sustainable urban form and transport elements when choosing the preferred scenario. Furthermore, the comparative methodology used meant stakeholders weren't able to consider approaches to urban form outside of those presented to them. The way that the 5Ds were incorporated in the scenarios was in part responsible for the rejection of scenario 5. Rejecting this scenario was not only a missed opportunity to integrate transport and land use, but was contradictory to the plans objective of ensuring sustainable and integrated urban development. The scenarios presented therefore constrained the sustainability of the final development plan.

I argue that there should have been more scenarios that incorporated the 5D elements, with a variation in their layout and approach. This would have allowed stakeholders to compare different but equally sustainable options, to ensure a best fit for the local context.

The multi criteria analysis assessment: how well were the 5Ds included in the criteria, and what effect did this have on the outcome?

While the scenarios framed which urban form and transport layouts were considered, it was the criteria against which the scenarios were tested that determined which issues were discussed by stakeholders. The extent to which the 5Ds and sustainable transport elements were included in the criteria therefore

played a key role in the sustainability of the final plan. This section will assess the extent to which this was done.

Only six of the fifty one criteria incorporated features that aligned with the 5Ds, as can be seen in table 6.1 below. The extent to which the 5Ds could be included in the final plan in order to induce more sustainable travel behaviour was therefore limited to what was contained in these six criteria. Discussions about the benefits of the 5Ds for urban sustainability were also limited to these six criteria.

Table 6.1. A list of the criteria which incorporated 5D elements. Taken from Appendix 1 of Boffa Miskell. Technical Report. July 2014.

#	Criteria which included the 5Ds	Planning principle	5D element
1	***Distinctive identity of existing*** *Maintains the identity of existing villages/urban areas for Pukerua Bay, Plimmerton, Mana, and Camborne.*	Regional/City context	Density
2	***Living environment choice*** *Complements the choice of living environments in the region – setting, densities, typology, and tenures.*	Regional/City context	Density
3	***City context*** *Connects with existing villages/urban areas to allow sharing of amenities, facilities, and services.*	Regional/City context	Destination accessibility
4	***Walkability and cycling*** *Provides for accessibility to a village or urban centre by 10 minute walk or cycle.*	Transportation and movement	Destination accessibility

5	***Public transport*** *Provides for accessibility to and supports/enhances public transport services/infrastructure and usage.*	Transportation and movement	Distance to public transport
6	***Multi modal transportation forms*** *Promotes multi-modal transportation forms, such as public transport routes, bus stops, cycleways, footpaths, bridge paths.*	Transportation and movement	Distance to public transport Destination accessibility
	Criteria favourable to sustainable urban development	**Planning Principle**	**5D Element**
7	***Impacts on climate change*** *Minimise impacts that contribute to climate change, such as through the provision of non-fossil-fuel transport mode enhancement (electric commuter trains, cycleways, walking), green corridors/neighbourhoods to reinforce biodiversity values, efficient use of energy (e.g. passive solar design) and potential forms of renewable energy generation (such as small and community scale distributed energy generation).*	Environment	Destination accessibility Distance to public transport
8	***Demand*** *Provides for the projected demand in terms of household numbers, dwelling sizes, and business land needed.*	Economic	Density
9	***Maintenance and Operational Costs*** *Provides a sustainable maintenance and operational basis of essential*	Economic	Resource efficiency

	infrastructure and community facilities for Council and community. Includes minimising Whole of Life Costs and recognising asset depreciation and funding requirements.		

Which 5D elements were included in the criteria?

Density, destination accessibility, and distance to public transport were all incorporated by name. Some of the criteria closely resembled the criteria recommended by sustainable urban form literature, indicating that planners had a knowledge of sustainable urban form concepts. However, these elements were not always framed in terms of their benefit for sustainable transport in the criteria. Furthermore, design and diversity were not explicitly included. As a result, their benefits for urban sustainability were not considered by stakeholders and had no influence on the outcome. The way in which the 5Ds were included and framed in the criteria constrained the consideration of their benefits for sustainable transport, and therefore swayed the decision made away from being more sustainable.

How well were these 5Ds incorporated in the criteria, and how were they framed?

Destination accessibility

Criteria four (in table 6.1 above) aimed to ensure that the chosen scenario provided accessibility to a neighbourhood centre within 10 minutes walk or cycle. This is the exact guideline recommended to induce more sustainable transport behaviour. This allowed stakeholders to consider the destination accessibility of each scenario and discuss the benefits of active transport and reduced distances. Scenario 5 best supported accessibility, and indeed, it was given a green rating for criteria four by stakeholders for this reason. Similarly, Scenario 3, the extension, was also given a green rating as it was 'close to existing villages' (Boffa Miskell 2014 MC results).

Arguably, intensification fulfilled the criteria better than the more distant extension scenario, as the suburb of Camborne has no amenities of its own, and development at the periphery would be at the furthest distance in the suburb from existing amenities in Plimmerton and Mana. However both were proximal enough to induce a shift away from car use compared to the other scenarios. Likewise both scenario 3 and 5 were given green ratings for criteria three, which while it did not explicitly use the term accessibility, also supported a good connection to neighbourhood centres. However criteria 3 did not explicitly aim to support connectivity to centres using alternative transport modes. Good connectivity by cars could also have allowed for better accessibility. As such this criteria was not framed in a way that meant accessibility was considered in terms of its benefits for better transport sustainability.

In conclusion, only two criteria included destination accessibility. Criteria four supported accessibility by alternative transport modes, allowing stakeholders to consider the benefits of this element for sustainable transport specifically. However the way criteria 3 was framed constrained the extent to which the benefits of connectivity was for sustainable transport behaviour could be discussed by stakeholders. I argue that this is shows a missed opportunity to integrate sustainable transport modes into urban form decisions.

Interestingly, Scenario 2, the new village, was also given a green rating for criteria 4, as it was argued to 'provide good connections… within (the) new village' (Boffa Miskell, 2014a). This rating was given regardless of the recognition that 'connection beyond the village is a concern' (Boffa Miskell, 2014a). Given that the proximity of development to existing centres, relative to the other scenarios, was the justification for supporting Scenario 3 and 5, it is difficult to understand why Scenario 2 also received a green rating when it was located so far away from existing development, or existing neighbourhood centres.

The green rating for all scenario 2 regardless of the comparatively better performance of scenario 5 (and 3) occurred for multiple reasons. Firstly, a 10 minute walk or cycle to an *existing* centre was not specified in criteria four. Support for the

new village was therefore given based on its proposed future town centre. However council planning does not ensure that a range of amenities and shops will be developed there in time to ensure new housing is adequately serviced. Shops and amenities will only become viable once the local population size is large enough to ensure sufficient demand. This could take decades, and in the meantime, accessibility from the new development to the existing centres in Plimmerton and Mana will be limited, and car dependent. Given that this constraint was recognised in the assessment, I argue scenario 2 should have received an orange rating, particularly as the performance of the scenario was meant to be judged relative to that of the others, which was arguably better. In giving a green rating to Scenario 2, the strength of the other two scenarios, particularly scenario 5, to enhance accessibility and sustainable transport was undermined. This was a factor in the rejection of Scenario 5.

Distance to public transport

Criteria five and six incorporated distance to public transport. Criteria five in particular supported public transport ridership, through increased accessibility to the train station. It was recognized by stakeholders that Scenario 3 and 5 provided 'good access to existing services (rail) and opportunities for expanded use', particularly scenario 5 due to 'intensifying existing commuter catchments'. It was also recognized that there were constraints on the ability of Scenario 2 to support public transport due to 'distance between the new growth area and existing facilities/services' (Boffa Miskell, 2014a). Regardless of the recognition of the better public transport outcomes that Scenario 5 could induce, and the limitations of scenario 2, Scenario 5 was still not chosen.

Density

The incorporation of density in the criteria was the most problematic, and the way it was included, as well as its consideration by stakeholders, was a large reason for the

rejection of scenario 5. While density was included (see table 6.1), it was not framed in terms of its benefits for sustainable urban form or transport, particularly its ability to induce walking or cycling or reduce distance to public transport. Instead the densities proposed were assessed based on whether they would maintain the distinctive identity of the existing urban area. By failing to identify the role of density in supporting public and active transport use, these criteria stopped stakeholders' from considering densities contribution to a sustainable outcome.

Instead, the density related criteria became a basis on which to reject Scenario 5. As existing densities in the NGA are low and housing typology is predominantly single dwellings of one to two storeys, Scenario 5's proposed 40dw/ha did not maintain the distinctive identity of the suburbs. Instead, the criteria acted in favour of Scenario 2, which was the only one to gain a green rating for criteria 1 as it 'does not impact identity of existing urban areas' (Boffa Miskell, 2014a). The criteria valued maintaining the distinct identity of existing urban form over the benefits that medium density could create. As Scenario 5 was the only one which proposed densities above the threshold recommended for sustainable transport outcomes, these criteria contradicted the value of including a medium density option in the first place, as well as contradicting other criteria which aimed to achieve sustainable transport. As a result of the framing of density in the criteria, scenario 5 was seen as the least desirable option, even though the benefits of scenario 5 for increasing sustainability were recognised, and the planning goal was sustainable development.

The perceptions of density seen in these criteria were also reflected early on in stakeholder discussions. At the beginning of the phase 2 workshop (before scenarios were assessed), a stakeholder queried the inclusion of an intensification scenario for Plimmerton and Mana. The facilitator response to this question was that as medium density was possible in Plimmerton and Mana, it should therefore be considered. However, the facilitator then placed a caveat on this statement, saying *'I'm not saying that it (medium density) is possible'*, but the process should *'at least give consideration to it'.* Another stakeholder asked what was meant by density, asking for it to be defined. The facilitator replied that the scale of density suggested for each

scenario was *'calibrated to what we think the area could handle… so we're not talking ten storey apartment blocks'.* They also stated that intensification would, *'not* (be) *infill, but replacing buildings with new medium density housing'.*

This interaction provides several insights into the way that the proposal of increased density was received by those involved in the process. Firstly, the concept seemed to be poorly understood by stakeholders. While no one expressed a negative opinion of higher density, it was viewed with caution. The tentative reception of increased density by stakeholders was also reflected in the way facilitators discussed the topic. That the facilitator felt the need to assure stakeholders that proposed densities would not be ten storey apartment blocks played into the polarized and fearful view of density that is commonly expressed by communities today. It indicated that facilitators were concerned about a negative reaction from stakeholders and the community to increased density. Whether this caution was derived from community, stakeholder or facilitator opinion, the result was that the benefits of density were avoided in discussions, rather than highlighted, which I argue limited Scenario 5 being viewed positively.

Further critiques of the inclusion of the 5Ds in the criteria

The inclusion of the 5D elements was undermined by the lack of consistency, as the other 5Ds were not included. Given that the 5Ds act as a whole to induce a greater reduction in VKTs and other benefits, this inconsistency limited the ability of the criteria to maximize a sustainable transport outcome.

This, and other factors leads me to argue that the inclusion of 5Ds was incidental more than deliberate. Firstly, there was no explicit reference to the concept of sustainable urban form in the planning documents that informed the criteria's content. In the criteria themselves, some elements were implied through more general terms, however the established terminology for sustainable urban form elements was not used. Criteria 3 in table 6.1 for example infers accessibility and diversity/mixed land uses through wording such as *'connects with'* and *'sharing of*

amenities'. These terms are ambiguous however, and lack a definition or measurement. Arguably this lack of understanding about what counts as a sustainable level of 'connectivity' or 'sharing' makes it difficult to test which scenario might best achieve them. This lead to a weakened consideration of the 5Ds, and restricted the extent to which decisions could constructively integrate sustainable transport elements. The explicit inclusion of 5D terms in the criteria would have provided clearer guidance on how to measure the scenarios against transport criteria, in order to ensure sustainable transport outcomes.

What was missed from the transport criteria?

Until now, the acknowledgement of climate change in the criteria has not been addressed. The impacts of development on climate change were included under criteria seven (see table 6.1). This was positive, particularly as it was framed in terms of the effect of development on climate change, rather than the more ambiguous approach taken in the RMA 1991 – which places the focus on the effects of climate change instead. Furthermore, the need to reduce the use of fossil fuel dependent transport was incorporated in criteria seven. However, this criteria did not highlight integration of transport and urban form as a way of achieving this.

Furthermore, the climate change criteria was included in the transport criteria section, nor was it included in other criteria that incorporated the 5Ds, such as those related to density. As a result climate change not considered by the transport stakeholders in their discussion of the scenarios. This meant that the criteria failed to properly consider the interrelationship between transport and urban form decisions, and their impacts on climate change, which limited the extent to which they could support a more sustainable urban future.

Summary

The criteria used to assess the scenarios determined what factors were considered important to realise in future urban form in the NGA. If the plan was to integrate

urban form and transport in order to achieve more sustainable development patterns and transport behaviour, it arguably needed to include the 5Ds and sustainable transport modes in a way which allowed stakeholders to discuss their benefits for the desired outcome. However it is argued that the 5Ds were not included in the criteria well enough to make this happen. Three of the 5Ds were incorporated into the criteria, allowing stakeholders to consider their benefits for inducing more sustainable transport choices when comparing the scenarios. However the way that these 5Ds were framed in the criteria often limited the likelihood that stakeholders would recognize their benefits for sustainable transport. For example, the way density was included contradicted its role as an instrument for more sustainable development patterns, or sustainable transport behaviour. This was one factor that led to Scenario 5 not being chosen, which was a missed opportunity for a sustainable transport outcome.

Stakeholder considerations of transport in the multi criteria assessment: what factors constrained support for Scenario 5?

Based on observation of stakeholder discussions and an interview with a key stakeholder involved in the planning process, this section argues that there were a range of factors considered in the decision making process that lead to the rejection of Scenario 5.

Existing urban character

While the framing of increased density constrained the consideration of scenario 5's benefits, there were several other factors which participants argued played a leading role in the scenario being rejected.

Firstly, it was argued by the key stakeholder interviewed that the NGA plan was driven in part by the need to manage inevitable development of rural land once the SH1 reverted to a local road (allowing for increased road connections to land off the

NGA transport spine). This meant that there was less emphasis on endorsing infill in the plan. However this seems counterintuitive – if the plan was driven by the need to avoid inefficient development of rural land, then supporting infill closer to existing infrastructure networks before allowing further tracts of land to be developed would seem the more logical development path.

Additionally, the structure of land ownership of infill lots in existing suburbs was argued to constrain the development of a strategic approach to intensification under Scenario 5. Developable land in the suburbs was dispersed, and owned by many different people. This meant decisions to develop were made individually, leading to sporadic development and incremental intensification over time. The stakeholder interviewed argued that endorsing infill through the NGA strategy would not hasten this development process, nor would it induce a strategically planned development pattern. Infill was therefore seen as an unreliable housing strategy, which was argued to constrain the suitability of Scenario 5. [25]

Secondly, it was argued that endorsing infill development in Plimmerton and Mana in the NGA plan was of little value, as infill was already permitted under the district planning rules which govern suburban zoned land in Porirua. However that existing planning rules negate the need for the NGA plan to support intensification can only be a valid reason for rejecting Scenario 5 if the district plan does sufficiently facilitate infill development already. On one hand, the district plan states that it provides for infill housing, and recognizes its contribution to sustainable urban form:

"Infill housing of established suburbs is provided for in the District Plan as a way to facilitate a compact, sustainable urban form…. this has facilitated some diversification in the range of housing choice within the City and enabled a greater range of housing needs to be met…"(Porirua District Council, 1999, p. C3.2.1: 2)

[25] In order for infill to be a practical option, it was argued that it would need to be implemented by a single organization who specialized on large scale infill development. However none currently exist in New Zealand.

That this statement is included in the councils' primary statutory planning document gives the impression that policies and rules governing development in existing suburbs will support (or at least be permissive of) housing intensification. However they instead act to constrain infill and intensification. While the plan states that rules for suburban zones will *'allow flexibility for a range of building types, building locations, and activities'*, they contradict this by imposing limits on the bulk and location of development, site coverage, building height, and yard requirements among other things, specifically with the aim of constraining infill developments.[26]

These rules reflect concerns of suburban communities in Porirua that new housing developments were of a type and density that was uncharacteristic of existing neighbourhoods, and detracted from the amenity value of the area.[27] As such, the plan enacted a policy which aimed:

*"To **protect and enhance the amenity and character of the residential resource** by defining standards for the bulk and location of buildings, the provision of open space, and the nature and scale of activities"* (Porirua District Council, 1999, p. C3.2.1: 6)

This policy was particularly aimed at infill development, and was justified on the basis that:

"*in some cases the benefits of infill housing have resulted in **reduced amenity** for adjoining property owners and a reduction in streetscape quality… the yard requirements, site coverage limits, outdoor living space requirement and height restrictions specified in the Plan… together contribute to ensuring an **acceptable density and size of development** sufficient to maintain minimum levels of sunlight,*

[26] *"The standards allow flexibility for a range of building types, building locations and activities, while also ensuring that the amenities of neighbouring occupiers are not adversely affected. Limits have also been placed on building bulk, siting, height, site coverage, and providing a minimum outdoor living area."* (Porirua District Council, 1999, p. C3.2.1:8); See also the footnote below:

[27] *"**r**esulted in development that is **incompatible and uncharacteristic with its surrounding neighbourhood**"* (Porirua District Council, 1999, p. C3.2.1: 3); *"Where the minimum permitted activity standards are not met, the Council will consider the degree to which non-compliance results in **a development density that is not consistent or compatible with the surrounding residential environment**"(Porirua District Council, 1999, p. C3.2.1: 9)*

daylight, retention of significant views, and loss of privacy" (Porirua District Council, 1999, pp. C3.2.1: 3-2, 3-8)

Essentially then, when the council considers the effects of an infill development on the environment in Porirua, existing neighbourhood character is prioritized over the benefits of infill. Arguably, the district plan is not permissive of infill development. The stakeholders argument that the district plan negates the need for support of infill in the NGA plan doesn't hold. In fact, as the purpose of the NGA Plan is to inform the council's review of the district plan by 2016/17, I argue that support for infill in the NGA plan is necessary if the council is to statutorily ensure sustainable development in the NGA.

Instead however, the unreliability of infill development was argued to be an important consideration in the rejection of Scenario 5, in light of the LGA 2002 requirement that local councils make cost effective investments.[28] The interviewee argued that the rates gained from infill would be less than those from new developments, and would therefore be insufficient to warrant investment in infrastructure. If this was the case, then it is an important consideration, given that the need for new income generated from rates was a key driver behind planning new housing development in the first place. The viability of infill was therefore argued to be a key constraint on acceptance of Scenario 5, as funding infill intensification was difficult under the current paradigm.

However if it is the case that the plan was driven by the need to be strategic about greenfield development, and did not need to endorse infill in order for infill to be supported by the council, then I question why infill was even included as a scenario. Based on this, and the above arguments made about the reduced need to support infill through the plan, I argue that intensification was not included in the scenarios

[28] See the Local Government Act 2002 s10(1)(b), which states that the purpose of local government is to *'to meet the current and future needs of communities for good-quality local infrastructure, local public services, and performance of regulatory functions in a way that is most cost-effective for households and businesses.'*

for serious consideration, but to act as an extreme option against which to compare developments that were predetermined to be more reasonable and infitting with the existing built environment.

This discussion also raises questions regarding the value of increasing densities within a suburban context. Density is given priority in sustainable transport literature, however this is often within urban employment and neighbourhood centres. In the NGA, density was viewed as the least important 5D element to focus on the key stakeholder interviewed. This was attributed to existing housing densities, community values, and viability. Furthermore, this was attributed to the fact that Porirua functions as a satellite suburb to Wellington, meaning daily travel is predominantly generated by commutes to and from Wellington. Increased density was therefore not seen as a way to reduce the travel demand created by commuters. The stakeholder instead emphasized the importance of distance of housing to public transport to induce more sustainable transport in the NGA, as better access to the train service could induce a more substantial reduction in car use for commuting.
In summary, increasing density to levels required for significant VKT reductions, while feasible within in urban centres, may not be as achievable within more satellite neighbourhoods. When considering travel demand within the regional context, such neighbourhoods may be too far from key employment centres for increased densities to induce significant reductions in commuter travel.

However one of the central assumptions of this thesis is that planning at the neighbourhood level is an important tool for reducing local car reliance. Therefore I argue that even given these contextual limitations, increased density has an important role to play in allowing residents to access local amenities by foot or cycle, as well as improving access by these modes to public transport for longer trips. This remains an important goal within the global context of rising GHG emissions, rising transport costs, and local resilience to the effects that these may have on communities.

Furthermore, if these constraints on intensification of Plimmerton and Mana were identified before scenario testing begun, I question why it was proposed without the addition of an alternate scenario, which provided a more feasible alternative to increased density. If infill was an issue scenario 3 for example could also have proposed an increased density, ensuring the housing area was closest to shops and the train station while bypassing the difficulty of single lot development under the existing funding framework.

Other factors that influenced the consideration of scenario 5

Cycling was mostly framed in terms of recreational opportunities in the area. This meant that its role as a mode of transport was not prioritised when transport infrastructure was discussed. Cycling was first discussed in phase 2 under conversations about open space, not under talks about transport. It was stated however, 'that all roads were to be designed to include provision for walking and cycling' (Boffa Miskell 2014b). Given the high level nature of the strategic plan, it may be that the identification of suitable cycling route design was outside the plans scope. However I argue that if the plan did aim to support the implementation of cycling within street designs through district plan rules, it would have acknowledged the importance of cycling as a commuter or non recreational travel mode. If this had been done, the need to provide for a 10 minute cycle to neighbourhood centres may have influenced the chosen scenario slightly more.

Secondly, the way the criteria were categorised and scored meant that even if scenario 5 performed the best against the criteria that supported the 5Ds and sustainable transport, it was rejected in favour of the better scores of other scenarios against other criteria. This happened in two ways: contradictory criteria within transport category, and the trade offs made against good performance in other criteria categories.

Within the transport category, there was a contradiction between criteria which supported sustainable transport modes, and criteria which favoured road

infrastructure. The latter included those that addressed compatibility with the roading capacity of state highway 1 and other roads, and safety of roading connections (see list of criteria in appendix 2). Scenario 5 performed poorly against these criteria, due to perceived issues of road capacity and conflict between different modes utilising the same space, a point which will be expanded on in the next section. However Scenario 5 performed well against the criteria which aimed to encourage sustainable transport. As a result of this, the benefits of sustainable transport were in a position to be traded off against the benefits of roading.

Across all criteria, the fact that there were only 6 of 51 criteria that incorporated the 5Ds meant that even when scenario 5 did perform the best against these criteria, its benefits for transport were still traded off against the performance of other scenarios in other categories of criteria. This is in part due to the integration of so many different planning goals under the RMA 1991: under which land use planning must ensure good economic, social, cultural, and other environmental outcomes, with transport being only one of these areas. It is also due to the fact that each criteria category had an equal weighting, meaning that an overall green rating in the three heritage criteria had the ability to outweigh an orange rating for transport. As a result of this, I argue that the way the criteria were structured did not give preference to the elements of land use that could achieve the planning objective of sustainable development the best.

Discussion of transport, and the rejection of Scenario 5

However one of the most important factors raised by transport stakeholders when assessing Scenario 5 was road safety issues and funding for road upgrades to address this. The intersection of the SH1 and collector road to Plimmerton is busy, particularly during peak hours. Furthermore, the collector road crosses the railway shortly before the intersection, creating a high risk traffic environment. As a result, NZTA stakeholders argued that the increased traffic flows generated by population growth in Plimmerton may exceed the safe capacity of the SH1 intersection. If Scenario 5 went ahead, this intersection would require upgrading to increase traffic capacity,

and to separate the different grades of transport (road, rail, cycle and pedestrian) from eachother to address safety concerns. The key issue was where funding would come from for such an upgrade. While upgrades along state highways are the responsibility of NZTA, the NZTA stakeholders stated that the organisation would not fund the upgrade. This was arguably because the section of the SH1 running through the NGA would revert to a local road under the control of the local council after the opening of Transmission Gully in 2021, and as such NZTAs did not have a vested interest in upgrading the road. Porirua City Council themselves were too financially constrained to be able to fund it. When observing stakeholder discussions, this stood out as one of the key factors which constrained the support of Scenario 5. When combined with the concerns of existing suburban character, and the comparative returns to the council from infill development compared to rural land development, lead to scenario 5 being rejected in favour of scenario 2 and 3, even though it performed well enough in the multi criteria analysis to be considered further.

That the funding of an intersection upgrade was a reason for the rejection of Scenario 5 meant that roading capacity issues overrode the benefits of intensification for sustainable transport behaviour in the area. Essentially, roading was valued higher than sustainable transport.

Chapter 7: Conclusion

Dispersed urban form has a range of impacts on the environment and the wellbeing of urban residents, the largest of which is CO2 emissions from private vehicle based transport. In order to increase urban sustainability, and meet the IPCCs recommended emissions reductions targets for 2050, experts in the field of urban sustainability have called for a reduction in emissions from private vehicles in urban areas. Achieving this will require the implementation of many different instruments such as fuel and vehicle efficiency, electric cars, and demand management methods including fuel pricing. However one of the key ways of achieving significant emissions reductions is reducing the use of private vehicles, and shifting to public and active modes of travel. Redesigning urban form to ensure land use integrates and supports sustainable transport modes is the best way to induce this shift. While many different models of sustainable urban form have been put forward, they all recommend five key features which increase the sustainability of urban form and transport, which are most succinctly described by (R Ewing et al. (2007)) as the 5Ds: density, distance to transport, destination accessibility, diversity, and design. Enacting these five elements in urban planning ultimately reduces the number of VKT travelled per person, and reduces transport related emissions.

Strategic spatial planning in particular provides the ideal opportunity to incorporate these features of urban form in order to achieve more sustainable transport outcomes. It is focused on long term outcomes, aims to ensure sustainable development, and proactively directs the form of future urban development through a blueprint that integrates building, transport, and other infrastructure systems. Given its long term nature, and its goal of sustainable development, it is the ideal forum in which to consider the problem of GHG emissions. While not required of local councils in New Zealand (apart from Auckland), strategic spatial plans are being increasingly adopted by them as a way to ensure sustainable development of towns and cities.

This thesis therefore aimed to assess whether this opportunity to support sustainable transport was being put into practice in strategic spatial planning in New Zealand, through a mixed methods case study of Porirua City Councils Northern Growth Area Structure Planning process in 2014. This case study was based on analysis of planning documents, passive observations of decision making workshops, and an interview with a key stakeholder in the process, and aimed to answer the question:

To what extent does decision making in the strategic spatial planning process in Porirua support the inclusion and consideration of sustainable transport in order to increase urban sustainability?

To answer this, the study posed four questions:

1. *How well are urban form elements that induce sustainable transport outcomes incorporated in the process?*
2. *How are these elements framed in the process?*
3. *How well are these elements then considered by stakeholders?*
4. *What factors drive or constrain stakeholder consideration of these elements?*

The study first undertook a comparative assessment of how well the development scenarios incorporated the 5Ds, in order to understand whether the proposed options could induce more sustainable transport behaviour of residents in the area and reduce VKTs. Of the five scenarios presented, only one included the 5D elements to the level recommended by the literature to induce significant increases in sustainable transport. However this option was not chosen by decision makers.

The study then assessed the factors which led to the rejection of this scenario, including an assessment of how well sustainable transport considerations were integrated into the plans objectives, issues and opportunities phase, and multi criteria analysis. Based on workshop observations and interviews, it then explored how the 5Ds were considered by stakeholders during the multi criteria assessment

workshops, to identify the factors that drove or constrained stakeholders to support sustainable transport and urban form options.

Summary of findings

The NGA structure plan presented an opportunity to ensure urban development supported more sustainable transport behaviour, through incorporating sustainable urban form elements such as those stipulated in the 5Ds, and prioritising alternative transport modes when making decisions about land use and transport connections within the area. Opportunities to integrate urban form and transport in order to ensure more sustainable development in the NGA were recognised by the planners: in particular, the passenger train line running through the area was seen as a key opportunity for development to support higher use of public transport. However this opportunity was not realised in the end decision due to a range of factors.

Firstly, the plans main objective was to ensure sustainable, integrated, and efficient development, and one of the sub objectives was to integrate land use development patterns with transport networks. However, the objectives did not specify the integration of land use and transport for more sustainable transport outcomes, nor did it specify the need to address climate change. As the objectives determine which factors are included for consideration in urban planning, they must include sustainable transport and its role for addressing climate change if future development is to support more sustainable transport, and therefore increased urban sustainability. Failure to do so meant that the integration of sustainable transport and urban form was not systematically included within the scenarios and criteria used to assess them, and ultimately limited the extent to which the plan supported sustainable transport outcomes.

As a result of this, the integration of transport and urban form as measured by the 5Ds were not included in the criteria to an extent which allowed stakeholders to consider their benefits for sustainable development. Of the fifty one criteria, only six

incorporated the 5D elements. While some were framed in a way which highlighted the benefits for sustainable transport, such as those relate to destination accessibility, some of them were framed in a way which contradicted their value for sustainable transport behaviour. Failure to include more of the 5Ds in the multi criteria analysis in a way which highlighted their benefits for sustainable transport limited the extent to which stakeholders could consider sustainable transport outcomes when assessing each scenario. This was another factor which influenced the rejection of Scenario 5.

Building on this, while some criteria included the need to consider density, it was only to the extent that the proposed densities maintained the existing character of the suburb. When assessed against these criteria, Scenario 5 was rejected as the proposed density was significantly higher than those existing. Existing character therefore overrode the benefits of increased density for more sustainable transport behaviour, and wider urban sustainability.

During the multi criteria assessment, other factors were raised and considered by stakeholders as reasons to reject Scenario 5 in favour of the new village and extension proposals. In particular, predicted road capacity concerns at the intersection of Plimmerton and SH1 that would result from the development of Plimmerton were argued to constrain Scenario 5. Issues of funding the upgrades necessary to allow safe access to Plimmerton in future were also a constraining factor on the ability to implement Scenario 5. I argue that this was a key factor that lead to the rejection of Scenario 5.

During the stakeholder interview, the role of returns on council investment from infill development was also identified as a factor which constrained the choosing of Scenario 5. The nature of development under an infill approach does not provide enough certainty of the rate of housing development and return for the council for it to be favourable, given that the council relies on the development and financial contributions from new development for a significant part of its income. Funding issues therefore constrained the support of the most sustainable transport outcome.

Limitations

This case study sheds light on the way strategic spatial planning can address sustainable transport issues, the extent to which local councils in New Zealand integrate transport considerations into their strategic spatial plans, and the factors that drive and constrain the integration of sustainable transport concerns in the decision making process. Porirua was chosen as a case study due to the timing of its strategic spatial planning, which provided a unique opportunity to observe and assess a strategic spatial planning process as it occurred, thus gaining insight into the backroom decisions which determine what is and isn't included in the resulting plan.

However the use of a single case study methodology means the findings have only limited representation the approach taken to integrating transport and urban form in strategic spatial plans in New Zealand more generally. In particular, a single case study does not allow wider conclusions to be drawn about the key factors that may constrain the integration of sustainable transport across all strategic planning processes. If transport sustainability is to be best supported through strategic planning in future then, it is recommended that a comparative study of strategic plans within the New Zealand planning framework be done in order to ascertain if there are common factors limiting the inclusion of sustainable transport and urban form elements in strategic planning.

Secondly, while the stakeholder interviewed shed significant light on the planning process; from the rationale behind the plans approach and what it included, to the factors that influenced the decisions made about transport, the study would have benefited from interviews with a wider range of transport related stakeholders. This would have provided a fuller picture of the factors which each stakeholder who evaluated the relevant criteria were considering when they discussed transport issues, and allowed for a more rigorous assessment of the arguments put forward by them in workshop discussions.

Future research

Local councils are increasingly adopting a strategic spatial planning approach throughout the country. As touched on in the above section, a comparative study of the approaches taken across existing strategic spatial plans would be useful in order to understand the factors constraining the support of sustainable form elements and transport modes in these plans. This research would provide stronger evidence on which to base recommendations for better planning practice in future. Such a study would also provide a comparison of the different approaches taken by councils toward integrating sustainable transport within their jurisdictions. This would give a valuable insight into the ways that concepts of urban form and transport integration and the 5Ds can be best implemented in real world local planning environments, and provide examples to planning practitioners for future strategic spatial planning.

Appendices

Appendix 1. Opportunities and constraints recognised in Phase 1 of the Northern Growth Area Structure Planning process

Item		Opportunities and Constraints
Land use and Characteristics	Rural area	Large area of rural land suitable for greenfield development. A number of gullies, wetlands and steep land pose constraints to development.
	Urban areas	Intensification of existing urban areas provides an opportunity to support existing town centres, transportation links and open space areas, as well as provide new types of housing not currently provided in Porirua City.
	Business/service areas	Opportunity to provide local employment through live/work areas. Risk of changing the character or impacting amenity in existing residential areas.
Geology and Geotechnical	Geology	Mix of geology across project area which poses a stability and erosion risk. Care will be required for earthworks and building, including run-off (sediment management).
Hazards	Ground shaking and fault rupture	The Pukerua Bay Fault and Ohariu Fault are in the vicinity of the project area and need to be considered in overall planning and development.
	Liquefaction	Liquefaction potential is classed as being low to variable within low lying areas with specific consideration of the risks in these areas.
	Stability	Potential for slope failure risk across the project area. Measures will need to be investigated and adopted to address this risk.
	Sea Level Rise/Storm Surge/Tsunami	Low lying areas, particularly in Mana and Plimmerton are at risk from sea level rise, storm surges and tsunami. Consideration of these risks would be required if these areas are to be identified for more intensive development.
	Flooding	Area around James Street, Ulric Street and Plimmerton Domain currently experiences periodic flooding. Development need to avoid areas of flooding, and potential opportunity to reduce extent and magnitude of flooding.
Transportation	Road – State Highway 1	Revocation of the State Highway status of existing SH1 to a local road (due to opening of Transmission Gully Motorway) provides opportunity for new connections and access.
	Road – Local Roads	Network of local roads within existing urban areas, but limited roads in rural areas. Opportunity to create a connected network of new roads. Constraint with the capacity of existing local roads which new roads may connect with.

Item		Opportunities and Constraints
	Public Transport - Bus	No current bus service. Potential opportunity for a bus service for the area if population sufficient.
	Public Transport – Rail	North Island Main Trunk Railway traverses through project area with the Wellington passenger rail service operating. Opportunities to expand rail service (e.g. more regular services, improved park and ride facilities).
	Pedestrian/Cycling	Ara Harakeke pathway provides an active transport route through project area. Opportunities to extend walking/cycling network and integrate this throughout the future development corridor.
Reticulated Infrastructure/ Services	Water Supply	GWRC bulk water supply runs through project area. New reservoir capacity would be required. Opportunity to incorporate water sensitive design to minimise demand for water.
	Wastewater	Existing wastewater trunk main is at or near capacity and an upgrade will be required to service new development. Opportunities to improve the efficiency of the existing wastewater network with additional flow. Contributions from development of the structure plan area will go towards upgrading the Porirua Wastewater Treatment Plant
	Stormwater	Stormwater follows natural watercourses with the majority entering Taupo Swamp or Pauatahanui Inlet. Opportunity to improve stormwater quality and quantity through design of stormwater management mechanisms as part of development, including adopting sustainable principles and measures.
	Electricity	Extension of the electricity network would be required. An expansion to the James Street substation or new substation may be required.
Community/Social Infrastructure	Schools	Capacity of existing primary schools likely to be exceeded by new population, prompting need for a new primary school. Existing secondary schools should have sufficient capacity, and if necessary this can be re-evaluated in the long term (beyond 2032) in considering further extension of the structure plan area.

Item		Opportunities and Constraints
	Health/medical	Existing local, city and regional facilities will generally met needs of the new community. Additional local facilities may be required.
	Recreation/reserves	It is considered that there is no need for new sports fields in the new community, however upgrades to existing fields nearby are likely to be required to cater for growth associated with increased use from the new community. Opportunity for enhanced green network with two new local neighbourhood reserves and a community reserve and walking/cycling network. Need for a 3rd neighbourhood reserve could be re-evaluated in the long term (beyond 2032).
	Cemetery	Whenuapu Cemetery is a key community asset. Opportunity to protect inappropriate development adjacent to cemetery and provision for expansion to meet future need.
Landscape/ Environmental	Rural	Areas of special landscape value, such as coastal ridgeline on the western side and the Kakaho ridgeline on the eastern side, and the northern side of Pauatahanui Inlet. Different landscape character areas identified which have distinctive features, values and capacity for change. Development to take into account these landscape values.
	Suburban	Existing urban areas have defined natural and physical characteristics. Intensification in these existing areas should respect and not detract from these qualities. New urban development should seek to reflect and adopt the positive attributes of the existing urban patterns and qualities.
	Ecological Sites	Number of significant ecological sites, including Taupo Swamp, regenerating indigenous vegetation and wetlands, principally in gullies. Risk to ecological values associated with development in close proximity to these areas. Opportunity to protect and enhance ecological values, such as connecting ecologically significant areas.

	Water bodies and Fish Species	Number of small permanent and intermittent streams, with the majority of the project area in the Taupo Swamp catchment. Development has the potential to adversely affect water bodies through direct impacts on the streams themselves (e.g. levelling the landscape, piping

Item		Opportunities and Constraints
		and diversions) and indirect impacts (e.g. run-off and escaping pests and weeds). Opportunities to protect water bodies and expand wetlands and retire land for riparian areas (headwaters).
Heritage/Cultural	Heritage Sites and Values	Various heritage sites including buildings, pa, middens, notable trees and places of historic events. Development can protect the values of these sites.
	Cultural Sites and Values	he project area has a long and rich history of use and occupation by Maori. Key areas of cultural interest include Ngati Toa Domain, Taua-Tapu Track, Taupo Swamp and Turi Kawera (old Toa Rangatira settlement). Development has the potential to disturb or destroy these values or sites. Opportunity to design development areas to avoid these sites.

Appendix 2. Criteria used to assess scenarios

REGIONAL/CITY CONTEXT

1. **Regional Land Supply:** Provides land supply for Wellington Regional household projections
2. **Employment Land Supply:** Encourages employment growth – industrial and commercial land supply
3. **Living Environment Choice:** Complements the choice of living environments in the region – setting, densities, typology and tenures
4. **City Context**: Connects with existing villages/urban areas to allow sharing of amenities/facilities, services
5. **Distinctive Identity of Existing**: Maintains the identity of existing villages/urban areas - Pukerua Bay, Plimmerton, Mana, Camborne

ECONOMIC

1. **Demand:** Provides for the projected demand in terms of households numbers, dwellings sizes and business land needed.
2. **Viability:** Provides for an economically viable form of development
3. **Economic Opportunities**: Enhances business and employment opportunities and distribution to reflect local, city and regional needs
4. **Existing Uses:** Provides for existing productive land uses such as farming to continue until land use changes (such as to residential) occur
5. **Interface between Land Uses:** Enables appropriate transitional/buffer zones between different urban land uses and urban and rural land uses
6. **Staging:** Provides for staged form of development to recognise market demand (rate and density of development) and practicalities of developing and maintaining essential infrastructure services and community facilities. Includes optimal performance and Whole of Life costs.
7. **Maintenance and Operational Costs:** Provides a sustainable maintenance and operational basis of essential infrastructure and community facilities for Council and community. Includes minimising Whole of Life Costs and recognising asset depreciation and funding requirements

IDENTITY

1. **Responds to Character and Amenity:** Enables the natural and aesthetic qualities and attributes of the area (e.g. views, landscape, ecology, proximity to other centres) to be recognised and provided for in the character of the development.
2. **Distinctive Form:** Distinguishes the form of development from that of other villages/urban areas - building areas that are responsive to the topography of the land.

TRANSPORTATION AND MOVEMENT

1. Public Transport: Provides for accessibility to and supports and enhances public transport services/infrastructure and usage
2. Walkability and Cycling: Provides for accessibility to a village/urban centre by 10 minute walk or cycle.
3. Safety: Enables safe (including CPTED) walking and cycling corridors to social infrastructure within village/urban centre.
4. State Highway 1: Compatible with capacity and provides safe local connections to revoked State Highway 1.
5. Other roads: Compatible with capacity and provides safe connections to existing local road network.
6. Other roads: Provides for an efficient and adaptive street and pedestrian/cycleway corridor layout and street orientation, which maximises connectivity and landscape responsive building development areas and minimises vehicle traffic/pedestrian/cyclist conflict.
7. Multi-modal Transportation Forms: Promotes multi-modal transportation forms, such as public transport routes, bus stops, cycleways, footpaths, bridge paths.
8. Property Access: Provides all properties with legal and physical access to roads (i.e. avoids land locking properties).

SERVICES INFRASTRUCTURE

1. Network Approach: Provides for an efficient reticulated network design which considers all services in a comprehensive and spatial manner
2. Water: Provides for potable and fire-fighting water supply with inbuilt resilience and water conservation considerations.
3. Sewer: Provides for sewer reticulation with inbuilt resilience, security, sustainability and water conservation considerations.
4. Stormwater Management: Provide for Low Impact Design storm water management within infrastructure and reduces discharges of sediment to sensitive environments including but not limited to Taupo Swamp, Pauatahanui Inlet and Porirua Harbour.
5. Long Term Planning: Provides flexibility to future proof infrastructure for anticipated long term development.
6. Non-Council Infrastructure: Ability for infrastructure not in Council's control to be operated and maintained in the long term (e.g. on-site stormwater treatment to be simple and robust).

ENVIRONMENT

1. Landscapes of Value: Minimises the physical and visual impact on Special Amenity Landscapes and Outstanding Natural Features – Porirua Landscape Management Strategy for Rural and Open Space Areas.
2. Landscape character: Maintains the local landscape character taking into account

visual features, associative values and sensitivity to change.

3. Landscape Enhancement: Enables development to enhance the landscape – e.g. land retirement, re-vegetation, feature protection.
4. Ecological Sites: Maintains the values of recognised ecological sites – including but not limited to Taupo Swamp.
5. Ecological Enhancement: Enables development to provide ecological corridors, linkages between existing sites, and retirement of areas to enhance ecological values.
6. Stormwater Management: Reduces discharge of contaminants (sediment and pollutants) into sensitive environments (e.g. Taupo Swamp, Pauatahanui Inlet and Coastal Marine Area).
7. Natural Hazards and Climate Change: Avoids development (buildings) in areas prone to high risk from natural hazards including Ground Shaking, Liquefaction, Stability, Sea Level Rise/Storm Surge/Tsunami, Flooding, including effects of climate change.
8. Resilience of Community Facilities: Resilience in the spatial distribution/ provision of community services and facilities, and service areas (shops, medical clinics, sites/facilities for the supply of goods and services).
9. Impacts on Climate Change: Minimise impacts that contribute to climate change, such as through the provision of non-fossil-fuel transport mode enhancement (electric commuter trains, cycleways, walking), green corridors/neighbourhoods to reinforce biodiversity values, efficient use of energy (e.g. passive solar design) and potential forms of renewable electricity generation (such as small and community scale distributed energy generation).
10. Hydrology: Stormwater management in terms of volume, peaks and flooding.
11. Earthworks: Minimisation of earthworks to reduce sedimentation of waterbodies. Erosion risk and not exacerbate natural hazards.
12. Stream Loss: Minimise impacts on stream loss, particularly headwaters, through no bulk earthworks. Development avoids perennial streams.

HERITAGE

13. Heritage/Cultural Sites: Protects the values of recognised sites of heritage/cultural value – archaeological, built heritage and Maori sites
14. Heritage/Cultural Management: Enables development to provide for the management, including but not limited to protection of heritage/cultural sites.
15. Unknown Sites: Allows protection of unknown areas and sites/areas of possible cultural/heritage significance.

OPEN SPACE

1. Linked Network: Provides for a linked network of open space - alternative walking/cycling movement network, informal recreational use, and ecological corridors and access to natural places.
2. Local Open Space Recreation: Provide for local open space recreational uses

including parks. Also provide variety in open space and recreation opportunities, for all ages and abilities.

3. Non-urban Open Space: Provide for the sustainable management of open space land not developed for urban purposes.
4. Crime Prevention through Design: Enables open space design in accordance with CPTED principles.

SOCIAL

1. Existing Capacity: Compatible with capacity of existing schools, healthcare and other social infrastructure needs within city context or provides for new facilities as appropriate.
2. Interaction: Provides for social interaction opportunities within urban form.
3. Social Services and Facilities: Enables safe operation of community social services and facilities in a way that contributes to community wellbeing – for people of varying ages and abilities.
4. Village Plans: Realisation of community outcomes specified in Village Plans.

Appendix 3: List of stakeholder groups invited to participate in the NGA workshops (taken from agenda of workshop 08/04/2014)

1. New Zealand Transport Agency
2. Ministry of Education
3. Department of Conservation
4. Greater Wellington Regional Council
5. Porirua City Council (staff from the following areas)
    a. Asset management
    b. Policy and planning
    c. Community planning
    d. Amenities planning
    e. Sustainability officers
    f. Consenting officers
6. Wellington Electricity
7. Capacity Infrastructure
8. New Zealand Historic Places Trust
9. Capital and Coast Health
10. Ngati Toa

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