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Lincoln University Digital Dissertation

Productive housing :
Exploring potential at the intersection of housing and highly productive land in New Zealand

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A dissertation submitted
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by

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Abstract

Aotearoa New Zealand's most productive soils are under threat from urban sprawl, and in particular by the subdivision of rural land for low to medium-density housing developments. Although strategic planning is undertaken by district councils to identify city limits and the best areas for urban expansion, district plans can be challenged privately by developers, through a 'plan change request' process.

Plan Change 69 (PC69) is one of many developer-led proposals in the Selwyn District seeking to rezone rural land for residential development. Using PC69 as a case study, this research investigates opportunities to reconcile the demand for housing and the preservation of highly productive land.

The study uses a 'design thinking' framework, first seeking to understand the sentiment of the existing community, then responding with potential design scenarios based on relevant urban design theory. The purpose of this design research, rather than finding a singular and conclusive solution, is to provide multiple opportunities as a source for discussion, debate and future research.

Alongside the PC69 proposal, three possible alternative futures are identified which explore potential at the intersection of housing and food, and the implications of prioritising one dimension over another. These highlight that there is potential to integrate both housing and food on highly productive land, though to achieve this, we may need to embrace residential models that differ from the current low-density approach applied in most peri-urban greenfield sites in Aotearoa.

Acknowledgements

Ēhara tāku toa i te toa takitahi, engari he toa takitini.
My success is not mine alone, but it is the strength of many.

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1 Introduction

New Zealand's most productive soils are under threat from urban sprawl, and in particular by the subdivision of rural land for residential developments. This issue is primarily related to the peri-urban setting, which has been defined as the zone on the fringe of cities, in between urban and rural areas (Opitz, Berges, Piorr, & Krikser, 2015; Viljoen & Bohn, 2009; Viljoen & Howe, 2005), and will be the focus of this dissertation. This chapter briefly looks at what the issue is, how it has come about, and the purpose and structure of the research.

1.1 The loss of highly productive land in Aotearoa

As our cities in Aotearoa New Zealand expand to meet population growth, agricultural land on the fringes of our urban areas is coming under increasing pressure from the demand for housing (Curran-Cournane et al.,2018; Greenhalgh et al., 2017, as cited in Ministry for the Environment & Stats NZ (2021)).

Large areas of this peri-urban land could be identified as 'highly productive land', owing to its capacity to support primary production activities, including factors such as soil type, climate, water availability and access to labour (Ministry for Primary Industries & Ministry for the Environment, 2019). Around 15 percent of New Zealand's land is considered 'highly productive' (Ministry for the Environment & Stats NZ, 2021); it is a finite resource and therefore in using this land for other activities we are diminishing our ability to produce food in the future.

In New Zealand, between 2002 and 2019, the area of highly productive land utilised by housing increased by more than 50 percent (Ministry for the Environment & Stats NZ, 2021). Figure 1 illustrates the amount of urban expansion onto highly productive land across six regions of Aotearoa between 1996 and 2018, showing that it is also predominantly a peri-urban issue. Recent efforts to manage urban growth include the 'National Policy Statement on Urban Development (2020)' (NPS-UD), and 'Valuing Highly Productive land: A discussion document on a proposed national policy statement for highly productive land (2019)'. The NPS-UD, seeks to enable greater intensification

and responsiveness, and more strategic planning with wider outcomes. The proposed ‘National Policy Statement for Highly Productive Land’ (NPS-HPL) has yet to be published however, and as a result there is limited protection for highly productive land from much needed residential development.

1.2 Planning for housing or food?

Although strategic planning is undertaken by district councils to identify the best areas for urban expansion, for example 'Greenfield Priority Areas', this can be challenged privately through ‘plan change requests’. The NPS-UD directs local councils to have particular regard to these proposals if they provide significant development capacity and meet other urban planning criteria (Ministry for the Environment, 2020), therefore councils must decide which land use activity to prioritise, housing or food.

1.3 Research purpose

Considering a spectrum of different responses to this issue, at one extreme we could preserve and protect all highly productive land, and at the other, continue with ‘business as usual’ suburban sprawl. A third response might ask, what opportunities lie between? The purpose of this research is to understand the issue of housing on highly productive land and tease out a range of possibilities for integrating housing and food, between these two extremes.

1.4 Research structure

The dissertation will take the following structure; Chapter 2 investigates the literature on housing, food and the intersection of these two themes. Chapter 3 discusses the methodology for this research which includes using a case study as well as the ‘design thinking process’ as a framework. Chapter 4 looks into the specific case study chosen for this research, which is a plan change request proposing housing on highly productive land. Chapter 5 involves a discourse analysis on the community submissions responding to the plan change proposal, while Chapter 6 defines a set of opportunities for spatial design which seek to address the community’s concerns. Chapter 7 develops some general concepts from the opportunities defined in the last chapter, and Chapter 8 applies these concepts to the case study site; developing three alternative future scenarios to compare with the current plan change proposal. Because of the reflexive and iterative nature of the approach the 'discussion' is distributed through Chapters 5 and 8. This is then followed by a conclusion in Chapter 9 which also discusses opportunities for future research.

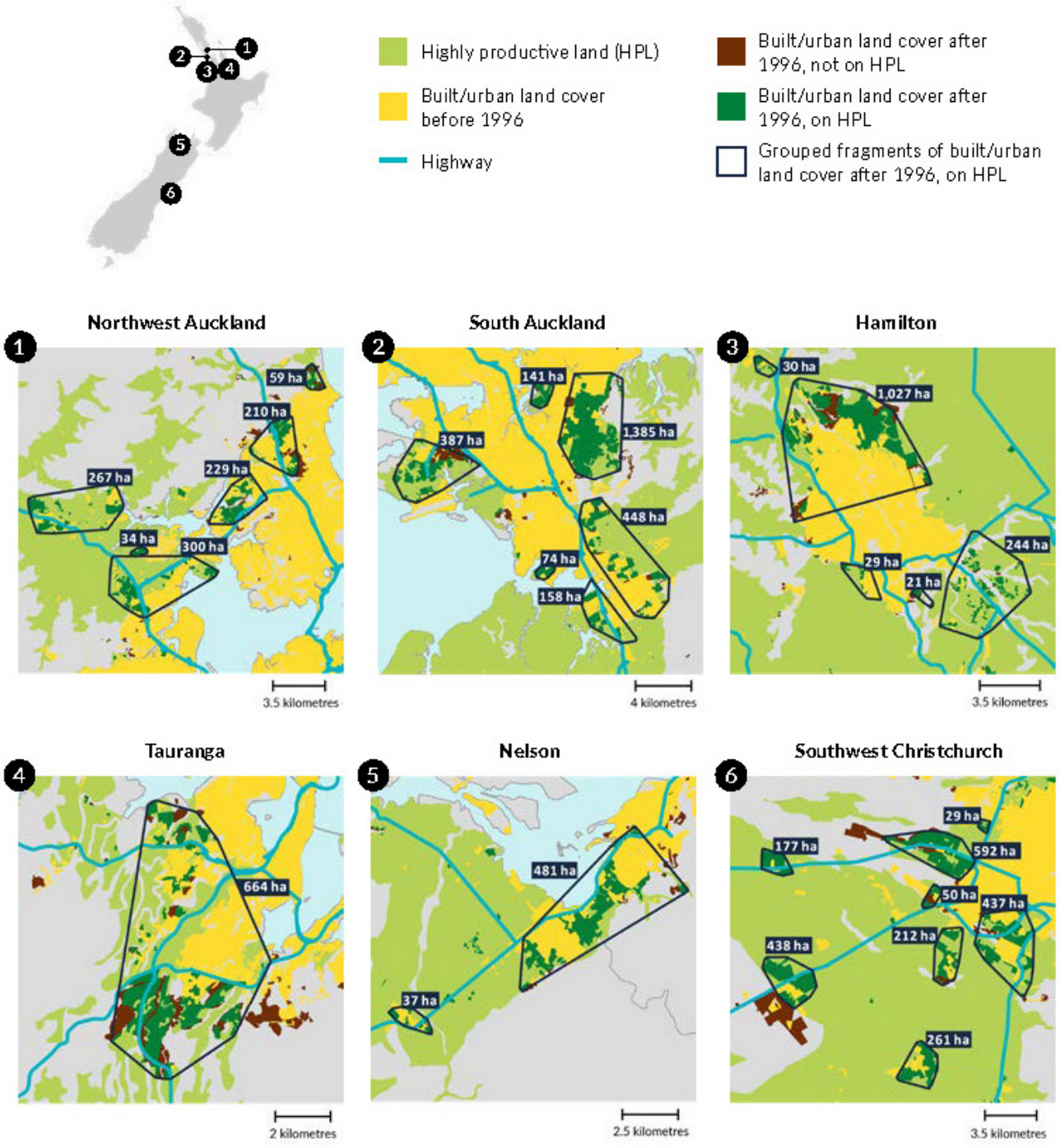

Figure 1. Residential expansion onto highly productive land
(From Ministry for the Environment & Stats NZ, 2021. p.21)

2 Literature Review

The topic is highly complex and covers a wide range of interconnected themes, for example housing, food production, urban planning, transport, community infrastructure, ecosystem services. However, given the limited scope of the dissertation, the literature review will focus on the two significant themes of housing and food, as well as the intersection of these. These will be grounded in an Aotearoa New Zealand context, using statistics and government reports, but also connect more broadly to relevant urban design theory.

2.1 Housing

Housing is the key land use component driving the issue on highly productive land, therefore it is important to understand why this is happening, what the outcomes are, and what some of the potential solutions might be. This section will look at the current situation in New Zealand including supply and demand, typologies, density and then finally neighbourhood design.

2.1.1 A Housing Crisis?

Aotearoa New Zealand's housing supply has grown significantly within the last thirty years, but this has been exceeded by "population growth, increasing demand for larger houses, and the desire for multiple home ownership" (Stats NZ, 2020, p. 113). In recent years, the media has frequently referred to Aotearoa's housing situation as a 'Housing Crisis', and to help combat this deficit in supply, the New Zealand government released the 'National Policy Statement on Urban Development (2020)' (NPS-UD) to help free up land for housing.

However, some argue that the crisis is more related to shortage of affordable homes (Stats NZ, 2020), which is the relationship between income and what people spend on housing. The accepted measure of affordability "is that housing is affordable if low income households spend less than 30% of their income on housing" (Chan & Adabre, 2019, p. 113). Using this figure, the number of households living in affordable housing in Aotearoa is trending downward, with around 40 percent

of renters and 25 percent of homeowners spending 30 percent or more of their income on housing in 2020 (Stats NZ, 2020).

If housing affordability in New Zealand is decreasing, are we building the right kinds of homes?

2.1.2 Housing Typologies

Standalone houses on large lots remain the most favourable typology in the Greater Christchurch Area (Christchurch, Waimakariri, and Selwyn Districts) (Greater Christchurch Partnership, 2019), and data shows that in the last fifty years house sizes have grown from an average of around 110m2 to more than 150m2 (Stats NZ, 2020). Although we have been seeing larger houses on smaller sections, we are also starting to build different typologies in New Zealand, with housing intensification resulting in more multi-unit dwellings at a higher density (Stats NZ, 2020). It is expected that future demand from elderly, and smaller average households will see this trend for smaller units continue (Greater Christchurch Partnership, 2019).

However, in a recent study of New Zealand housing preferences, Bryson (2017) found that there was a reluctance by New Zealanders to accept these new typologies, with stand-alone houses preferred by most. She argues that this may be in part, due to the location and design of medium density housing in New Zealand and that many developments of this nature still have a heavy dependence on car travel (Bryson, 2017).

In fact, this transportation issue is linked to suburban development in general, rather than being limited to medium density developments. In the book chapter 'What is Sprawl?', Gillham (2013) discusses how the accessibility of different transport types tends to be quite limited in the suburbs, and as a result many trips must be taken by car.

What does medium density mean, and how does it relate to housing design?

2.1.3 Density

Density is a measure of housing units or population on a given land area and is often expressed as the number of dwellings per hectare (dph) (Bryson & Allen, 2017; Llewelyn-Davies, 2000). Housing can also be generalised as low, medium, or high density, but the meaning and perception of these terms varies in different regions and contexts, (Bryson & Allen, 2017) and is greatly affected by cultural norms (Lozano, 2013).

In Aotearoa, neighbourhood densities are usually measured as a net figure, rather than gross. The Canterbury Regional Policy Statement defines 'net density' as including all land for residential purposes, local roads, pedestrian and cycleways and local reserves (Environment Canterbury Regional Council, 2021). However, it excludes land designated for stormwater management, community services, or regionally significant open space, as well as land with significant ecological, cultural or heritage values or that is geotechnically constrained (Environment Canterbury Regional Council, 2021).

Most residential development in the Selwyn District measures at 10 dwellings per hectare or less, but the Selwyn District Council would like to see more diversity and argues that higher densities can be achieved through either smaller lot sizes, or by taking a comprehensive approach to housing design (Selwyn District Council & Context Urban Design, 2011). Figure 2 shows various small lot and comprehensive housing typologies and their approximate densities. Comprehensive housing development requires an integrated approach to the entire subdivision, including buildings, roads and house lots (Selwyn District Council & Context Urban Design, 2011). It has the advantage that higher yields can be achieved along with a greater level of cohesiveness when compared with small lot subdivision (Selwyn District Council & Context Urban Design, 2011).

At a site scale, density can used to describe typologies rather than neighbourhood density, often characterised by the physical dimensions of the house or lot. For example, Bryson and Allen (2017) state that in Aotearoa low density housing is generally understood to be between one and two stories and on sections greater than 400 square metres, whereas high density housing is generally considered to be any apartment building greater than 6 stories in height. Anything in between these two is generally regarded as medium density (Bryson & Allen, 2017).

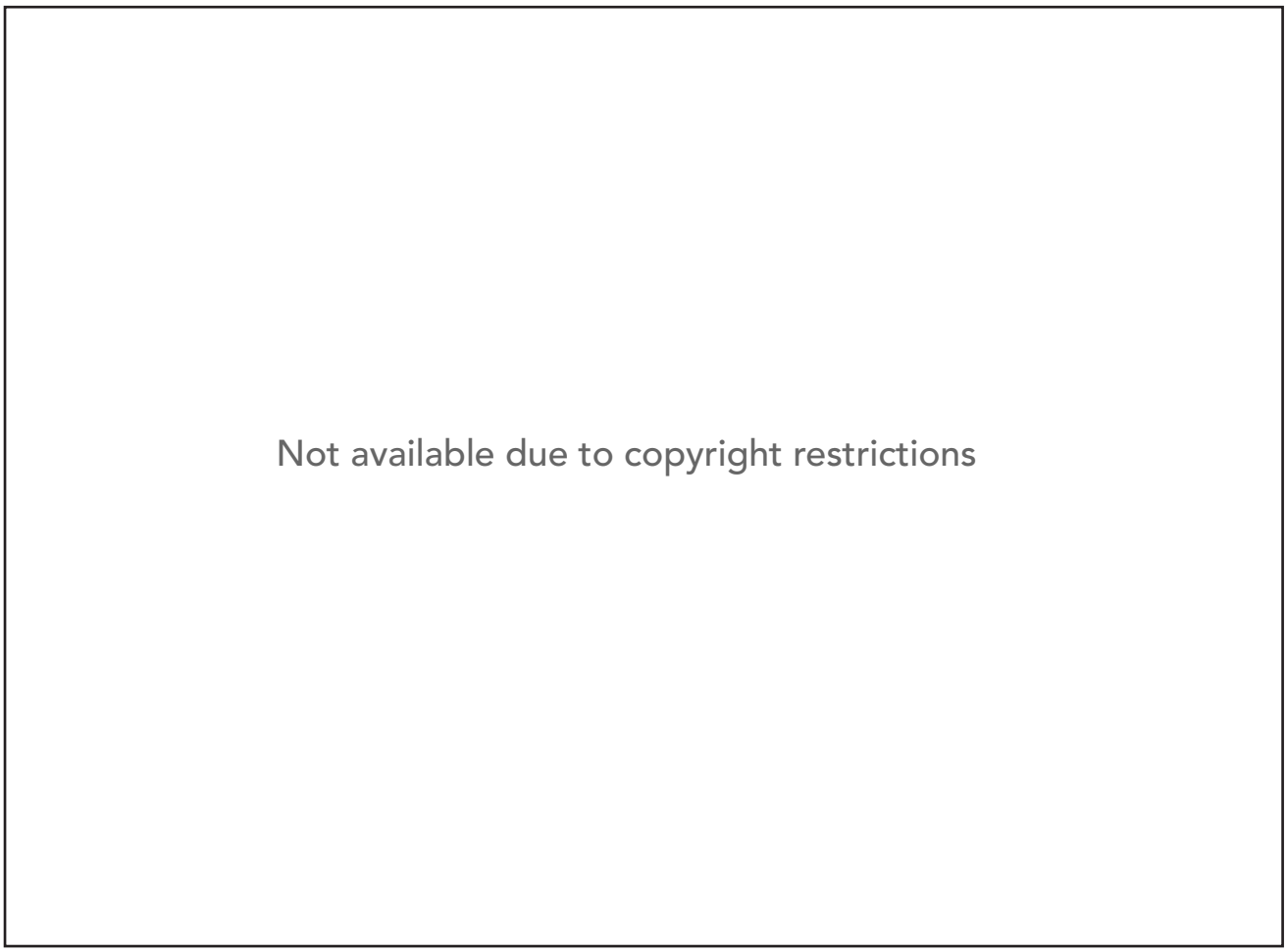

Figure 2. Small lot and comprehensive housing typologies
(From Selwyn District Council, 2011. p.3)

2.1.3 Density and Design

In the article, 'Density: Objective Measure or Critical Tool of the Neoliberal Agenda?' Harper (2019, p. 50) states that "The measurability of density ratios gives them great veracity, enabling developers to calculate potential returns based on ratios of rentable floor space per square meterage of site". Harper argues that care needs to be taken when prescribing density ratios for planning urban development, and expecting particular outcomes. To illustrate this, she gives the example of architects Leslie Martin and Lionel March, who demonstrated that high density requirements, could be used to produce low-rise urban form and would not necessarily have to result in tower blocks (Figure 3). Clearly there is a distinction between measured and perceived density, and therefore consideration needs to be given to design's role in density decisions (Harper, 2019). Studies have shown that design can help mitigate the "negative perceptions of density" (Lozano, 2013).

With regard to design at higher densities, Lozano (2013, p. 409) argues that we need balance and variety, stating, "Optimal density is not one constant value but many different values. In the continuum between personal privacy and community-wide interaction, density is one of the key factors in increasing choice." He goes on to state that ideally we get to choose at different times how we participate in urban life, whether that is amongst the crowds or in more private settings.

These examples give support to an integrated and holistic approach to the design of our neighbourhoods, which could provide housing choice using a variety of typologies.

2.1.4 Neighbourhood Design

Typical suburban planning separates land uses into individual mono-functional zones (Gillham, 2013), meaning that people's homes are not in close proximity to their workplaces or other amenities. A concept which addresses this issue is 'Smart growth'; a term referring to development which prioritises pedestrian friendly, mixed-use environments, often within existing city limits (Monclús, 2018). Consolidating growth in a compact form creates efficient transport connections and is a way of supporting local businesses and amenities while also making sure that communities can access everything they need within walking distance (Greater Christchurch Partnership, 2019).

There are a few benchmarks for the size of a walkable neighbourhood; with five and ten-minute walking distances commonly used, these equate to 400 and 800 metre catchments from the centre, respectively. Figure 4 illustrates the concept of a 'ten-minute neighbourhood', highlighting the

Figure 3. Two variations of the same density
(From Martin and March, n.d. cited in Harper, 2019. p. 41)

Figure 4. The ten-minute neighbourhood
(From Greater Christchurch Partnership, 2019. p. 36)

elements needed to meet people's everyday needs and create a walkable neighbourhood (Greater Christchurch Partnership, 2019). These neighbourhood facilities may include schools, medical facilities, employment opportunities and open space, but will vary depending on connectivity to other centres, and on the community's population size for example, Table 1 gives an estimation of the population needed to support various local facilities in the United Kingdom (Barton, Grant, & Guise, 2021).

Llewelyn-Davies (2000) illustrates that walkable neighbourhoods could take different forms depending on its context, for example, Figure 5 shows how the centre as well as the overall shape of the neighbourhood might respond to various infrastructure and landscape settings. Llewelyn-Davies (2000) also argues that centres are ideally positioned at the intersection of main movement corridors to integrate public transport and commercial functions in one high activity zone. There is strong support for positioning centres at the intersection of main movement corridors and public transport nodes, to bring together functions in one high activity zone and reduce dependence on private vehicles (Llewelyn-Davies, 2000; Rogers, 1997) .

This review of literature on housing reveals that it is a complex topic and needs to be addressed at a much wider scale than can be understood by looking at buildings alone. The theory suggests that the success of housing is related to its integration within compact, walkable neighbourhoods that have the right balance of diversity and choice to serve its community. This is supported by the National Policy Statement on Urban Development (NPS-UD) which under Policy 1, discusses the need for a variety of homes, and good accessibility between "housing, jobs, community services, natural spaces, and open spaces, including by way of public or active transport" (Ministry for the Environment, 2020, p. 10).

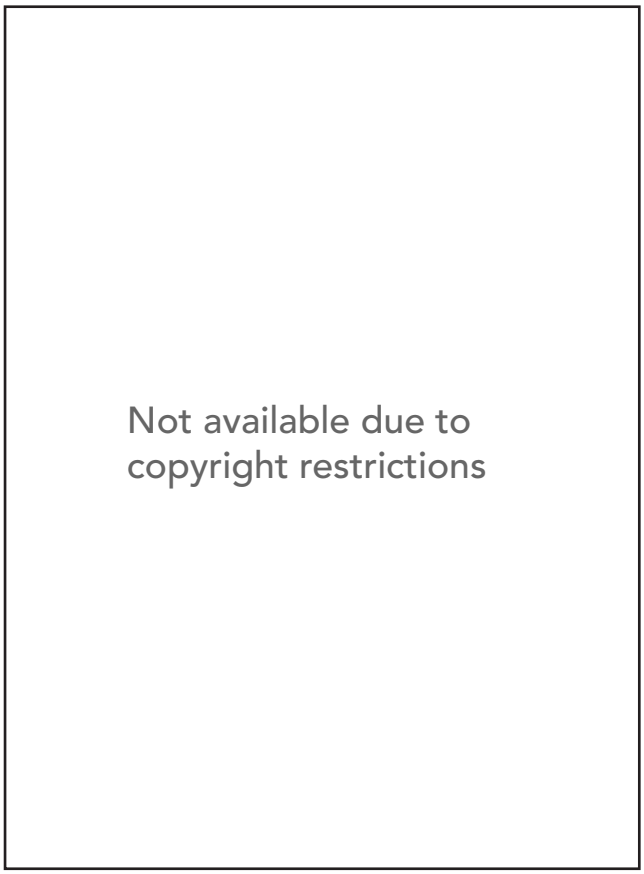

Table 1. Population thresholds for local facilities
(From Barton, Grant, & Guise, 2021. p.143)

Figure 5. Neighbourhood form
(From Llewelyn-Davies, 2000. p.40)

2.2 Food

2.2.1 Highly Productive Land

Around 15 percent of New Zealand's land is considered 'highly productive' (Ministry for the Environment & Stats NZ, 2021), owing to its capacity to support primary production activities, including factors such as soil type, climate, water availability and access to labour (Ministry for Primary Industries & Ministry for the Environment, 2019). Large areas of this highly productive land lie in the peri-urban zone on the fringes of our cities; the land's food production capabilities often the primary reason for the city's establishment in these locations (Hunt 1959; Coleman 1967; Cox 1968; Leamy 1975, as cited in Curran-Cournane et al., 2023).

Currently, Aotearoa exports over 80 percent of the food it produces (Bayne & Renwick, 2021) and the demand for dairy products globally is increasing, putting more pressure on New Zealand's highly productive land (Vogeler et al. 2014; Ministry for Primary Industries 2020b, as cited in Curran-Cournane et al., 2023). However, this may not be the best use of this land, since highest quality soils are most valuable for growing crops such as "potatoes, onions, and leafy green vegetables. Land in lower LUC classes is most suitable for grazing livestock" (Lynn et al., 2009, as cited in Ministry for the Environment & Stats NZ, 2021, p. 19).

Furthermore, highly productive land has been noted as being particularly significant for meeting Aotearoa's domestic food production needs (Curran-Cournane et al., 2023; Ministry for the Environment & Stats NZ, 2021). What are our local food consumption requirements, and how much land is needed to support the local population?

2.2.2 Quantifying local food needs

There have been a number of references to the land area required to sustain people throughout history, from the middle-ages, through to city-scale utopian schemes of the early 20th Century. According to 'The Wiley Blackwell Encyclopedia of Anglo-Saxon England', the unit of land which was farmed to support a peasant family during Anglo-Saxon times was termed a 'hide' (Lapidge, 2014). The land area was frequently around 48 hectares, but this could vary based on the land's value and available resources (Lapidge, 2014). By the eleventh century the 'hide' could support four families. Although this gives us some idea of land area, "it is the size and nature of the family that is still in

doubt" (Lapidge, 2014, p. 366). Additionally, the term 'resources' also indicates a broader meaning than food alone.

Allotments were very popular during the late 19th and early 20th Centuries, and defined as "a small plot of land, not attached to a dwelling, that is cultivated to produce food intended for the consumption of the gardener and his or her family" (Nilsen, 2014, p. 7). They had a standard size associated with them which changed over time, but was between the range of 10 and 40 poles, the equivalent of between 250 and 1,000 square metres (Nilsen, 2014). Although there are anecdotal reports of these being extremely productive, it is not clear if the allotment was meant to supply all food for the family, or if this was supplemented with produce from elsewhere.

The designers of several utopian city-scale schemes deliberately planned for productive land to feed their residents. Ebenezer Howard's Garden City set aside 5/6 of the total land of each settlement for farms and forest, around 2000 hectares, to support the population of around 32,000 people (Figure 6) (Fishman, 1982). In addition, each residential lot would be around 240m2, giving families more space for growing food. In Frank Lloyd Wright's conception of an ideal city Broadacre City, each

Figure 6. Ebenezer Howard's Garden City surrounded productive land
(From Howard, 1902. cited in Fishman, 1982. p.46)

person would be given at least 1 acre (roughly 4,000 square metres) and allowed as much as they could utilise (Fishman, 1982).

Other studies have looked into calculating land area requirements using recommended daily food needs of the population, and compared that with average yields of production. For example McClintock, Cooper, and Khandeshi (2013) modelled the yield, in weight, of different production methods, to test if it met the vegetable requirements of the population, if applied to vacant land in Oakland, California.

Looking at global figures, Figure 7 shows that around half of the world's habitable land was used for agriculture in 2019, roughly 51 million square kilometres in total (UN Food and Agriculture Organisation (ND) as cited in Ritchie, 2017), and feeding a population of 7.7 billion (United States Census Bureau, 2022).

However, using any of these figures is problematic and they are not a true reflection of the amount of land each person needs in each geographical area, as there are many complex factors involved, including unique growing conditions (soil, climate, inputs), and varying diets (meat, vegetables, grains).

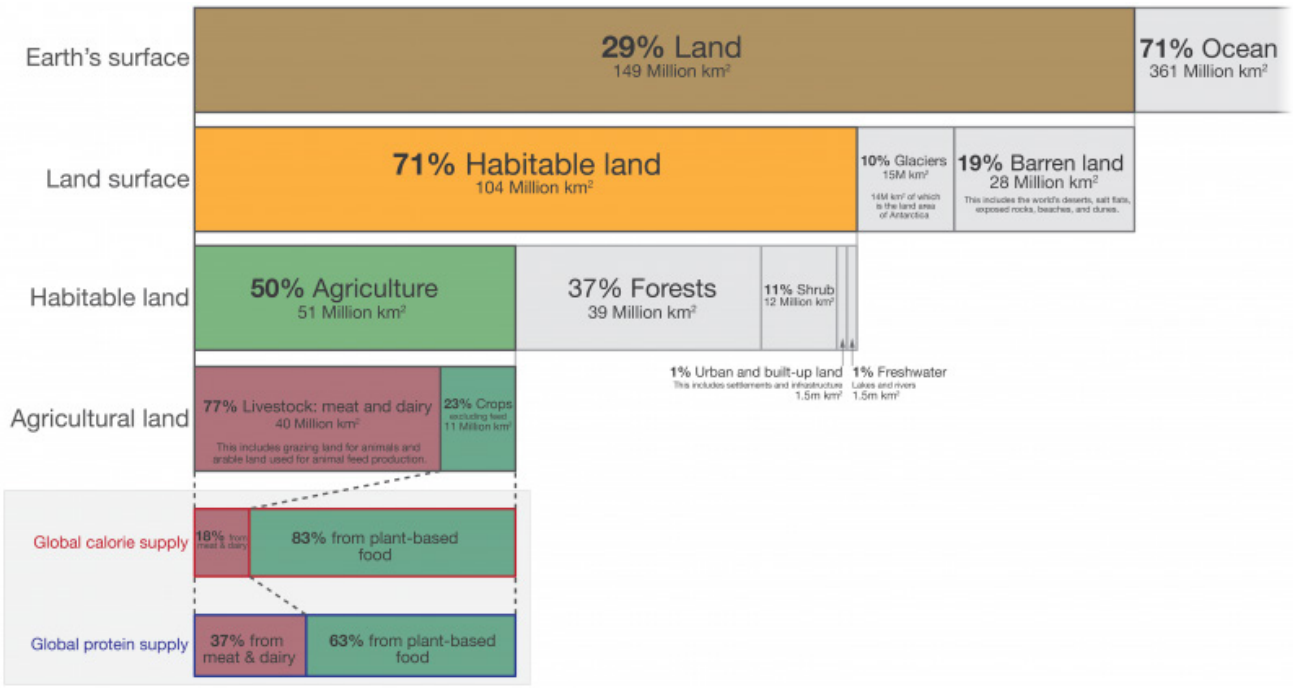

Figure 7. Global land use for food production
(From H.Ritchie, M.Roser, 2019 via Our World in Data. CC-BY-4.0)

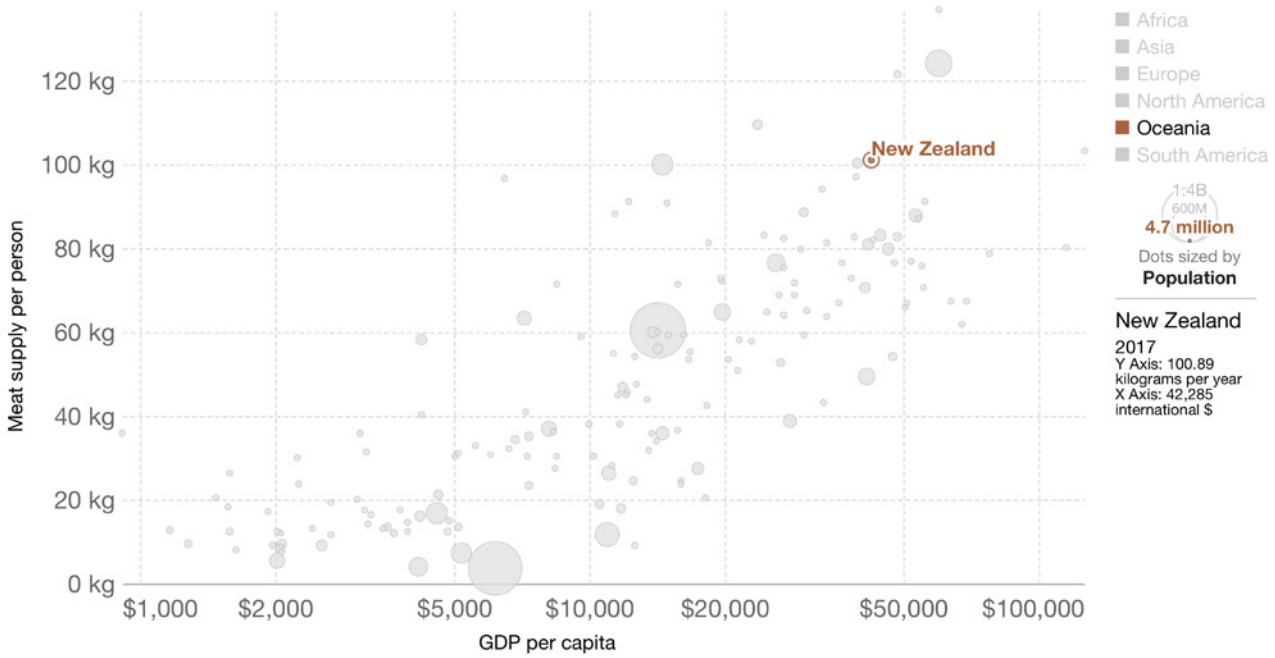

Figure 8. Meat consumption vs GDP per capita
(From Food and Agriculture Organization of the United Nations (2019) via Our World in Data. CC-BY-4.0)

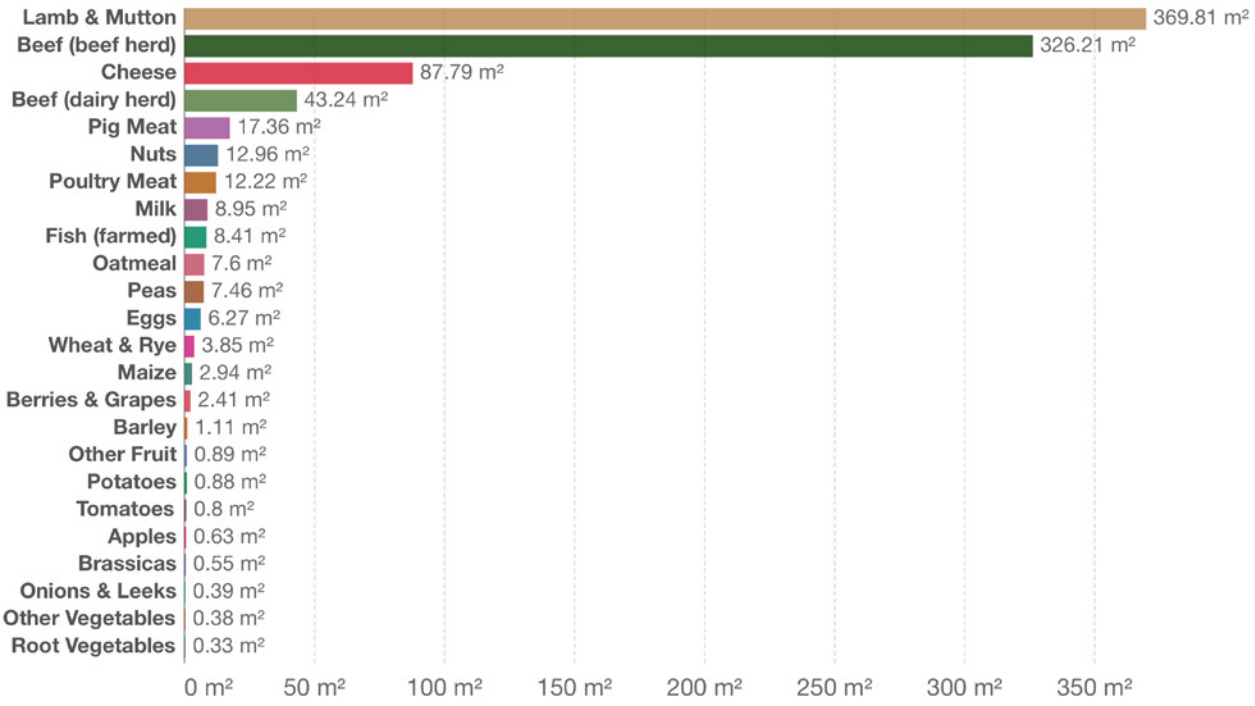

Figure 9. Land use per kilogram of food product
(From Poore, J., & Nemecek, T. (2018) via Our World in Data. CC-BY-4.0)

2.2.3 Diets in Aotearoa

In considering Aotearoa's context, the average New Zealander's diet is meat-rich compared with diets in most other countries (Figure 8). Figure 9 illustrates that much more land is needed to produce a similar quantity of meat, than other food products. This suggests that the land needed for food production in Aotearoa within the current paradigm, is far greater than average. Notwithstanding the required land area, the environmental cost of producing meat is also high; Steel (2008, p. 21) argues that "it takes an estimated 11 times as much grain to feed a man if it passes through a cow first". However Smaje (2020, p. 134) argues that "the inefficiency of livestock looms large in the modern case against meat, but it's actually their efficiency as farmhands that justifies their presence on the traditional low-energy holding". Smaje goes on to state that grazing ruminants play a vital role in transferring nutrients across different areas of a farm, without the need for external inputs, and also provide other products such as milk and wool.

Do we need to strike a balance, given the benefits of livestock, but the inefficiencies in farming purely for meat production? What other alternatives could be considered?

2.2.4 Alternative models?

Aotearoa's land use is heavily influenced by domestic and global consumer demand (Ministry for the Environment & Stats NZ, 2021), and consumers are becoming increasingly interested in where their food comes from, and how it is produced (Horticulture NZ, 2017; Ministry for the Environment & Stats NZ, 2021). According to Horticulture NZ (2017), consumers of organic foods are prepared to pay more for crops that they understand to more environmentally-friendly.

In the article, 'Beyond Sustainable Intensification: Transitioning Primary Sectors through Reconfiguring Land-Use', Bayne & Renwick (2021) note that due to growing social and environmental challenges, there is a global ambition to transition farming models away from those which value high productivity, to those with more sustainable practices. In the article they identify a range of alternative methods; including mixed farming, diversification, land sparing, infrastructure sharing and land sharing (Bayne & Renwick, 2021). These models look to a move away from the conventional monocultural farming approaches, to systems that support biodiversity, nutrient cycling, and encourage co-operation between farms (Bayne & Renwick, 2021).

2.3 Housing x Food

2.3.1 Why integrate?

The benefits of integrating food production spaces in urban environments are well documented and include environmental, economic, social, health and educational benefits (Doron, 2005; Fox-Kämper et al., 2018; Pulighe & Lupia, 2016; Wesener, Fox-Kämper, Sondermann, & Münderlein, 2020).

Closing the distance between people and food production has environmental advantages such as lower 'food miles' and enabling easier composting of domestic food waste (Doron, 2005). Educational opportunities are enabled by connecting the community with food, for example workshops and school programmes, and could go some way to increasing food security (Franck, 2005). Doron (2005) argues that communal food production has the social benefits of instilling a sense of ownership as well as encouraging cooperation between people from different ages, ethnicities, class and gender.

2.3.2 Models of integration

The idea of integrating food practices into human settlement is not a new concept. Ancient civilisations considered agricultural land to be part of the city, and in pre-industrial times, animals and grains were often kept in houses and yards within the cities walls (Steel, 2008). Food can be planned to integrate with our cities in different ways, sometimes separated as a rural entity, and other times integrated into urban and social fabric of the city.

Within the book, 'Garden Cities: theory and practice of agricultural urbanism', Duany and DPZ (2012) identify four models which categorise approaches to agricultural planning. These models are; 'Agricultural retention', 'Urban agriculture', 'Agricultural urbanism', and 'Agrarian urbanism' defined as follows:

- Agricultural retention refers to those approaches which are applied to conserve existing farmland. These are often applied at a regional scale, with examples including planning urban limits, and greenbelts.
- Urban agriculture includes those activities within the city and suburbs, often utilising vacant land, and participation is usually a part-time interest. Typologies in this category include; community gardens, roof-top gardens, allotments, farmers' markets, and community kitchens.

- Agricultural urbanism refers to communities focussed around a working farm. The farm is usually open to the community, but few residents are actively involved in the productive work. Examples include; agrihoods and garden cities following Ebenezer Howard's theoretical model.
- Agrarian urbanism is defined as settlements in which the community is involved in whole food system; from propagation and production to processing and consumption. One of defining characteristics of this category is that the physical form of the settlement and its infrastructure, support the function of an "intentional agrarian society" (Duany & DPZ, 2012, p. 8).

These four models provide a useful framework to understand which approaches could be applied at different scales and contexts. The agricultural urbanism and agrarian urbanism models could be the most applicable for this study due to the relationship between housing and food, and suitability for peri-urban and greenfield sites, rather than urban infill.

2.3.4 Precedents of integration

Several utopian city-scale schemes had food production intrinsic to their design, but were organised in very different ways (Figure 10). Frank Lloyd Wright's Broadacre City, followed a low-density decentralised model set out in a grid pattern (Fishman, 1982), though the concept was based on self-sufficiency rather than community farming. Ebenezer Howard's Garden City, followed a polycentric form with a compact urban area surrounded by vast areas of open space farms and forest (Fishman, 1982). Food production was also considered in the residential areas, both on private lots and allotments surrounding the towns (Doron, 2005). In Le Corbusier's concept for the Contemporary City, food was integrated at different scales and densities; with large rural zones on the periphery, large kitchen gardens for suburban houses, and allotments for the more urban zones (Doron, 2005).

Agrihoods are a recent phenomenon in North America with the purpose of integrated food and housing, and are defined by the Urban Land Institute as communities that have been developed with a focus around a working farm (Norris, 2016, 2018). Common features of agrihoods include; protected farmland, community food production spaces, conservation areas, events spaces, market areas, community centre, shops and restaurants, connection to schools and other community infrastructure, transport connections (Norris, 2018).

Figure 11 illustrates how three agrihoods spatially integrate food production within their respective

KEY

- Residential
- Productive Land
- Other open space

Broadacre City

Garden City

Contemporary City

Figure 10. Utopian spatial configurations

Note: Diagrams show spatial relationship only and are not to scale.

KEY

- Residential
- Productive Land
- Other open space

Serenbe

Chickahominy Falls

Prairie Crossing

Figure 11. Agrihood spatial configurations (Adapted from Wulfkuhle, 2022. p43-55)

Note: Diagrams show spatial relationship only and are not to scale.

developments. All three have a clear definition between the productive land and housing, siting the farm at the periphery of the development. The size of the Serenbe development in Georgia, is the largest at approximately 400 hectares (Norris, 2018), and it also has the smallest percentage of productive land, whereas the productive land at Prairie Crossing, Illinois takes up one third of the development and spatially wraps around the housing.

2.3.5 Agrarian Urbanism

Duany and DPZ (2012) propose that agrarian urbanism could follow a new-urbanist approach, with transect zones defining development rules and activities from an urban core, out to a rural hinterland (Figure 12). Duany and DPZ (2012) argue that this transect allows for people to choose how much they engage in agricultural activities, for example those that live on the larger lots, must agree to farm the land, whereas people who did not wish to participate might live in an apartment for instance.

One precedent of agrarian urbanism is Southlands, in Canada, which allocates one third of the land to each of urban, agriculture and open space zoning (Duany & DPZ, 2012). Figure 13 illustrates how the productive land, and open space is spatially integrated in between the housing clusters, in contrast to the more isolated approach in the agrihood model. This model could present a solution for accommodating different preferences regarding density and farm involvement, and also give greater access to productive land and other open space to the whole community.

2.3.6 Challenges of integration

Several challenges have been identified which are related to the integration of housing and agriculture including management of the farm, and reverse sensitivity. Firstly, not everyone is interested in farming, so measures would have to be put in place to ensure smooth operation of an agricultural activities. In terms of management and work on the farm, Duany and DPZ (2012) state that there would need to be paid employees to manage some of the activities in the agrarian urbanism model. To manage allotments on a large scale, Le Corbusier proposed that "there would be a farmer in charge of every 100 such plots" in his garden city housing scheme on a cellular system (Le Corbusier, 1987, p. 207). Norris (2018) discusses the staffing requirement for the management of agrihood farms in terms of the scale of the farm; farms less than 2 hectares requiring one to two full-time staff, those between 2 and 8 hectares needing between 10 and 20 full-time staff, farms larger than 8 hectares will require mechanisation, and at least 10 staff.

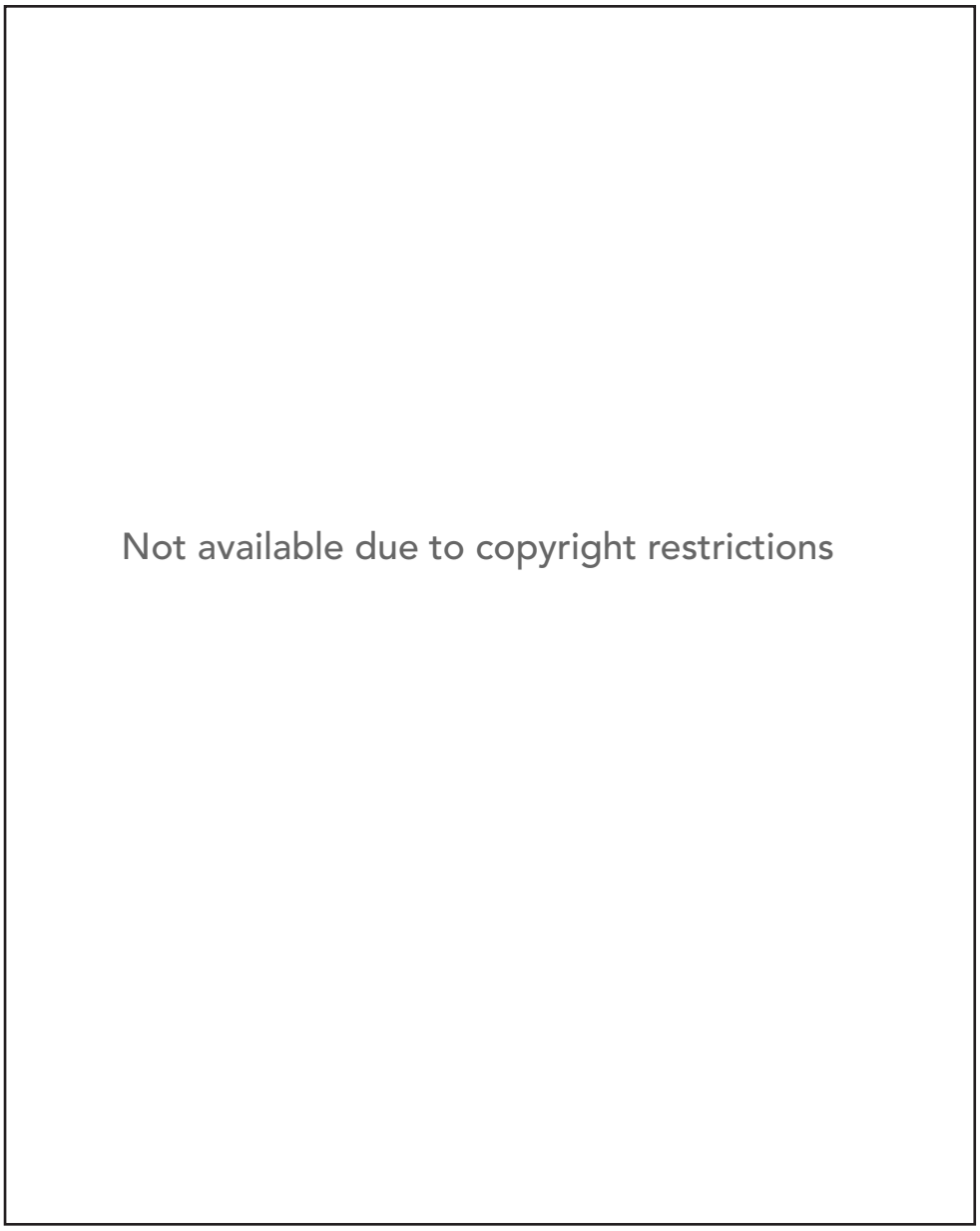

Figure 12. Transect zones
(From Duany & DPZ, 2021. p41)

Southlands

KEY

- Residential
- Productive Land
- Other open space

Figure 13. Agrarian urbanism spatial configuration
(Adapted from Duany & DPZ, 2021. p53)

There are also some issues with integrating farming and housing in terms of people's preferences and expectations. For example, often there are loud noises and odours associated with farming activities that some residents may be opposed to (McClintock et al., 2013; Norris, 2018). Duany and DPZ (2012) highlight that agrarian urbanism is not for everybody, though if people have chosen to live in a community like this, then they are likely more open to accept and participate in the lifestyle. Targeted marketing is discussed as a key method to ensure the right kind of people move into these kinds of developments (Duany & DPZ, 2012).

2.4 Research Questions

This research is focused on the competing interests of housing and highly productive land. As modern zoning does not currently protect land for food production within urban development, we are left with the conundrum of which land use activity to prioritise, housing or food. Considering a spectrum of different responses, at one extreme we could conserve and protect all highly productive land, and at the other, continue with 'business as usual' urban sprawl. The purpose of this research is to understand the issue of housing on highly productive land and tease out a range of possibilities for integrating housing and food, between these two extremes.
Therefore my research question is:

What is the potential for integrating housing and food in peri-urban Aotearoa?

In order to answer this there are a series of sub-questions which help to break the study into smaller stages:

- *What are the community concerns regarding peri-urban development and how might these be addressed from a landscape architectural perspective?*
- *What are the opportunities to address the community concerns from a landscape architectural perspective?*
- *How might those opportunities be translated into spatial ideas for the site?*
- *How might those spatial ideas create different land use scenarios for the site?*

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3 Methodology

There are a variety of methods used in landscape architectural research, which differ in their epistemological approach and also range from objectivist to subjectivist perspectives (Table 2) (Deming & Swaffield, 2011). A research design that uses a mixed-method approach could utilise the strengths of each method, and have the advantage of generating a more diverse and insightful set of information than a single method approach (Creswell, 2014 cited in Swaffield, 2016). In applying different methods, my research will move between the inductive and reflexive modes, understanding that “in creative disciplines each researcher is an active participant intimately and explicitly involved in the research" (Abbott, 2018, p. 98).

3.1 A Case Study Approach

A case study is “a study of a specific event, situation, or complex phenomenon investigated in their real world context” (Yin 2014, as cited in Swaffield, 2016, p. 127). As landscape architecture embraces a complex and diverse spectrum of interests across multiple contexts, case studies might provide a suitable framework for an extensive research inquiry (Abbott, 2018; Deming & Swaffield, 2011; Swaffield, 2016).

Swaffield (2016, p. 130) states that a valid technique of selecting a case study is by finding one which has the features “central to the theoretical purpose of the investigation”. 'Plan Change 69', which will be discussed in more detail in the next chapter, has been chosen as the case study for the research on the basis that it is a housing proposal located on highly productive land. The plan change request provides a rich source of data in the form of submissions from the community, expert evidence from professionals, as well as a spatial design layout put forward by the developer's design team.

3.2 A Design Thinking Model

As the outputs of this research involve design projection, the PC69 case study will be explored

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Table 2. Strategies of Inquiry
(Adapted from Deming & Swaffield, 2011. p.9)

through a design thinking model that was developed by the Hasso Plattner Institute of Design (d.school) at Stanford University. The process moves through the five modes; empathise, define, ideate, prototype and test, each mode with a different function (Figure 14), and each applying different methods for this research project (Figure 15, Table 3).

3.2.1 Empathise

One of the critical parts of the model is that it positions the 'empathise' mode first, directing the designer to set aside any preconceived ideas, and engage with the end-user to understand their needs. The main method used in this stage is discourse analysis, which is an interpretative strategy that aims to interpret the meaning within a body of words and text, with the purpose of achieving a greater understanding of this discourse within a community or larger group within society (Deming & Swaffield, 2011).

Written submissions from the community, as well as expert evidence from professionals, have been presented to the council in response to the plan change request proposal. Using 'Nvivo', this data will be gathered and coded into themes relating to the concerns and considerations of the community. The act of coding data is a form of classification, which Deming and Swaffield (2011, p. 127) discuss as being useful "to reveal and refocus attention on specific, meaningful patterns and themes hiding within data."

This stage asks the question: *what are the community concerns regarding peri-urban development and how might these be addressed from a landscape architectural perspective?*

3.2.2 Define

The purpose of the define mode is to bring clarity to the design problem by looking for patterns and themes within the collected data (Hasso Plattner Institute of Design, 2010). Continuing with the discourse analysis method, the data collected and coded from the previous phase will be analysed further and opportunities for design will be defined for the next stage.

This stage asks the question: *what are the opportunities to address the community concerns from a landscape architectural perspective?*

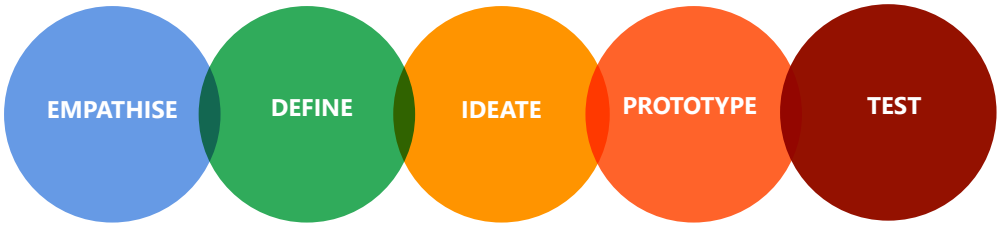

Figure 14. The Design Thinking Process
(Adapted from Hasso Plattner Institute of Design at Stanford, 2010. p11. CC BY-NC-SA 4.0)

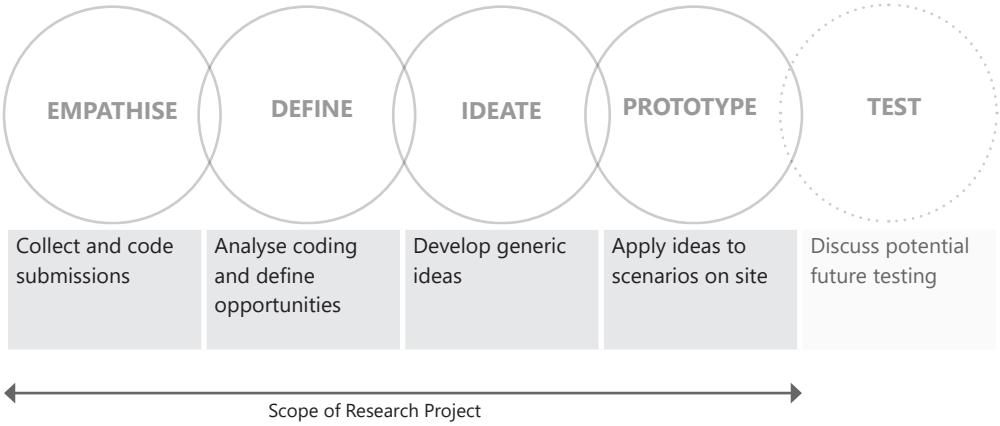

Figure 15. The Design Thinking Process applied to this research project
(Adapted from Hasso Plattner Institute of Design at Stanford, 2010. p11. CC BY-NC-SA 4.0)

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Table 3.Strategies of inquiry as applied to this research project
(Adapted from Deming & Swaffield, 2011. p.9)

3.2.3 Ideate

The ideate mode shifts the focus from problems to solutions, with the purpose of generating a number of concepts and source material for building prototypes (Hasso Plattner Institute of Design, 2010).

The problems and opportunities defined in the previous stage will be used as a starting point to produce concepts for the project. The key method used in this mode is design projection. In the article 'Placing design and designing's place, in landscape architecture research.' Abbott (2018) discusses the use of design in research, and that its purpose is to open up potentials and possibilities, rather than to bring closure. He goes on to state that "in design-directed research, it is the identification of a range of possibilities, where it might not be essential for one to be identified as preferable, that is critical" (Abbott, 2018, p. 95).

This stage asks the question: *how might those opportunities be translated into spatial ideas for the site?*

3.2.4 Prototype

The prototype mode involves the "iterative generation of artifacts intended to answer questions that get you closer to your final solution" (Hasso Plattner Institute of Design, 2010, p. 8). This stage also uses the design projection method, but with more focus, as the concepts developed in the ideate mode will be applied to the site to create a number of land use scenarios. These scenarios will give themes different weightings, to show the implications of prioritising one aspect over another. The purpose of this stage is to provide a source for discussion, debate and future research.

This stage asks the question: *how might those spatial ideas create different land use scenarios for the site?*

3.2.5 Test

In order to refine and improve the design, the test mode utilises the prototypes to gain feedback from the users (Hasso Plattner Institute of Design, 2010). This stage will not be carried out due to the limited scope of the dissertation, however could be carried out in future research.

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4 PC69 Case Study

This chapter outlines the context of Plan Change 69 (PC69), then goes into the specifics of plan change site and finally the details of the outline development plan (ODP) that was submitted with the plan change request.

4.1 Plan Change 69

Plan Change 69 (PC69), is one of many current 'plan change requests' within the Selwyn District south-west of Christchurch (Figure 16). The proposed plan change seeks to amend the Selwyn District Plan Planning Maps to rezone approximately 190 hectares from 'Rural Outer Plains' Zone to 'Living Z' and 'Business 1' Zones.

The PC69 site lies directly to the south of Te Whāriki and Verdeco Park subdivisions which have residential zoning (Figure 17). There is a pocket of business zoning to the north and the remaining land to the south, east and west of the site is zoned rural has a rural character.

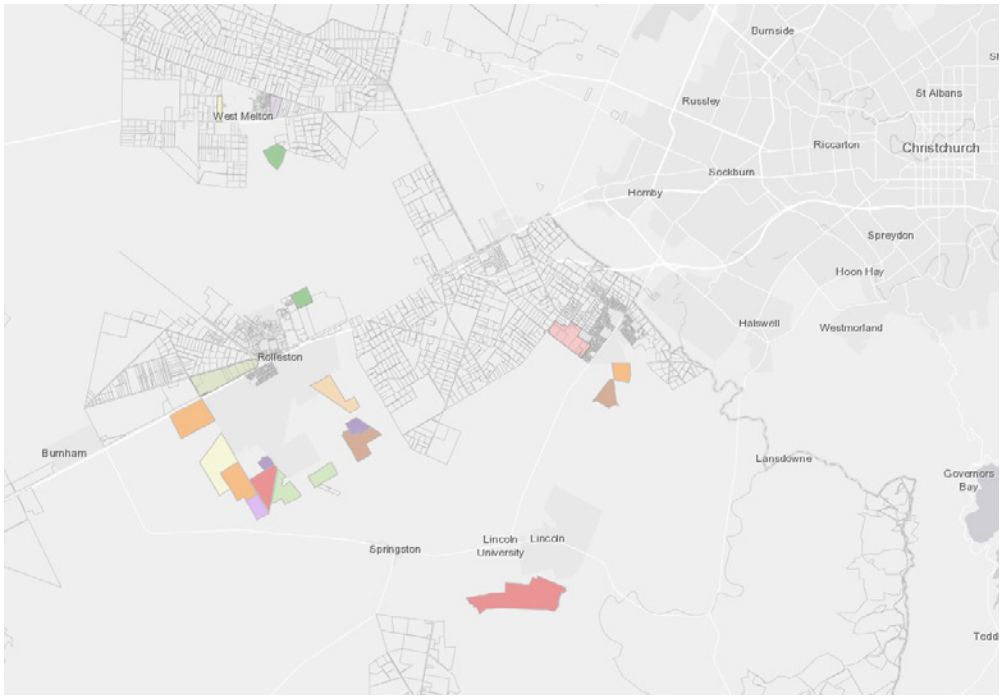


Figure 16. Plan changes in Selwyn District - February 2023
(From Selwyn District Council, 2023)

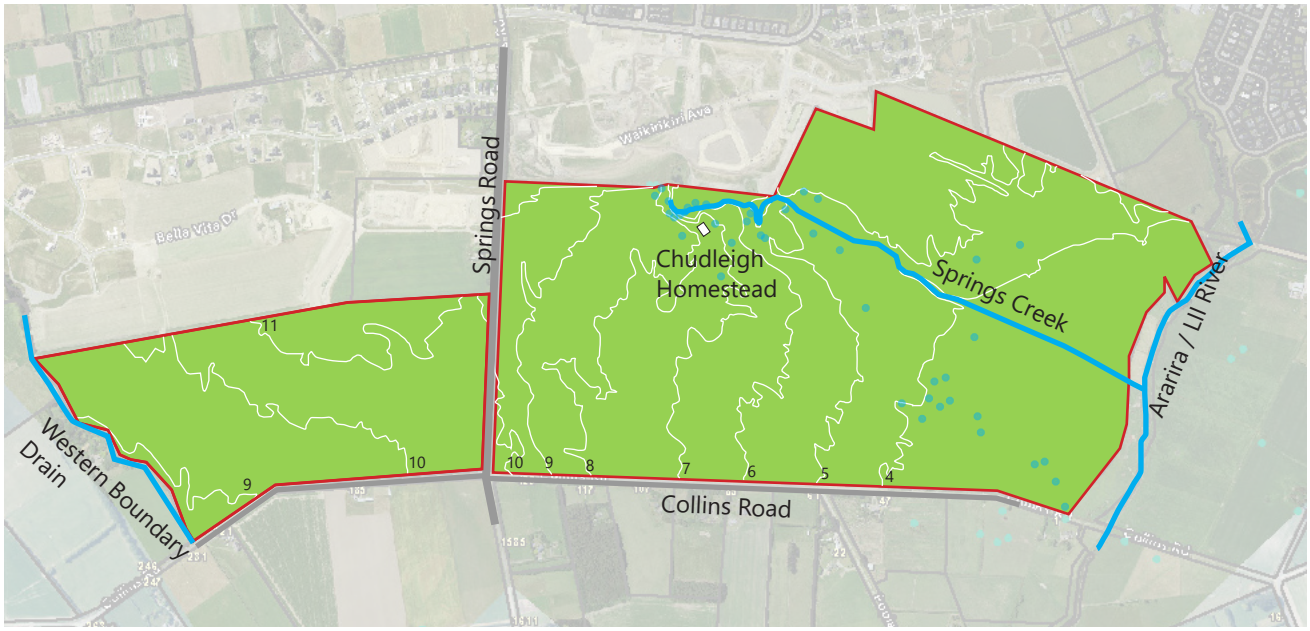
Figure 17. Planning context
(Adapted from Canterbury Maps, 2022)
Contains data sourced from the CanterburyMaps and partners licensed for reuse under CC BY 4.0.

4.1.1 PC69 Site

Figure 18 illustrates the sites characteristics showing that it is bisected by Springs Road and is bounded by Collins Road to the south. Its boundary to the east is situated adjacent to the Ararira River, and to the west, Western Boundary Drain. The site contains the historic 'Chudleigh' homestead, amongst other farm buildings. More than 20 springs have been identified on the site, many of these located near the homestead and flow via Springs Creek following the natural slope of the land from west to east.

4.1.2 PC69 Outline Development Plan

Figure 19 shows the Outline Development Plan (ODP), which illustrates the proposed amendments to the district plan. Under the PC69 proposal, the majority of the site will be residential development, providing for a maximum 1710 dwellings at a density of around twelve dwellings per hectare, similar to the neighbouring Te Whāriki and Verdeco Park developments. The most recent ODP indicates three distributed business zones, a park and ride facility, a network of open space, and a series of connected stormwater management and wetland areas. The land use zones are connected throughout the site and into the surrounding context with a network of roads, and pedestrian and cycleway routes. 'Chudleigh' homestead is given a 'Heritage setting' and the spring locations appear to coincide with open space and stormwater management as indicated on the plan.



KEY

- Contours
- Springs
- Waterways
- Roads
- Heritage buildings

Figure 18. Site Inventory
(Adapted from Canterbury Maps, 2022)
Contains data sourced from the CanterburyMaps and partners licensed for reuse under CC BY 4.0.

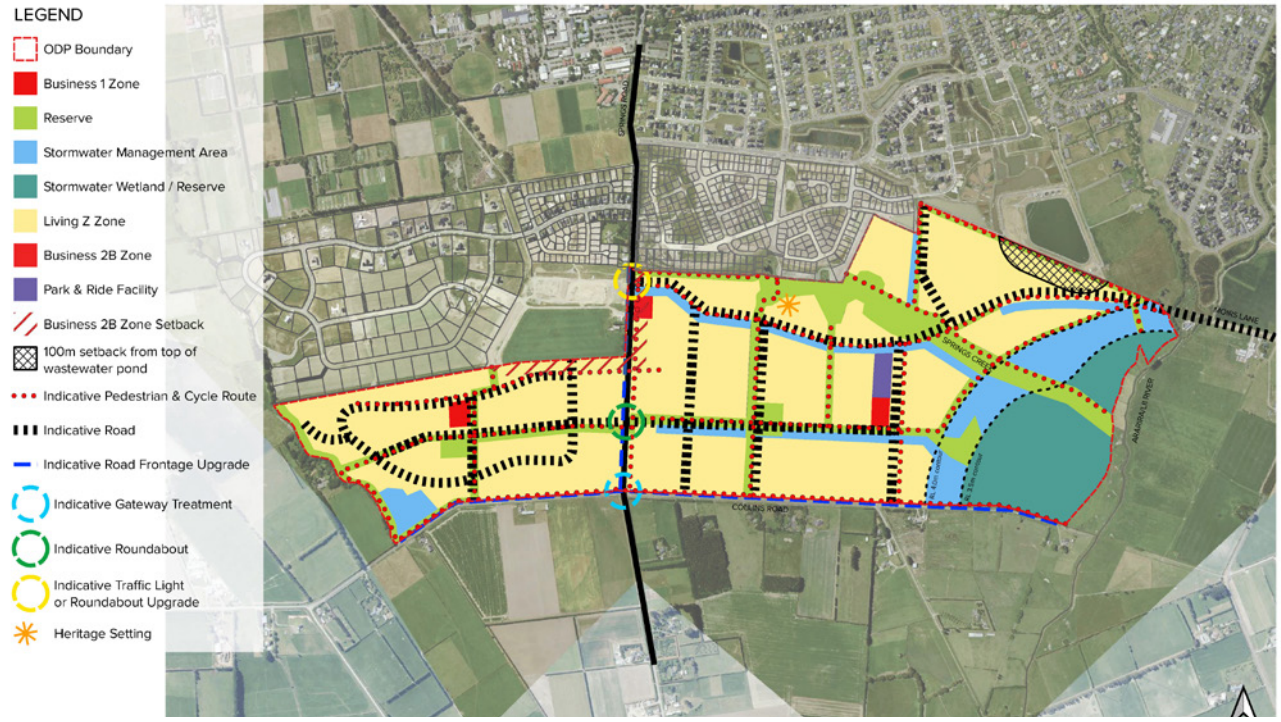


Figure 19. PC69 Outline Development Plan - Revision H
(From DCM Urban Design Ltd, 2021, used by permission)

5 Empathise

According to the 'Design Thinking' process; understanding the values that people hold is a core component of the empathise mode (Hasso Plattner Institute of Design, 2010). Though the existing community is not necessarily the end-user of the design, they are the closest proxy for the residents of the development and will have to live with many of its consequences.

5.1 Themes

Through the discourse analysis, nine major themes emerged (Figure 20), with other minor sub-themes nested within these, for example 'climate change' was categorised under the major theme 'environment'. Transport was the most commonly discussed theme, followed by community infrastructure and then environmental concerns. Other themes included, housing, food, planning character, context and social concerns. Many of the issues discussed overlapped several themes, for example, housing sprawl, traffic and carbon emissions. These statements were included across each relevant category.

Of the 266 community submissions, the overwhelming majority were in opposition to the proposal with only 10 submissions in support. This reveals an incongruence between the proposal and the values of the existing community.

Figures 21 to 29 capture some of comments from the community within the submissions, related to each identified theme.

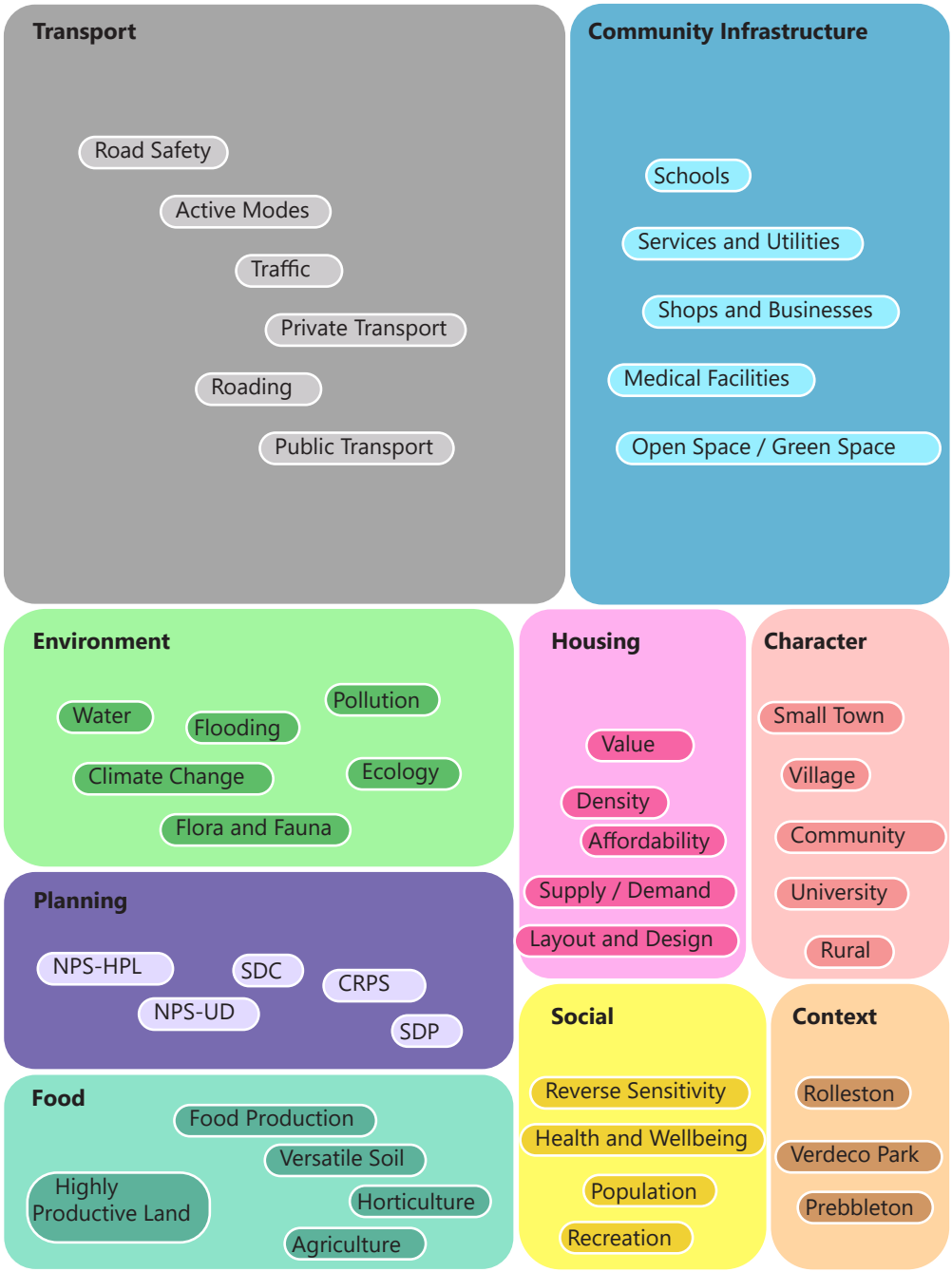


Figure 20. Themes emerging from PC69 submissions (Author, 2022).
(Size of theme 'bubbles' relate to frequency of occurrence in submissions).

5.1.1 Transport

Transport was the most widely discussed issue across all of the submissions with many submitters raised their concerns over the infrastructure and its ability to cope with increased traffic. Traffic considerations also led into concerns about safety; children walking and cycling to school were of particular concern. Provision for active transport modes such as cycling and walking were strongly supported in some submissions. However, some submitters noted the lack of integration and connectivity with Lincoln Township and its amenities. The environmental impacts of car dependency were also mentioned in some submissions.

5.1.2 Community Infrastructure

Many submissions were concerned with the impact of Plan Change 69 on Lincoln's community infrastructure, and that Lincoln's current infrastructure would not cope with the future demands of residents. Many people noted that even the current demand wasn't being met well, for example, it was argued that schools, preschools and medical facilities all have long waitlists. Other facilities and amenities of note were supermarkets, sports facilities, and green space.

5.1.3 Environment

Environmental considerations mentioned within the submissions included the increased carbon footprint from 'greenfield' development, for example increased reliance on cars particularly in relation to urban sprawl. There was concern for the effect on waterways and native flora and fauna, for example; eels, freshwater crayfish, geckos, frogs, heron and other native birds. A number of people reflected on the lack of sustainable design consideration for example; public transport, solar power, wind turbines. Some submissions mentioned air, noise and light pollution, including odour from sewage facility and dust from earthworks, and light from future dwellings affecting the night sky. Climate change was seen as being a substantial and tangible threat to the proposal, with submissions discussing the high risk of flooding on the land.

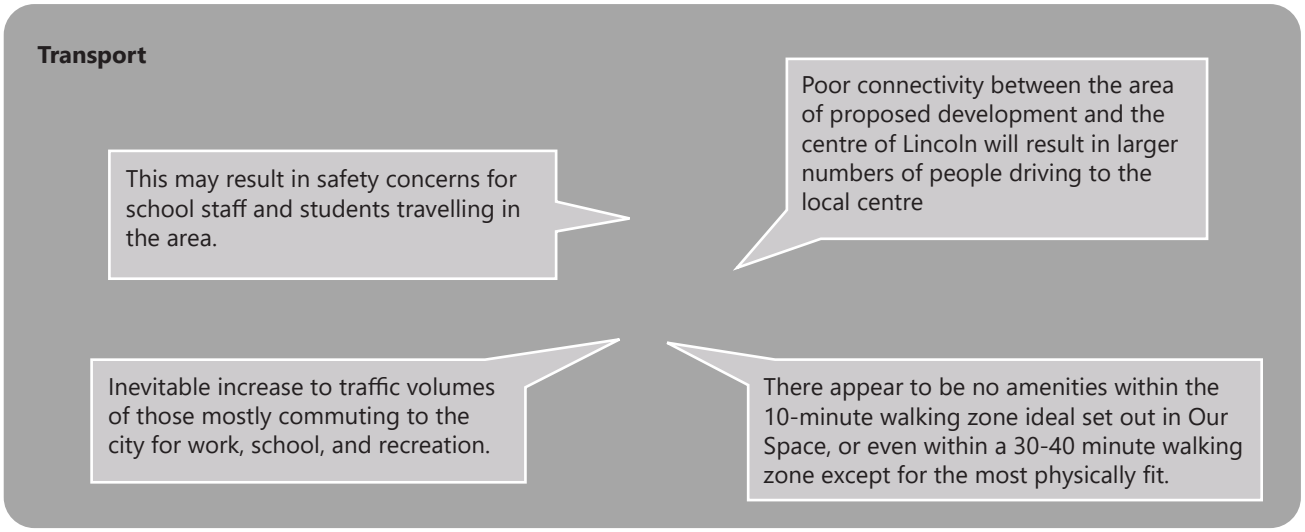


Figure 21. Community concerns related to the transport theme (Author, 2022).

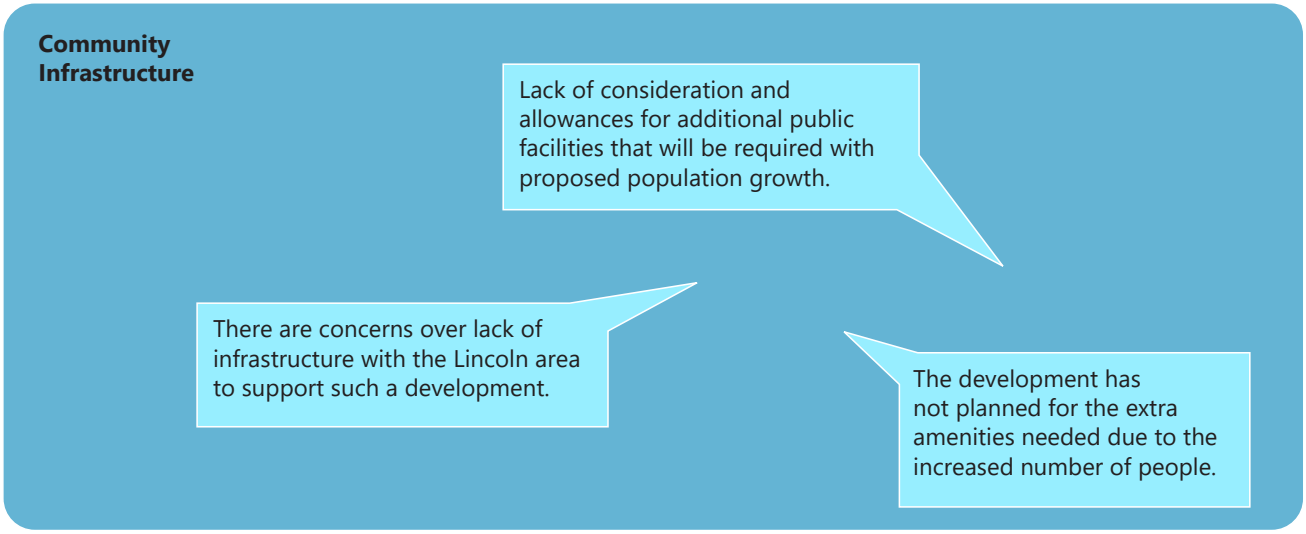


Figure 22. Community concerns related to the community infrastructure theme (Author, 2022).

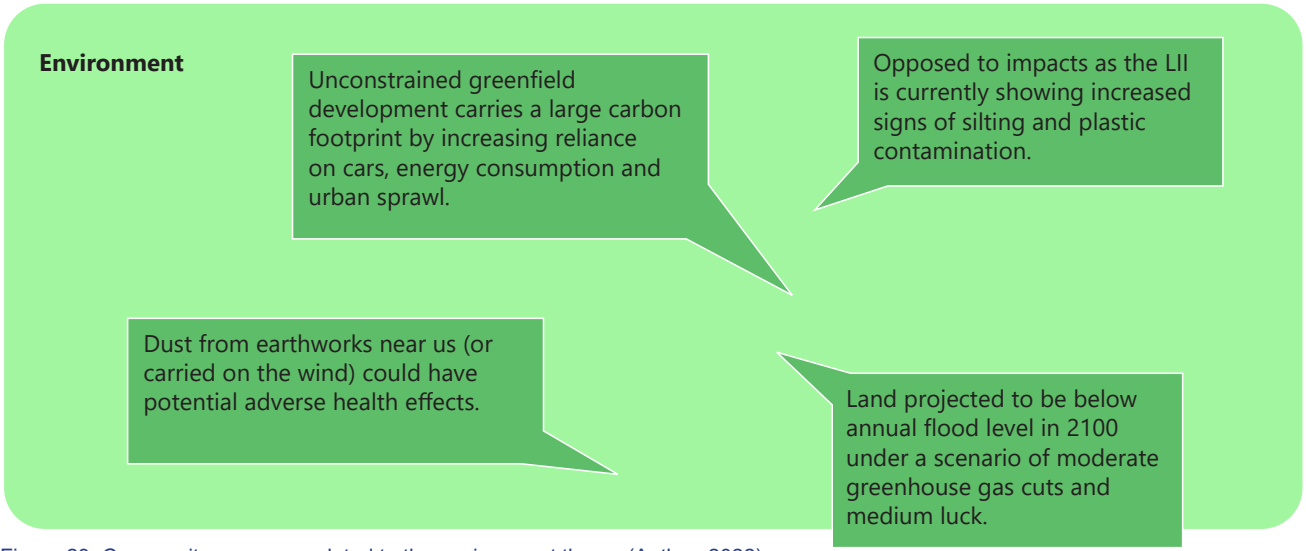


Figure 23. Community concerns related to the environment theme (Author, 2022).

5.1.4 Planning

Numerous submissions highlighted the proposed NPS-HPL and how it should protect this land from development. There was some concern with the plan change process and how this kind of proposal should be considered holistically as part of a strategic planning process, such as Selwyn district plan or the Greater Christchurch Urban Development Strategy. Some submissions claimed that this proposal fails to meet the NPS-UD requirement of well-functioning urban environments.

5.1.5 Food

A large number of submitters were concerned with the permanent loss of highly productive land. Many referenced the proposed NPS-HPL, stating that it should be taken into consideration for this proposal. The soil was described as being versatile, elite, top-class, highly productive, fertile, unique, and rare. People wanted to protect the soil from development to continue its use for food production, and in particular for horticulture purposes.

5.1.6 Housing

In terms of the layout and design of housing there were a number of concerns. Many indicated that the size of proposed development is too large, and the potential future population would be too great for the existing community. The community had mixed views on the density of the proposal, with some stating that the developments density was too high, while others suggested that higher density options should be explored. There was concern that the proposed small lot size, and medium density typology is not consistent with existing character. Many submissions suggested exploring different housing models, for example higher density multi-storey apartments over commercial ground floor with communal open space. Some submitters were interested in seeing more sustainable and innovative options, for example, selecting building orientation for passive solar gain, requiring rain water harvesting, solar panels, providing community gardens and tool libraries.

Location of housing was an issue that was raised a number of times, for example some people had concerns with the development in terms of urban sprawl. Some stated that housing should be in close proximity to community infrastructure. Many submitters argued that housing should not be located on highly productive land, and others noted that there are already many subdivisions in areas around Lincoln, and questioned whether more were needed.

Some of the submissions related to supply and demand or the economics of housing, for example,

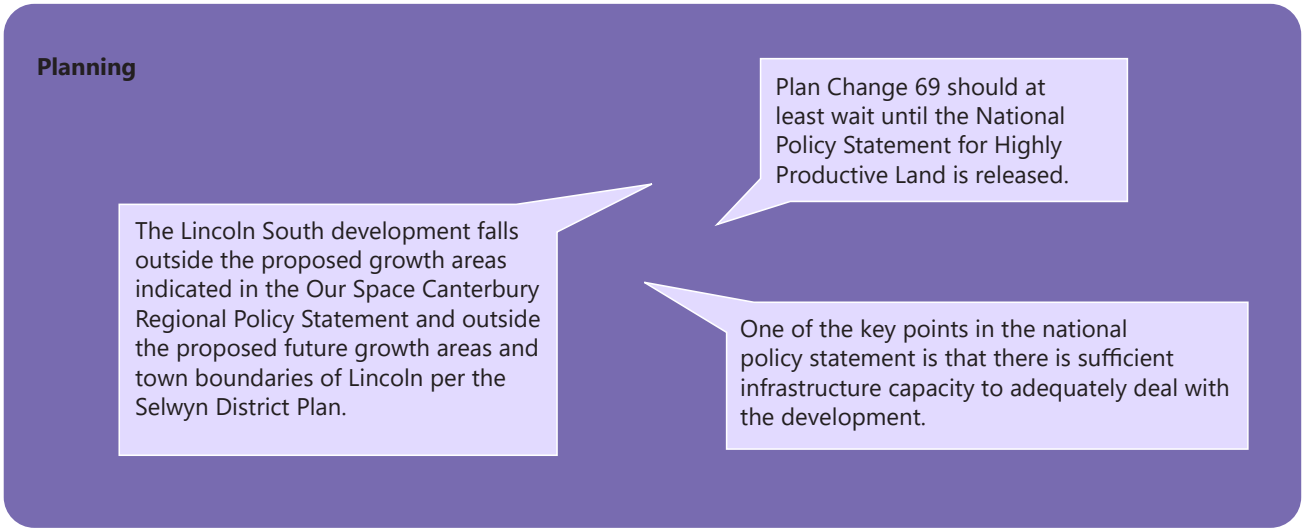


Figure 24. Community concerns related to the planning theme (Author, 2022).

Figure 25. Community concerns related to the food theme (Author, 2022).

Figure 26. Community concerns related to the housing theme (Author, 2022).

some recognised the demand for more housing in New Zealand, but others said that this had already been factored in to the operative district plan and that Greater Christchurch already has enough supply. Some people argued that the proposed housing types would not provide affordable options, and that there needs to be a way of ensuring these are delivered to the market. Many submissions were concerned the development might devalue their own house and community.

5.1.7 Character

Many submitters were concerned that Plan Change 69 would adversely affect the character of Lincoln. The existing character was described by the submitters under three general themes; the small village-like community feel, the rural identity, and the university town. Other words people used to describe the character included; quiet, unique, and charming. The change in character was described by submitters as moving from a rural, village feel towards an urban or suburban character and in some cases a high-density environment. Words used to describe the potential change in character ranged from: 'permanently changed'; to 'lost'; 'ruined'; and even 'totally destroyed'.

5.1.8 Social

Some submitters were worried about the impact of this proposal on future generations, for example future food production. There was concern about the adverse effect on places that currently enable and foster a sense of community. Some of the submissions were concerned with reverse sensitivity, for example rural activities that are noisy. A potential increase in crime was mentioned a few times by people. Other concerns related to the impact on health and wellbeing, for example, the pressure on recreational areas and medical facilities, and loss of the current relaxing lifestyle.

5.1.9 Context

The towns surrounding Lincoln were discussed in a large number of submissions, for example, Rolleston, Prebbleton, Tai Tapu, and Springston. Rolleston featured in the majority of these cases, described as the place designated for urban growth in the district. The reasons submitters gave for proposing future development should occur in Rolleston were, that it is designated within the Selwyn District Plan, that Rolleston already has the transport and community infrastructure to cope with growth, and it is on poorer soils than Lincoln. Some people reacted quite strongly, arguing that Lincoln would become the next 'Rolleston' should PC69 go forward. Prebbleton featured in a few submissions, with people discussing the potential impact that increased traffic would have on the town.

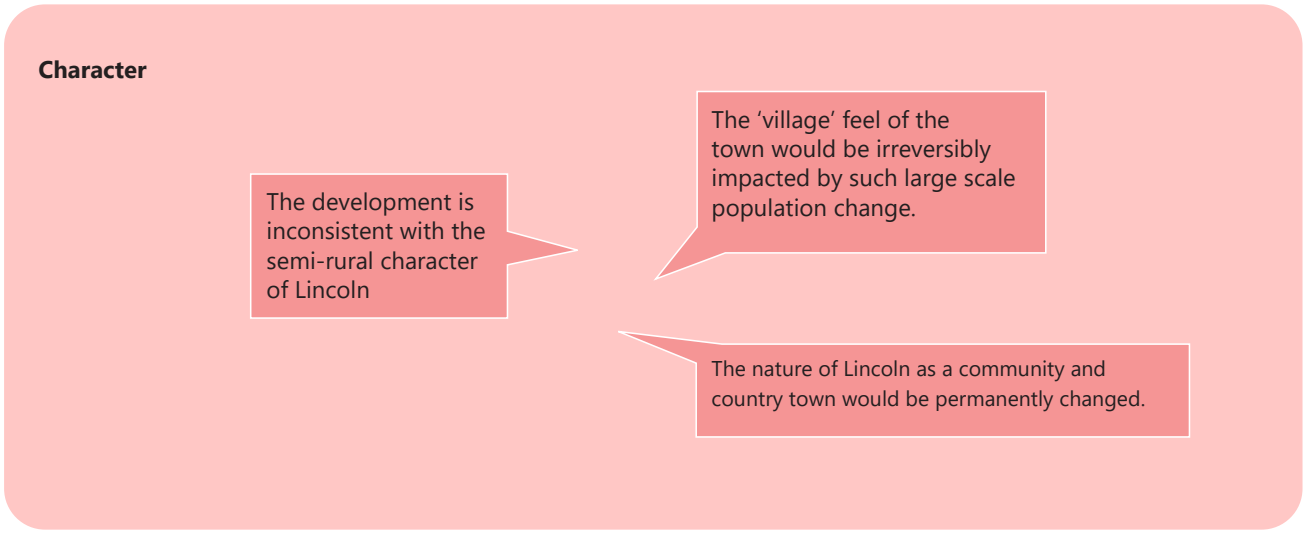


Figure 27. Community concerns related to the character theme (Author, 2022).

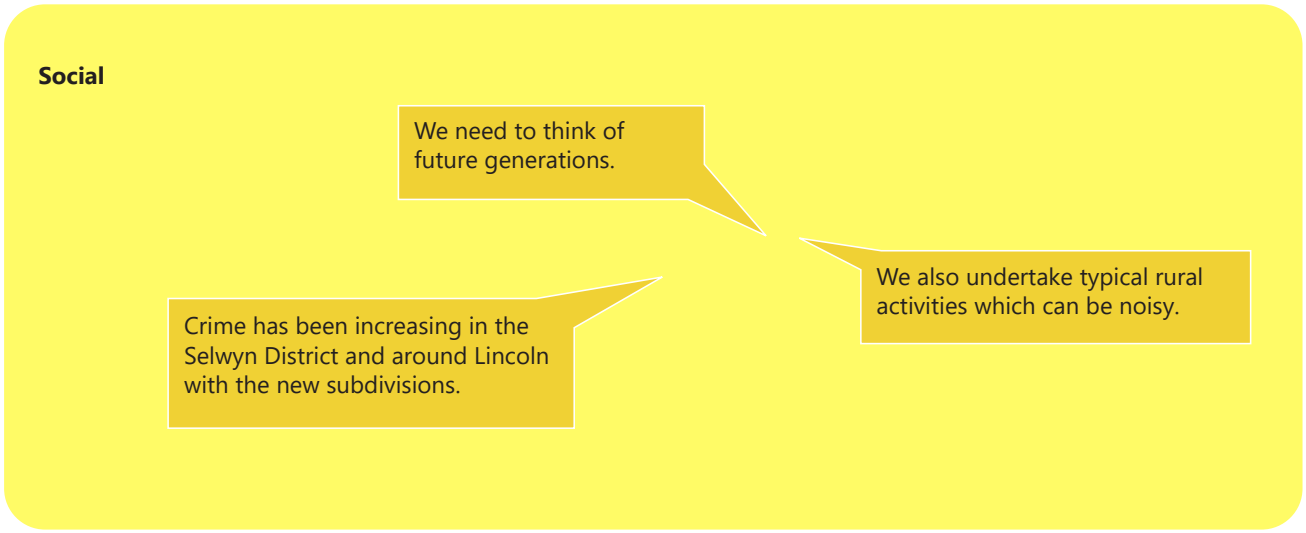


Figure 28. Community concerns related to the social theme (Author, 2022).

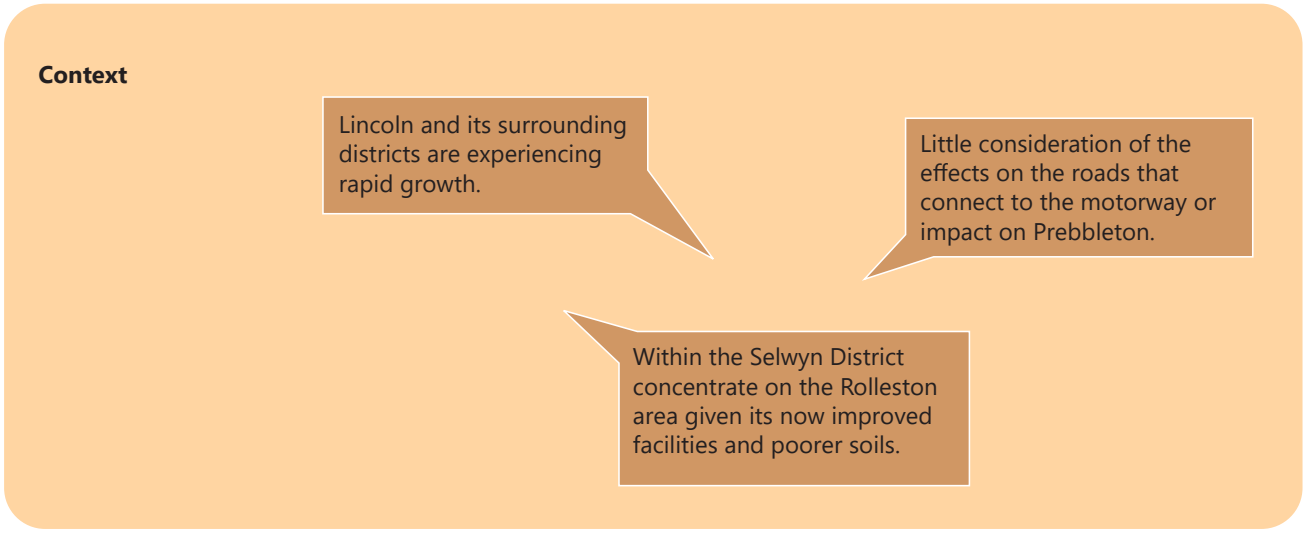


Figure 29. Community concerns related to the context theme (Author, 2022).

6 Define

The purpose of the define mode is to bring clarity to the design problem by looking for patterns and themes within the collected data (Hasso Plattner Institute of Design, 2010). Continuing on with the discourse analysis method, the data collected and coded from the previous phase will be analysed further and opportunities for design will be defined for the next stage. Within each theme, the main concerns from the community will be synthesized into a clear set of spatial opportunities for design.

6.1 Themes

6.1.1 Transport

The issues related to the increased volume of traffic and the ability of the infrastructure to cope could be addressed in a number of ways. One of the strategies could be to reduce the number of cars, either through greater uptake of other modes, for example public transport, cycling and walking, or to reduce the commuting population. The former might be achieved through implementation of a good public transport service, a strong network of paths for active transport, and a compact and walkable neighbourhood design. A proposal with fewer total dwellings would also help to reduce the volume of traffic on the road. A more radical approach would be to create a car-free community, with an internal public transport network and parking at the periphery. Key opportunities for spatial design related to the 'transport' theme are summarised below:

- Create compact and walkable neighbourhoods
- Create a network of pathways for active transport modes
- Consider fewer proposed dwellings

6.1.2 Community Infrastructure

Much of the concern around community infrastructure cannot be solved spatially and requires an

increased level of service from education and healthcare providers. As with transport, a reduction in the total number of dwellings would also help to reduce the stress on the existing infrastructure. Future provision could be improved with more compact walkable neighbourhoods, giving greater access to facilities and amenities close to residents. Consideration should also be given to how open space is integrated with the neighbourhood to ensure residents have easy access. Summarised below are the key opportunities for spatial design related to the 'community Infrastructure' theme:

- Create compact and walkable neighbourhoods
- Consider fewer proposed dwellings
- Create connected and accessible open space

6.1.3 Environment

Many of the environmental concerns were related to urban sprawl, and the associated carbon footprint from increased private motor vehicle use. Again, fewer total proposed dwellings and a more compact neighbourhood design, would help to see a reduction in commuting by car.
To address concerns about biodiversity and water quality, ecological patches and corridors could be established within the development, to provide habitat and refuge for native flora and fauna. Existing waterways could be protected with large buffers including extensive riparian planting to improve water quality.

Should the proposal take potential flood risk into account, flood maps could be used to identify areas less suitable for residential development. Figure 30 shows approximate rainfall flood depth across the site based on a 200-year ARI (Average Recurrence Interval), and indicates that there is some risk of flooding across the site, particularly in the south-east, but also along the western boundary of the site. Although food production could occur in areas at high risk of flooding, it makes more sense to utilise these for ecological purposes due to the risk of damage to crops. Key opportunities for spatial design related to the 'transport' theme are summarised below:

» Create compact and walkable neighbourhoods

» Consider fewer proposed dwellings

» Create ecological patches and corridors

» Plan for stormwater management in flood prone areas

6.1.4 Planning

The planning conundrum of this case study is that there are two competing interests over this land. The developer is seeking a plan change to develop housing, while a large percentage of the community would like to see the highly productive land protected and are hoping that the proposed NPS-HPL will carry enough weight to achieve this. One objective of this study is to understand if both housing and food can coexist on this land, and perhaps this requires more flexibility in zoning so that future demands can be met.

The community was concerned that the proposed development did not meet the requirements of the NPS-UD, and in particular, the specifics around what constitutes a 'well-functioning urban environment'. NPS-UD (Ministry for the Environment, 2020, p. 10) states in Policy 1, that "Planning decisions contribute to well-functioning urban environments" and as a minimum; enable a variety of homes that meet people's needs, have good accessibility between housing, employment and amenities, support the reduction of greenhouse gas emissions and take into account effects of climate change. The PC69 proposal could do a lot more to meet these requirements for example, further consideration of low-carbon transport options, more variety and choice in housing, development of compact walkable neighbourhoods, and keeping development outside zones at risk of flooding.

Concerns that PC69 is being designed in isolation of strategic spatial planning undertaken by local council, could be remedied by community involvement in participatory design workshops. This could involve workshopping various design scenarios with various stakeholders including, local council, local planners, urban designers and the community, to understand which might work best. Summarised below are the key opportunities for spatial design related to the 'planning' theme:

» Create compact and walkable neighbourhoods

» Enable housing choice and variety

» Consider flexible zoning

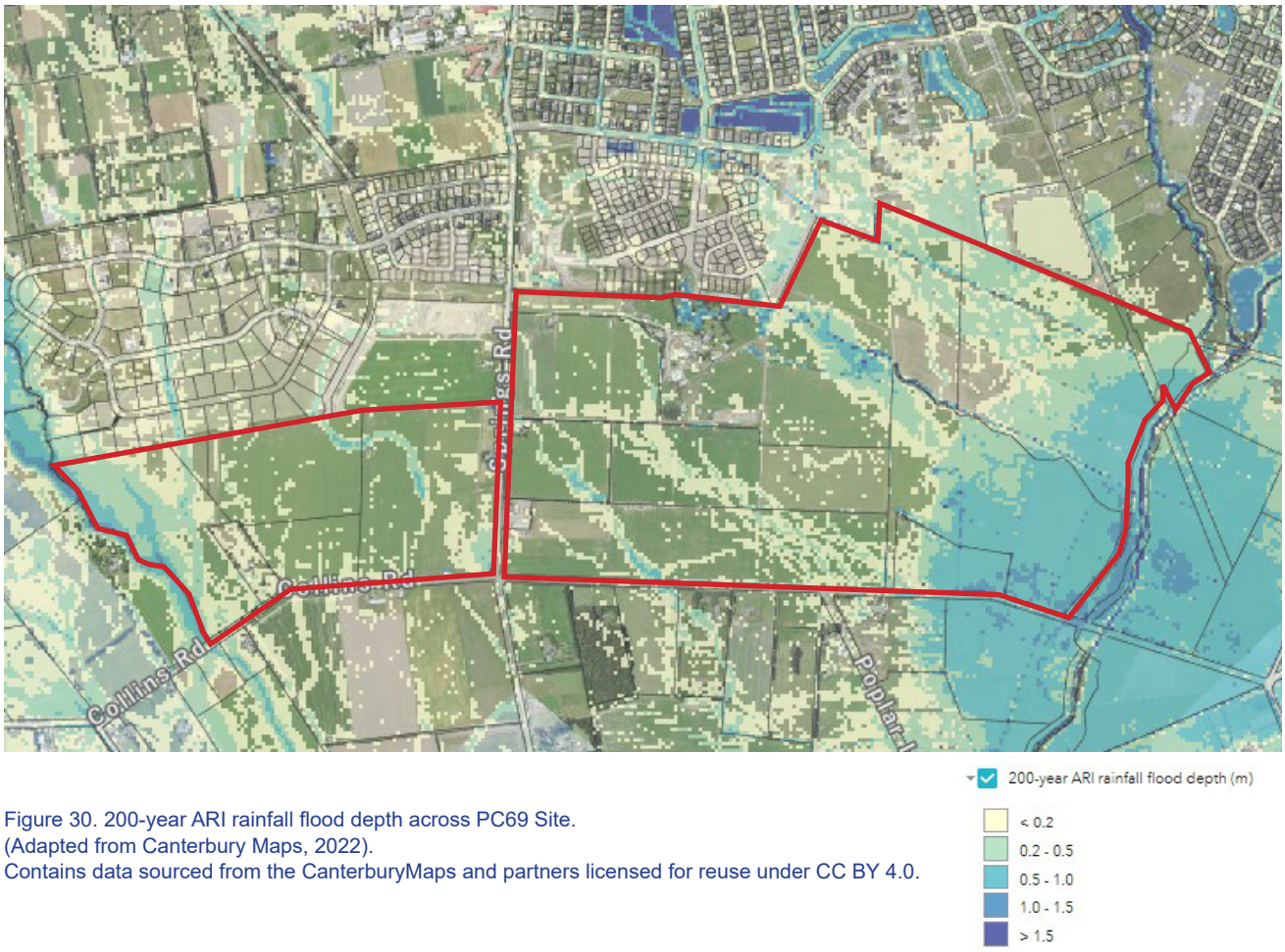


Figure 30. 200-year ARI rainfall flood depth across PC69 Site.
(Adapted from Canterbury Maps, 2022).
Contains data sourced from the CanterburyMaps and partners licensed for reuse under CC BY 4.0.

» Consider low carbon transport options

» Plan for stormwater management in flood prone areas

» Develop design scenarios to workshop with community

6.1.5 Food

The loss of highly productive land was the main concern in this theme. Spatially, there is only really one solution to this which is to protect some or all of the site from development. The question is how much land should be spared, the whole site, or just part of the site? An understanding of soil quality could help determine the most suitable soils for food production and which soils could be used for development. Figure 31 shows PC69's various soil types and their respective Land Use Capability (LUC) class. Higher LUC classes have greater value as they are more versatile and are also more valuable for cropping than the existing use for dairy farming (Table 4).

Proposed residential yields could be retained by increasing housing density, which would lower the residential site coverage and maximise the use of the most valuable soil. The highly productive land could also be utilised as a community resource to maximise its value, this might involve community gardens or allotments which connect back into the neighbourhoods surrounding the PC69 site. Summarised below are the key opportunities for spatial design related to the 'food' theme:

» Utilise soil mapping

» Decrease residential site coverage

» Enable higher housing density

» Preserve land at periphery to connect to surrounding neighbourhoods

6.1.6 Housing

Concerns around future population size could only be resolved by fewer proposed dwellings, though the perception of population size might be mitigated if the new community is self-sufficient and has very little interaction with the existing one. The density of the project was a contentious issue, with no clear resolution, except that most people reacted strongly against the 'business as usual' small-lot development that is currently being built in the Selwyn District.

There was some interest in a different approach to housing including vertical mixed-use

Soil Type	LUC Class
Wakanui	2
Templeton	2
Flaxton	3
Tai Tapu	3

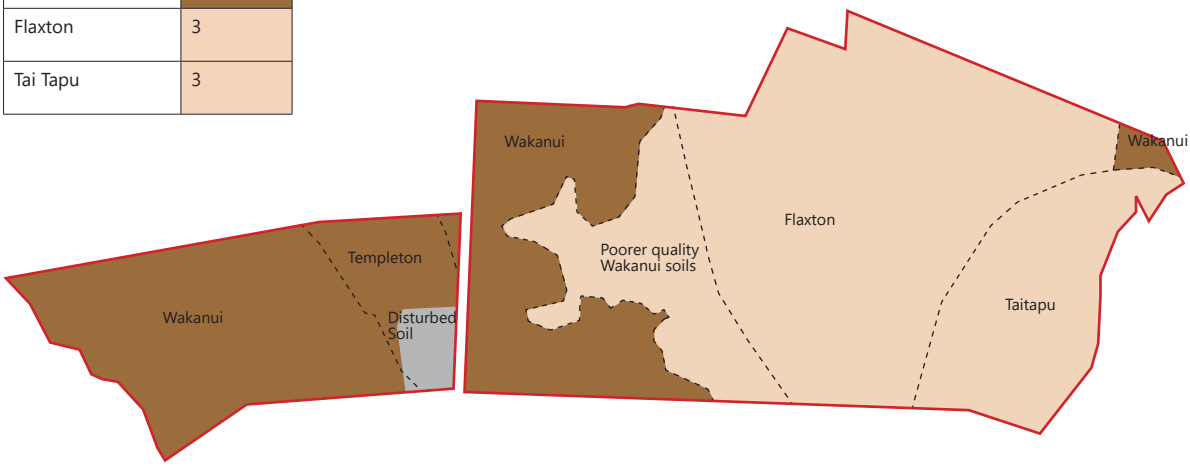


Figure 31. LUC on the PC69 Site
(Adapted by permssion from Almond, P. (2021) p.6)

Not available due to copyright restrictions

Table 4. LUC Classes and their respective uses
(Adapted from SCRCC, 1974., cited in Lynn et al., 2009)

development, multi-storey apartments, and more sustainable and innovative options. This suggests that a range of new typologies and lot sizes could be explored at higher densities. This would provide choice, and hopefully allow for more affordable options. Proximity of housing to community infrastructure was a concern that could be remedied, again through the design of compact and walkable neighbourhoods. As indicated within the food theme, the community wanted to spare highly productive land from development, and a smaller residential site coverage would begin to address this concern. Summarised below are the key opportunities for spatial design related to the 'housing' theme:

- Create compact and walkable neighbourhoods
- Enable housing choice and variety
- Enable higher housing density
- Decrease residential site coverage

6.1.7 Character

Protecting the existing character of Lincoln was an important consideration for the community. This could be addressed through two strategies, either by trying to fit in with the existing character, or separating the new development from the existing community. The development could take on the form of one, or all of the three character themes; small village, rural, and university town (Figure 32). For example, the buildings could follow the form and materiality of those on the Lincoln University Campus, the Lincoln Township, or surrounding rural environment. Visual buffers around the periphery of the site could maintain a rural character, provided they were designed to look like the existing rural landscape, for example shelterbelts and paddocks.

To lessen the impact of the development on the existing community village, the proposal could have fewer dwellings and therefore a smaller population. The new development could also provide adequate community infrastructure close to housing, to lessen the need for travel outside the proposed neighbourhood. Summarised below are the key opportunities for spatial design related to the 'character' theme:

- Consider existing character for the new development
- Provide buffers to retain existing rural character
- Consider fewer proposed dwellings
- Create compact and walkable neighbourhoods

Figure 32. Three characters of Lincoln Township (Author, 2022).

6.1.8 Social

Noted within the submissions, reverse-sensitivity is one of the foreseen issues with developing housing adjacent to agricultural activities (McClintock et al., 2013; Norris, 2018). In this case it refers to the objection to the noises and smells of the rural environment by residents moving into the area. Buffers around the periphery could help mitigate these concerns to the adjacent subdivisions, but within the development perhaps there could be a spectrum of participation in agricultural activities, with those that were less interested, located further away. This issue could also be addressed through branding and communication to potential purchasers that the new development would embrace the agricultural lifestyle, so that people that choose to live here, choose this lifestyle.

Concerns around health and wellbeing and crime could be addressed through creation of equal opportunities for everyone to thrive, for example providing housing choice, transport choice, employment opportunities, and spaces that enable community interaction. There were also concerns around the impact on future generations and their ability to grow food. This is again linked to the loss of highly productive land and could be mitigated through a smaller residential site coverage. Summarised below are the key opportunities for spatial design related to the 'social' theme:

- Create buffers around the site periphery
- Design to allow different levels of participation
- Enable housing choice and variety
- Create compact and walkable neighbourhoods
- Decrease residential site coverage

6.1.9 Context

There were many concerns that Lincoln is not the appropriate place for this kind of residential development and that it should be occurring in Rolleston where there is a plan for urban growth within the Selwyn District (Figure 33). Some of the detail provided by submissions included impact on traffic, community infrastructure and highly productive land, each which have been examined in the sections above. This is however a complex issue and could include a number of other concerns for example; general nimbyism, population concerns, issues relating to housing sprawl.

Clearly there is a need to consider the site in its context, for example, what is the value of this land

Figure 33. Housing in the new Faringdon development in Rolleston (Author, 2022).

compared with other parcels, what are the effects of the development on neighbouring towns and existing residents, and how might this development be unique and site specific? Summarised below are the key opportunities for spatial design related to the 'context' theme:

- Create compact and walkable neighbourhoods
- Create a network of pathways for active transport modes
- Decrease residential site coverage
- Create housing different to offerings in wider context
- Consider site specific design

6.2 Five key goals for spatial design

Many of the opportunities highlighted within the themes above, have similar and overlapping objectives, while others are not seen as crucial to high-level land use planning. For example, transport connections could be implemented at a more detailed stage without impacting the land use zones since they have been included within the residential zone. The opportunities with the most potential to address the community concerns within a land use plan have been summarised into five key goals for spatial design, listed below:

GOAL 1: Provide housing variety and choice and enable higher densities

GOAL 2: Reduce residential coverage and dwelling numbers

GOAL 3: Utilise soil and flood mapping to maximise potential and manage risk

GOAL 4: Create compact and walkable neighbourhoods near existing transport routes

GOAL 5: Retain perimeter buffers to maintain rural character and provide food and ecological corridors

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7 Ideate

The ideate mode shifts the focus from problems to solutions, with the purpose of generating a number of concepts and source material for building prototypes (Hasso Plattner Institute of Design, 2010). The last stage identified a range of opportunities which will be used as a starting point to produce concepts for the project. The key method used in this mode is design projection.

7.1 Housing

7.1.1 Housing typologies

Although standalone houses on large lots remain the most favourable typology in the Greater Christchurch Area (Christchurch, Waimakariri, and Selwyn Districts), it is expected that future demand from elderly, and smaller average households will result in smaller sections and houses, and multi-unit dwellings (Greater Christchurch Partnership, 2019). This provides support for testing a range of typologies to accommodate people's preferences in the future.

For this study, four indicative typologies have been utilised to give a variety of choice and density; single-storey stand-alone housing, terrace housing and apartments at 3 floors, and six floors (Figure 34). The building form is indicative of mass only, and could be articulated in later design stages to produce more interest and variation. The lot size and dimensions are also indicative only, and have been generated from a standard block depth of 30 metres and varying setbacks to side and front boundaries to comfortably accommodate landscaping and outlook space. The lot sizes also ensure less than fifty percent building coverage of the site, but recession planes have not been taken into consideration at this stage. The expectation is that using a comprehensive neighbourhood design approach, which is discussed within the literature review, building and lot sizes would be varied and integrated in a more cohesive way.

The approximate median floor area of new stand-alone houses consented in 2019, was 180 square metres (Stats NZ, 2020), which gives a standard to apply to the typologies. Multi-unit homes,

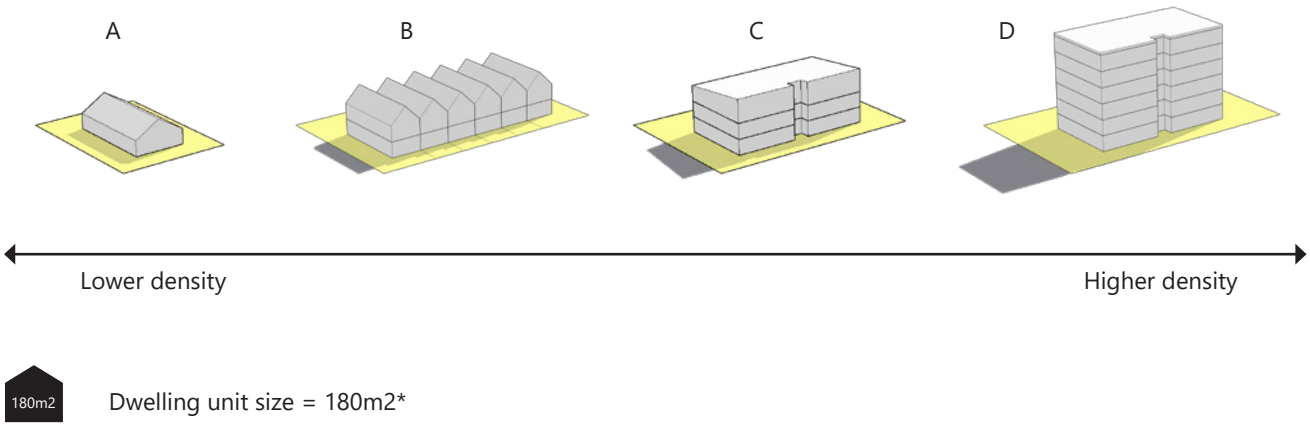


Figure 34. Indicative housing typologies (Author, 2022).

such as terraces and apartments, are usually smaller at approximate median of around 100 square metres (Stats NZ, 2020), however for this study it is important to show a like-for-like comparison to understand the efficiency of space in each typology.

7.1.2 The case for higher greenfield density

Plan Change 69 requires a minimum net density of 12 dwellings per hectare (dph), which includes residential lots, roads and open space, with a total maximum of 1710 units across the development site. As this is only a minimum requirement, there is an opportunity to increase this density. A report carried out for the Greater Christchurch Partnership, 'Greenfield Density Analysis' (Harrison Greerson, 2020), recommends a minimum density of 15dph for greenfield developments to make

most efficient use available land. The report continues on to state that even higher density could be proposed if designed appropriately with supporting facilities and amenities, and in close proximity to centres and key transport connections (Harrison Greerson, 2020).

To demonstrate the land use efficiency of higher densities, the four typologies have been used to model a one hectare site at a net density of 12dph, giving a total of twelve units each (Figure 35). The first is the stand-alone house, which uses the entire land parcel for residential lots and infrastructure, such as roads, utilities, and stormwater management. The terrace housing and low-rise apartments begin to see some efficiencies in the land required for both residential parcels and infrastructure, while the six-floor apartment typology reduces the overall land take considerably while providing the same number of dwellings.

While the six-floor apartment may not look appealing sitting within a one hectare block by itself, when other activities are programmed into the remaining space the benefits become clearer (Figure 36). Instead of covering the entire site with housing and roads, the space could be used for a range of activities of benefit to the local community, including but not limited to, food production, native restoration, or recreation.

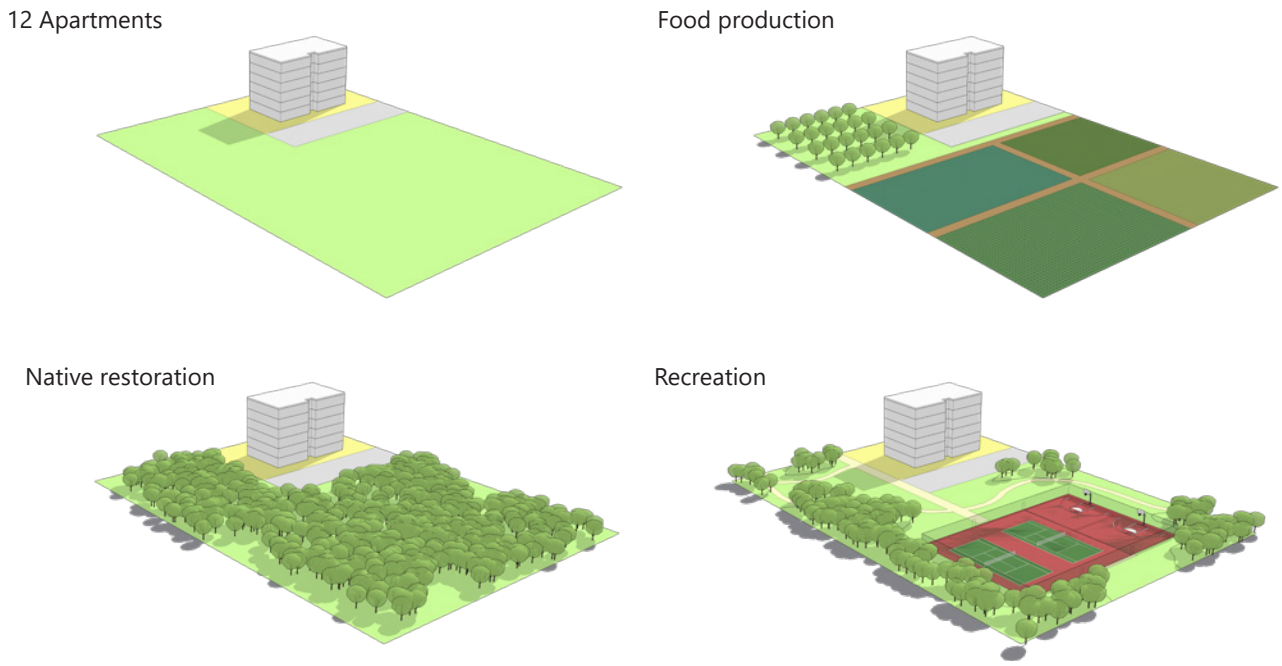
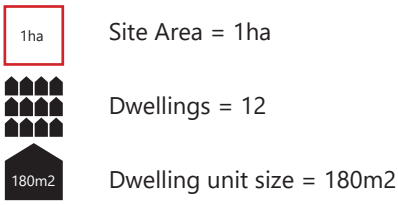


Figure 36. What could you do with the remaining open space? (Author, 2022).

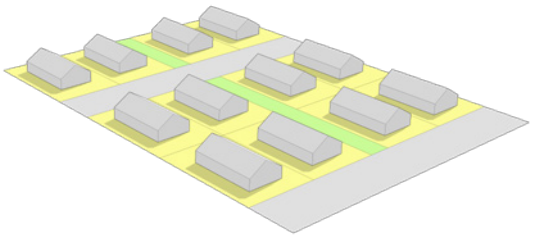


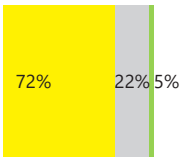
SITE COVERAGE

Residential Lots

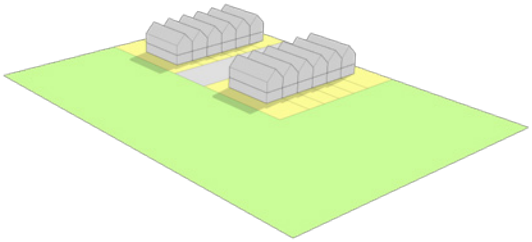
Roads

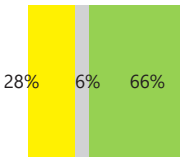
Open Space



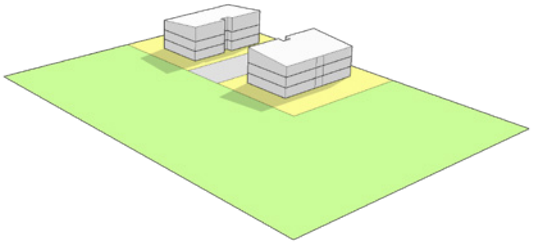


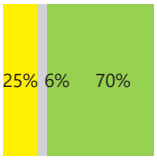
12 Stand-alone Houses	
Net Density (Lot, Roads, Open Space)	12 dph
Net Density (Lots only)	17 dph



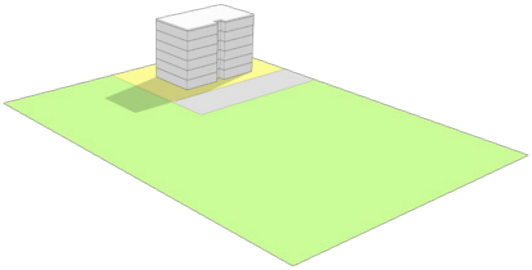


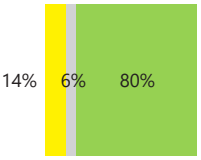
12 Terrace Houses	
Net Density (Lot, Roads, Open Space)	12 dph
Net Density (Lots only)	43 dph





12 Apartments over 3 Floors	
Net Density (Lot, Roads, Open Space)	12 dph
Net Density (Lots only)	49 dph





12 Apartments over 6 Floors	
Net Density (Lot, Roads, Open Space)	12 dph
Net Density (Lots only)	85 dph

Figure 35. Variations of 12 units on 1 hectare (Author, 2022).

7.1.3 Understanding PC69 Land use

While the PC69 Outline Development Plan (ODP) designates open space, not all roads have been designed, making it difficult to measure exact areas for each land use zone (Figure 37). In order to calculate unit numbers and compare the PC69 ODP like-for-like with different scenarios, open space has been separated from the residential density calculations, and roads have been included. Figure 38 illustrates the densities of each typology using this method.

In addition the land use graphics have been simplified into just three categories to make changes to density and land use legible (Figure 39). The Residential category includes residential lots, and roads, while the open space category brings together reserves, wetlands, stormwater management, and buffers. Node is the third category, which combines community infrastructure and public transport together. This simplified land use illustrates that residential zone equates to approximately 57.5 percent, the open space 24 percent, and the node 1.5 percent of the total land area.

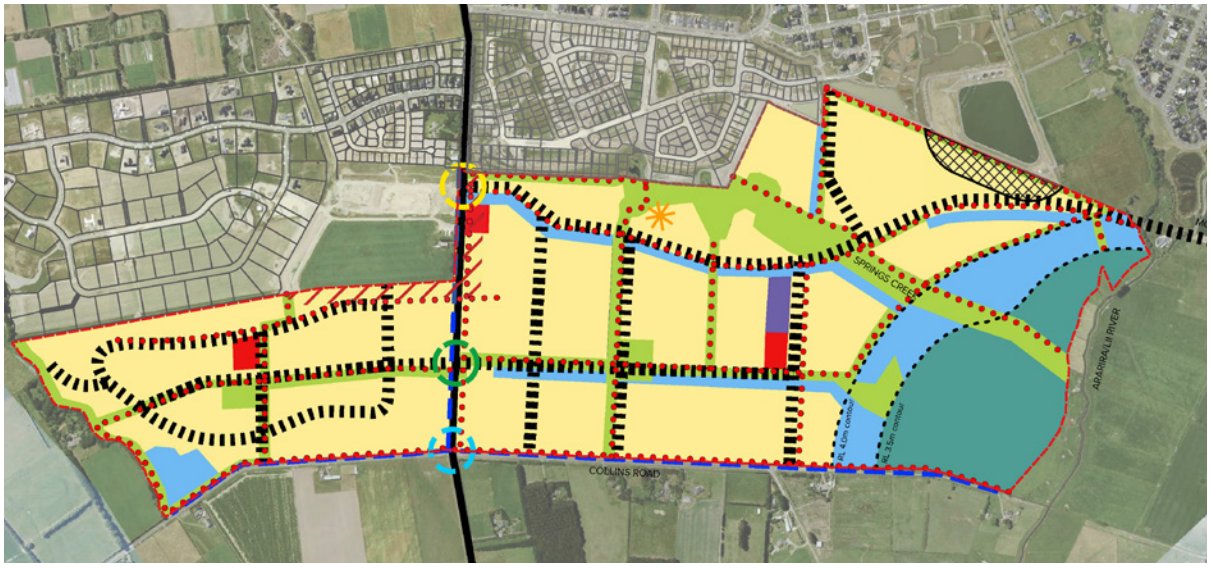
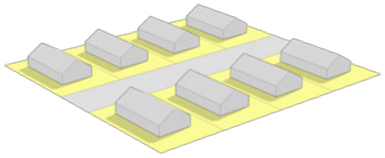
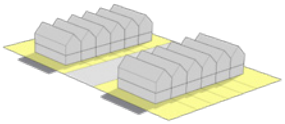


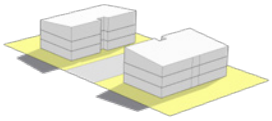
Figure 37. PC69 ODP includes some roads within Living Z Zoning
(Adapted by permission from DCM Urban Design Ltd, 2021)



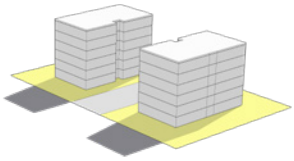
Stand-alone Houses	
Net Density (Lots and roads only)	14 dph



Terrace Houses	
Net Density (Lots and roads only)	35 dph



Apartments over 3 Floors	
Net Density (Lots and roads only)	40 dph



Apartments over 6 Floors	
Net Density (Lots and roads only)	69 dph

Figure 38. Typology densities (Author, 2022).

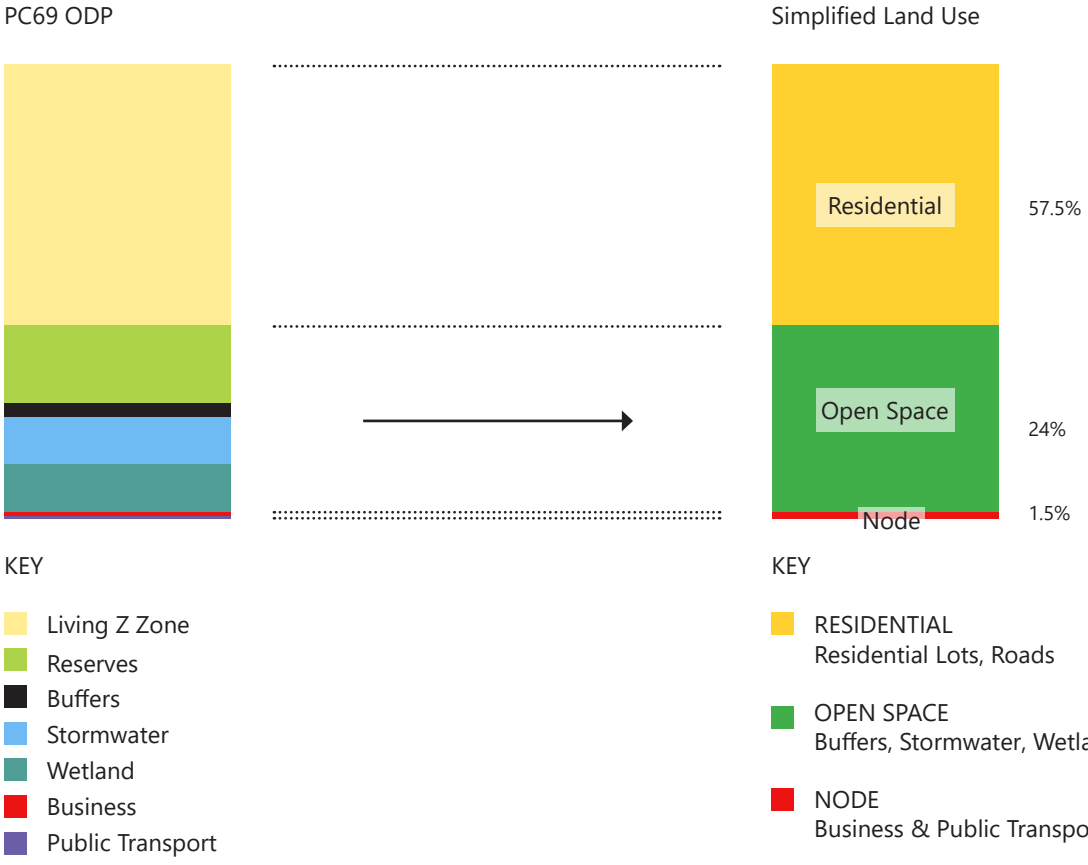


Figure 39. Simplified land use categories (Author, 2022).

7.1.4 Reducing residential coverage

Four land use options have been created to compare with the current PC69 proposal to understand the implications of reducing residential site coverage, and in particular which densities are needed to meet target unit numbers (Figure 40). In each option a greater percentage of residential land is exchanged with open space, with the PC69 site with 57.5 percent residential area, through to Scenario D with only 10 percent.

Table 5 shows the density required to meet the maximum permissible number of dwellings for each scenario. As discussed earlier in this study, the development impact could also be mitigated with a smaller proposed population, so target dwelling numbers have been modelled at 100 percent, 75 percent, and 50 percent of maximum allowable numbers.

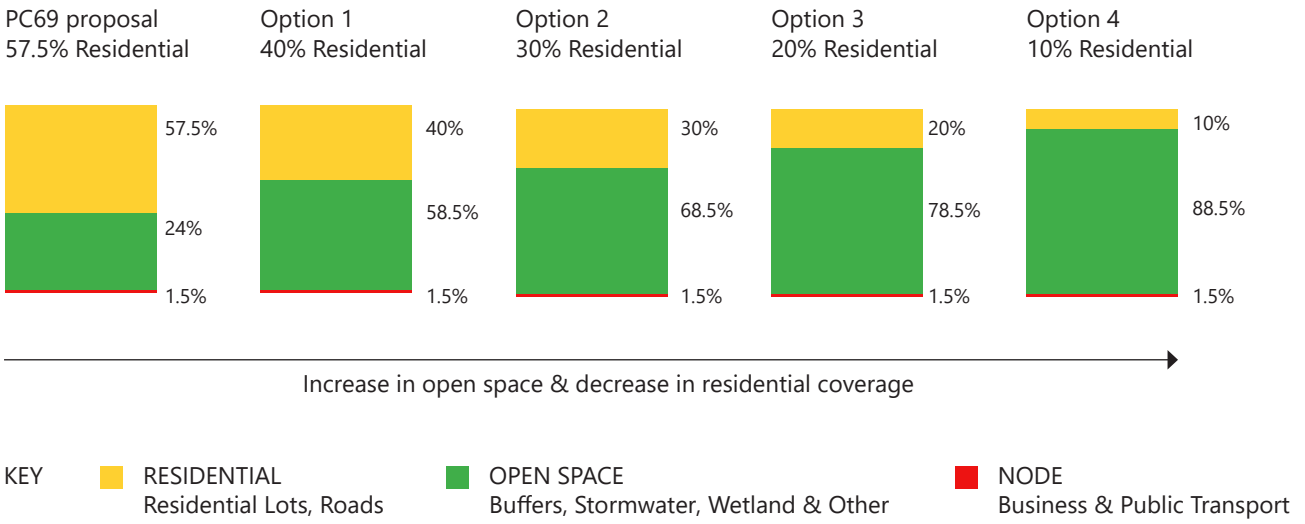
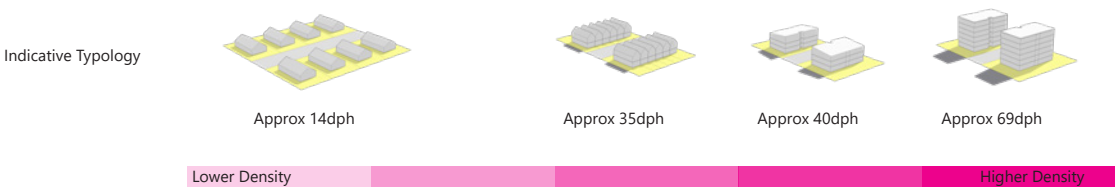


Figure 40. Potential land use options (Author, 2022).

POTENTIAL LAND USE OPTIONS

Percentage of max. allowable dwellings	Target number of dwellings	Net density* required to reach target units				
		PC69 Proposal	40% Res	30% Res	20% Res	10% Res
100%	1710 units	15dph	22dph	29dph	43dph	86dph
75%	1282 units	12dph	17dph	21.4dph	32.3dph	64.1dph
50%	955 units	8dph	11dph	14.3dph	21.5ph	43dph



* Net density calculated using combined Residential Lot and Road Areas.

Table 5. Land use density matrix (Author, 2022).

7.1.5 Land use scenario selection

Analysing the land use density matrix further, we can see that there is a wide range of densities to explore. Table 6 highlights some of the constraints that may make some densities less suitable, for example, low density options that mean providing diversity and choice in housing will be challenging and may not provide the quantity of open space that the community wanted. The options exploring 50 percent of the maximum allowable units has question marks over feasibility, and may not be economical for the developer. The options with densities over 60dph may not be acceptable to the community, but might be worth exploring with fewer units.

Figure 41 shows the options with the most potential to develop further which are those with 30 percent, 20 percent and 10 percent of the total land area zoned for residential.

Percentage of max. allowable dwellings	Target number of dwellings	Net density* required to reach target units				
		PC69 Proposal	40% Res	30% Res	20% Res	10% Res
100%	1710 units	15dph	22dph	29dph	43dph	86dph
75%	1282 units	12dph	17dph	21.4dph	32.3dph	64.1dph
50%	955 units	8dph	11dph	14.3dph	21.5ph	43dph

* Net density calculated using combined Residential Lot and Road Areas.

Table 6. Land use selection matrix (Author, 2022).

KEY

- Low density may not provide the choice in housing, or the quantity of open space that the community wanted
- Poor economics may not be acceptable to developer
- Density above typology limits and may not be acceptable to community
- Scenarios with the most potential

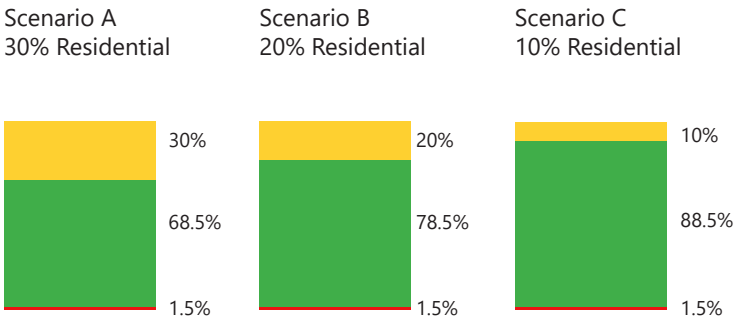


Figure 41. Scenarios chosen for further exploration (Author, 2022).

7.2 Food

7.2.1 Maximising the site's food potential

The loss of highly productive land was a significant concern of the community, in particular the permanence of housing development on this land, locking small lots into private ownership which would make it very difficult to reverse the land use back into food production.

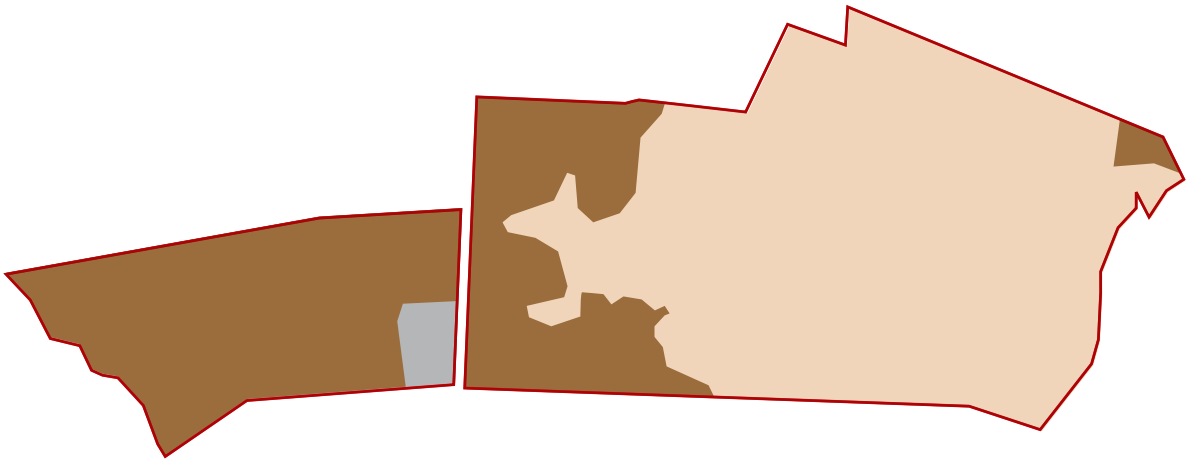
As identified in the define mode, the solution to this problem involves preserving some or all highly productive land by limiting the development over this land. The question of how much land should be spared is contentious? The entire site might be considered highly productive, as the proposed NPS-HPL stipulates that any land in LUC classes 1 to 3 should be classified as highly productive land by default, until mapping has been carried out by the relevant local authority (Ministry for the Environment, 2020). Notwithstanding the site's high soil quality, if there is a need to locate housing on the land, then perhaps this should occur on the lower quality Class 3 soils as shown in Figure 42.

7.2.2 Models of agricultural land allocation

As explored in the literature review, there are a range of precedents and models that can be used to understand how much land should be allocated for food production. Table 7 summarises and compares several models which are detailed in the following paragraphs.

Firstly, evidence suggests the 'Hide' from Anglo-Saxon times, an area of approximately from 48 hectares could support four families (Lapidge, 2014). With an average family size of around four persons, this equates to 3 hectares or 30,000 square metres per person.

The allotment garden ranged between 250 and 1,000 square metres per family, giving a maximum of around 250 metres squared per person (Nilsen, 2014). Ebenezer Howard's Garden City set aside 2,000 hectares of agricultural land for a population of 30,000, but also included allotments of 240 square metres for each family (Fishman, 1982). In total, this model allocated approximately 700 square metres per person. Frank Lloyd Wright's Broadacre City provided exactly one acre, or



KEY

- LUC Class 2 soils
- LUC Class 3 soils
- Disturbed soils

Figure 42. PC69 Land Use Capability
(Adapted by permssion from Almond, P. (2021) p.6.)

Model	Approximate land area per person (m2)	Notes
Hide	30,000	Potentially includes more than just food
Global Average	6,600	Total agricultural land divided by global population
Broadacre City	1,000	Larger families would have access to more land
Garden City	870	Includes common agricultural land and residential allotments
Allotment	250	Supplementary to other food sources
Oakland, CA	94	Current vegetable consumption only

Table 7. Land allocated for food production in various models (Author, 2022).
NOTE. These figures have been rounded and approximated and use an average family size of 4 persons.

4000 square metres per person, though larger families would have access to more land if required (Fishman, 1982). Though these models give a general indication of productive land allocation, they are either outdated or not tested empirically to meet our current food demands.

A study into land requirements to meet daily food needs in Oakland, California, revealed that one hectare could support approximately 106 people in terms of their current daily vegetable consumption (McClintock, Cooper, & Khandeshi, 2013). Using these figures, each person would require 94 square metres of land in vegetable production. Using current global figures, if we divide the 51 million square kilometres used for agriculture (UN Food and Agriculture Organisation (ND) as cited in Ritchie, 2017), by the world's population of 7.7 billion (United States Census Bureau, 2022), we get a figure of around 6,600 square metres of agricultural land, per person.

These models, though not particularly accurate or specific to the site, give a broad range to which we can apply to the site to have an understanding of what agricultural land allocations might look like.

7.2.3 Applying models to the PC69 Site

The maximum number of dwellings permissible under the plan change is 1710 units. If this figure is reached, then the development's population could be around 4,275, using Aotearoa's average household size of around 2.5 people (Stats NZ, 2019). Using this population we can test the land requirement for the PC69 site based on the models above. Figure 43 illustrates how many PC69 sites would be needed to feed the proposed population, from the current global agricultural land average needing 15 times the land area, to Oakland, California's vegetable consumption requiring just 20 percent of the site.

From this analysis we can see that it is unlikely the site could produce enough to feed the sites predicted population, particularly if we consider Aotearoa's meat-rich diet. However, the site still holds huge potential to supplement our diets, whether that be through the form of small farms, allotments, or community gardens.

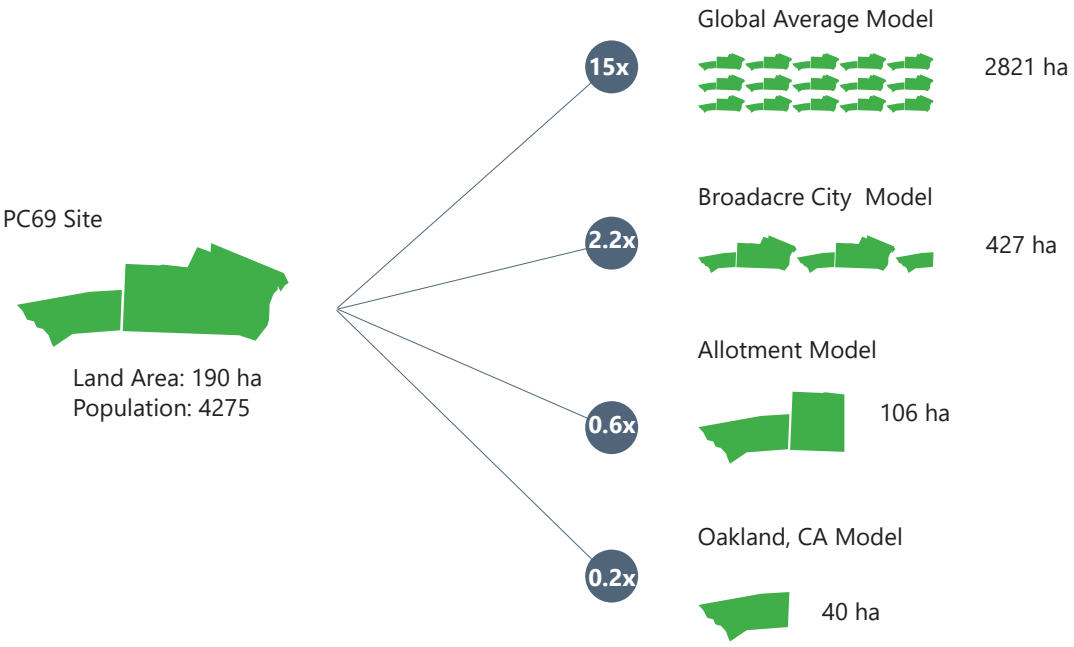


Figure 43. How many PC69 sites would it take to feed the proposed development? (Author, 2022).

7.2.4 Comparing existing and future site food production

Another way to maximise the land's soil value, is to consider the current volume of food produced on the site and increase this with any potential future yields. The site is an existing dairy farm of approximately 190 hectares (Figure 44), and though there are no figures on the exact quantity of dairy product produced, some global averages could be used to draw some comparisons between different food types.

Figure 45 shows the average land area needed to produce one kilogram of food for various different food types. We can see that in general animal products need a far greater land area than plant based foods. Using this generalised approach we can compare the existing site's productivity with other possibilities. Figure 46 shows a comparison between milk and other food types produced in the Canterbury region, and how much of the site would be required to produce the same quantity of food, for example only 7 percent of the site would be used to produce the same weight in apples. Although this is an extremely simplified analysis, it does highlight the fact that the land could be used for housing and still produce as much food in weight, if not more than in the present condition.

Diversification into fruit and vegetable production on the site also aligns with the research that the highest quality soils are most valuable for growing crops "like potatoes, onions, and leafy green vegetables" (Lynn et al., 2009, as cited in Ministry for the Environment & Stats NZ, 2021, p. 19).

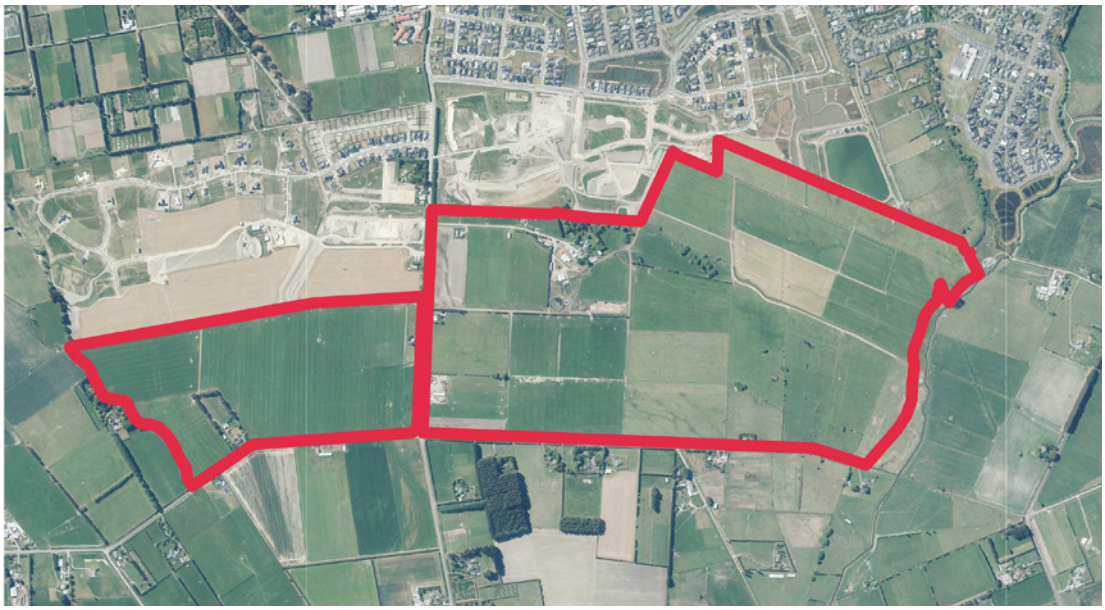


Figure 44. The existing PC69 site (Adapted from Canterbury Maps, 2022).

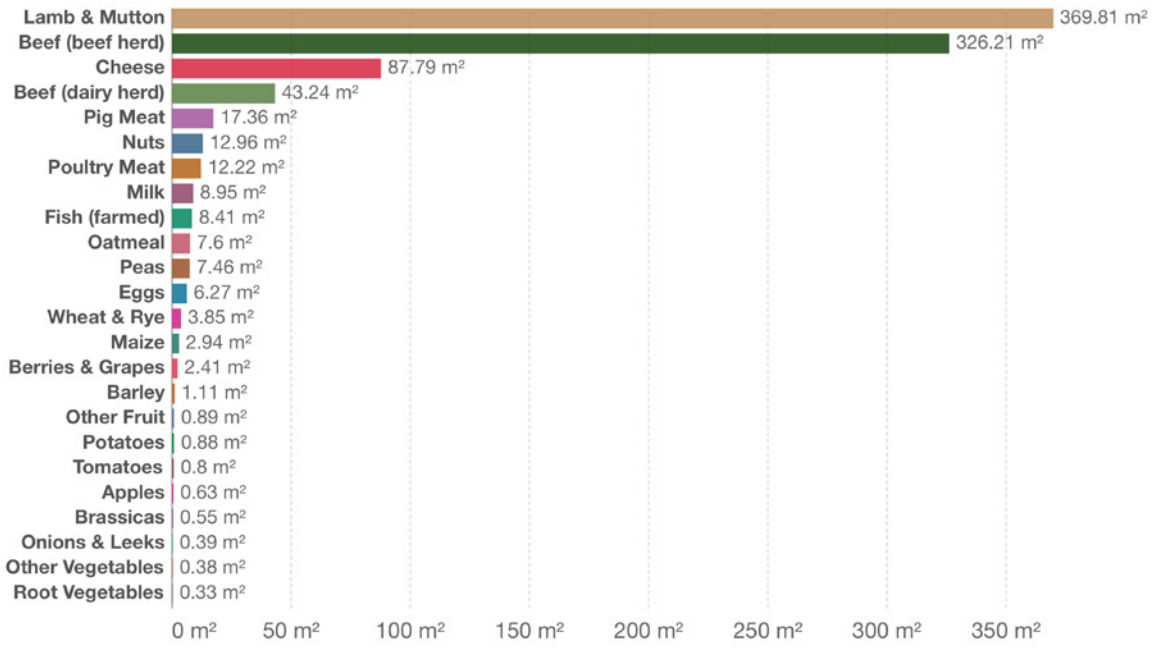


Figure 45. Land use per kilogram of food product
(From Poore, J., & Nemecek, T. (2018) via Our World in Data. CC BY 4.0).

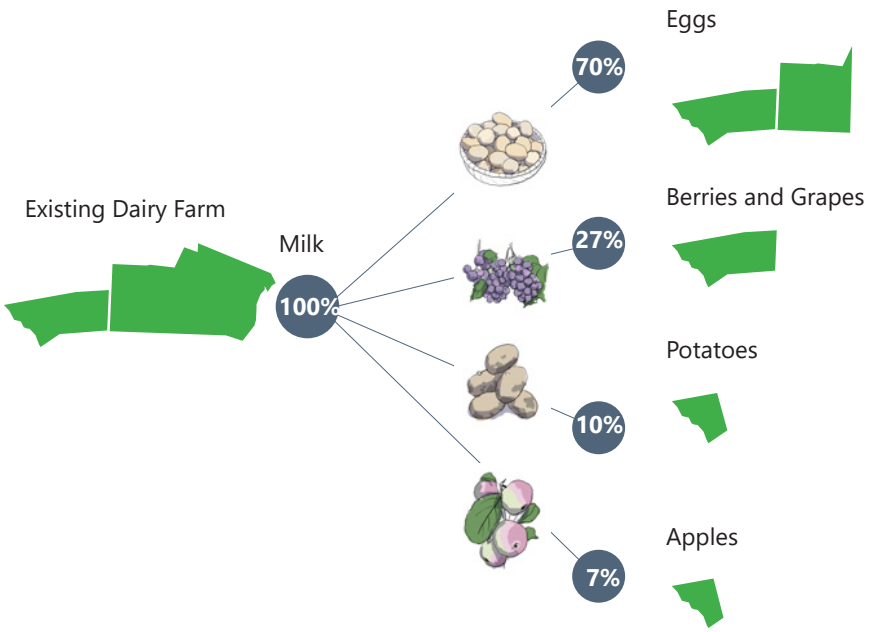


Figure 46. How much of the PC69 site would it take to produce the same weight in food? (Author, 2022).

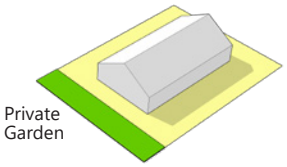
7.2.5 On-lot food production

All of the analysis to this point has focussed on food production on public land, within the open space areas. Although this land has the most potential, Figure 47 illustrates that there are many opportunities to produce food on the residential lots, from traditional backyard vegetable and fruit gardens, to balcony gardens and even communal roof gardens. This highlights that residents will have the choice to participate in food production individually, communally, or not at all if they wish.

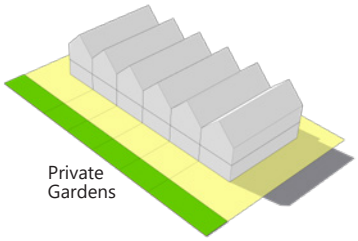
KEY

Private Lot

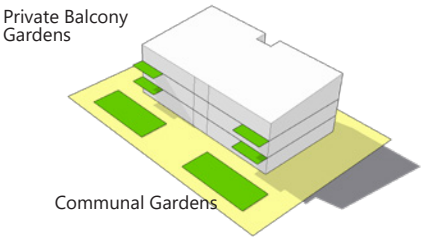
Potential food production



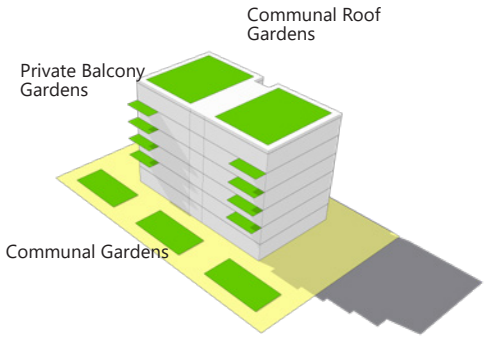
Stand-alone Houses



Terrace Houses



Apartments over 3 Floors



Apartments over 6 Floors

Figure 47. Opportunities for on-lot food production (Author, 2022).

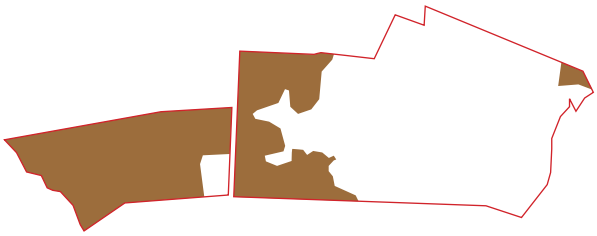
7.3 Site Analysis

Some of the opportunities identified in the define phase involve a closer analysis of the site, for example mapping of soil and flooding, creation of buffers and connecting nodes with key transport routes. Mapping these as layers is a useful exercise as the land has inherent characteristics which make it more suitable for food production, housing or other activities (Figure 48).

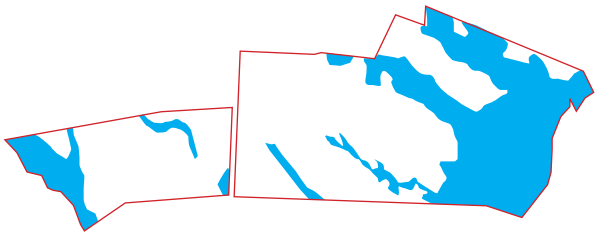
As previously discussed, under the proposed NPS-HPL most of the soils on the site could be classified as highly productive. Class 2 soils have been separated from those in Class 3 in order to map the best soils for food production. Flood risk areas have been mapped based on a 200-year annual rainfall intensity (ARI) with a flood depth of 0.2 metres or greater. Housing should be avoided in these areas, and food production also makes less sense due to the risk of crops being devastated.

Around the perimeter, buffer zones of approximately 30 metres will help to reduce the visual impact of the development, and also provide additional space for ecosystem services and food production. In terms of locating commercial and community nodes, Springs Road is the only key transport route adjacent to the site, and there is potential to link public transport services to the site from Lincoln University and Lincoln Township.

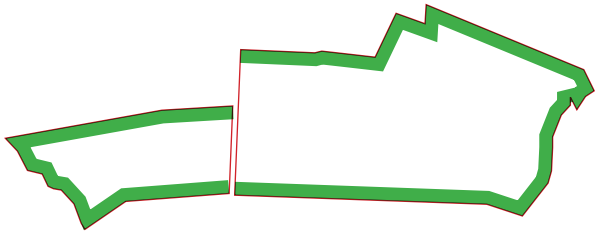
Combining these layers, Figure 49 highlights the land most suitable for different uses which can be used as a framework to explore the different land use scenarios.



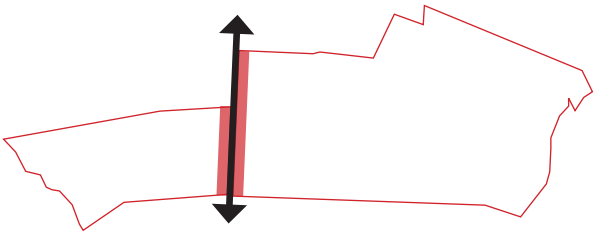
Layer 1. Utilise Class 2 Soils for food production



Layer 2. Avoid development in flood risk

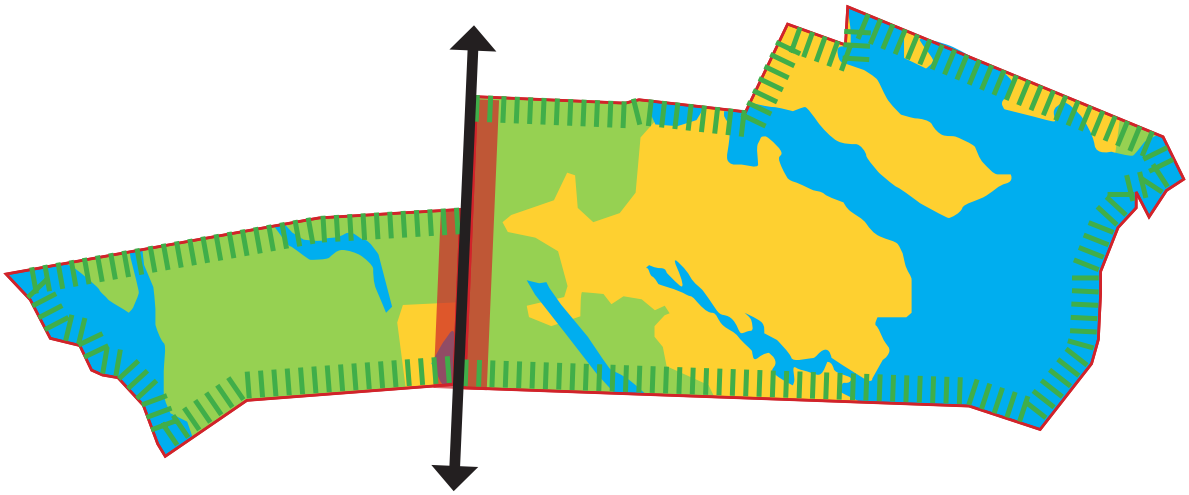


Layer 3. Create 30m buffer zones around perimeter



Layer 4. Locate nodes close to key transport routes

Figure 48. Site analysis layers (Author, 2022).
Note: Layer 1.Adapted by permssion from Almond,P. (2021) p.6.



KEY

- Land most suitable for food production
- Land suitable for recreation and ecological purposes
- Land suitable for residential development and with some potential for food production including animal grazing
- Potential buffers
- Land most suitable for node

Figure 49. Site analysis (Author, 2022).

8 Prototype

The prototype mode involves the "iterative generation of artifacts intended to answer questions that get you closer to your final solution" (Hasso Plattner Institute of Design, 2010, p. 8). This stage also uses the design projection method, but with more focus, as the concepts developed in the ideate mode will be applied to the site to create a number of land use scenarios. These scenarios will give themes different weightings, to show the implications of prioritising one aspect over another. The purpose of this stage is to provide a source for discussion, debate and future research.

8.1 Four Scenarios

Including PC69, four scenarios have been identified as potential futures for the PC69 site. Figure 50, compares each land use scenario which have been simplified to just show land zoned for open space, residential and the node. The PC69 proposal is the first scenario, with 57 percent residential land, three nodes distributed over the site and a large portion of open space to the east. Scenario A will have a housing focus; it has 30 percent of the site allocated for residential zoning, and larger zones of open space to the east and west and one node adjacent to Springs Road. Scenario B allocates 20 percent to residential land, and will have a focus on conserving highly productive land. Scenario C designates just 10 percent of the site to residential land, and focuses on creating a compact walkable neighbourhood.

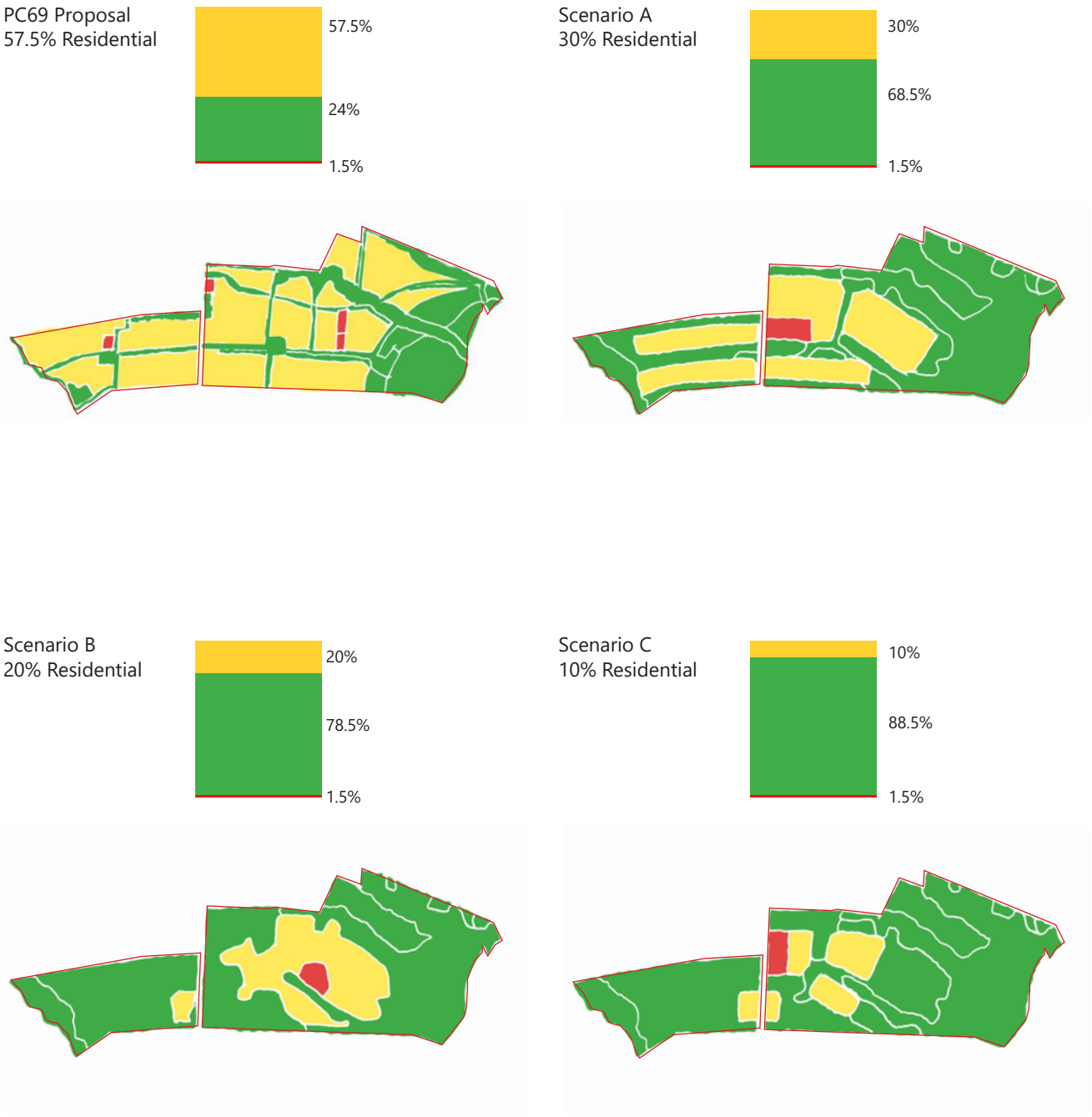


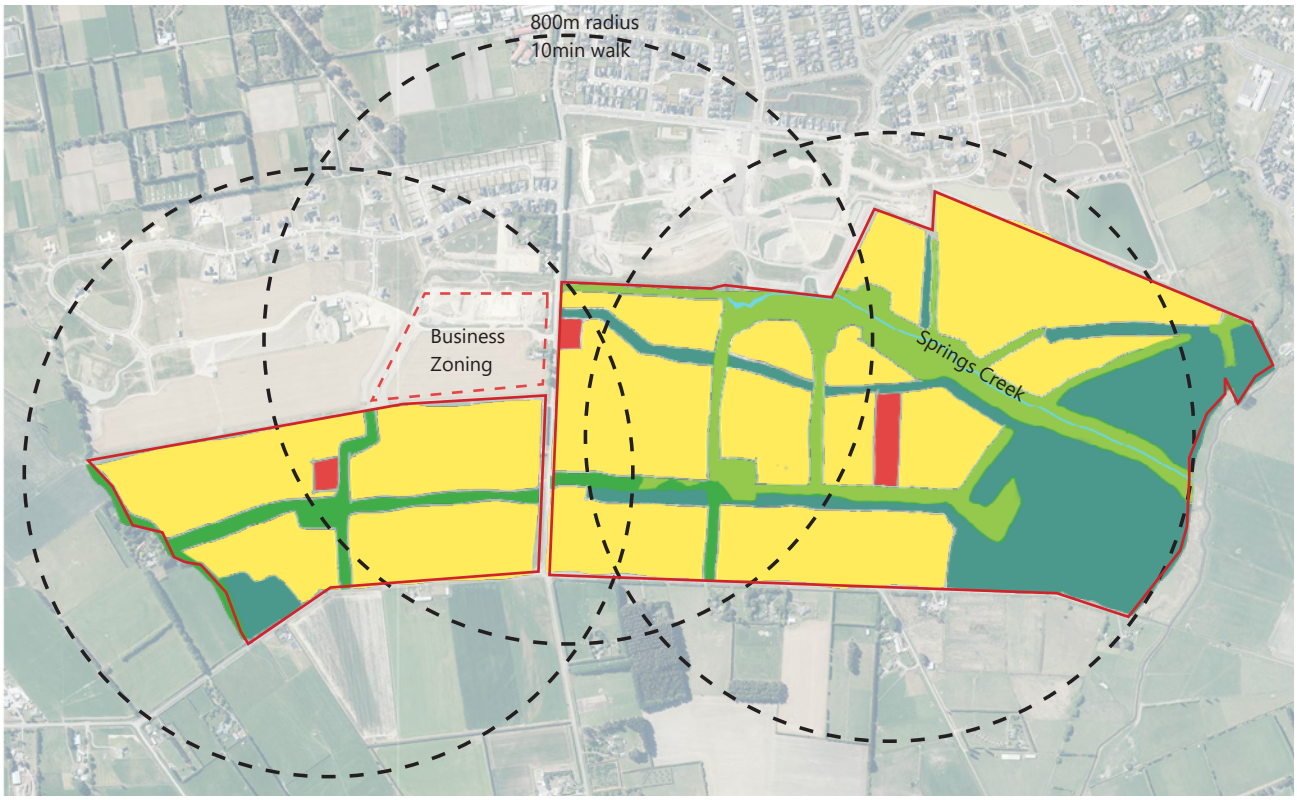
Figure 50. Four alternative land use scenarios (Author, 2022).
Note: PC69 Proposal adapted by permission from DCM Urban Design Ltd (2021).

8.2 PC69 Proposal

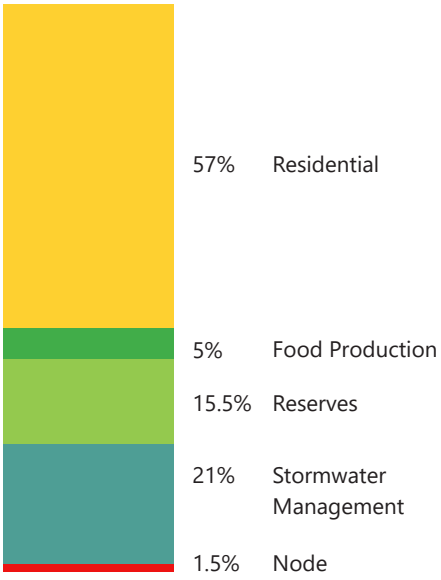
Figure 51 shows a simplified version of the outline development plan, which is the current proposal for the site. The residential offering would mainly consist of stand-alone housing, due to the proposed low density of the development. This has the advantage of delivering what the market and insurance companies expect and therefore potentially offers lower risk for the developer.

There are three nodes within an 800 metre catchment of residents, equivalent to around ten-minutes walk. If each of these nodes are convenience stores to meet the needs of the residents in their respective catchments, then they are repeating the same function three times. If they are diverse offerings then they would require other forms of transport to reach them from the other side of the development.

Food production on Class 2 soils is very limited, with only 5 percent of the site available. Notwithstanding, other open space could still be used for food production, especially animal grazing. This proposal has a very large amount of open space, with a combined total of close to 42 percent. A recent study of seven greenfield developments across Aotearoa New Zealand showed that the allowance given for open space and storm water management ranged between 4 and 19 percent, averaging around 11 percent (Harrison Greerson, 2020). Springs Creek and most of the springs are protected within green spaces and a considerable amount of the flood prone area has been excluded from housing development.



Land use



Potential typology mix

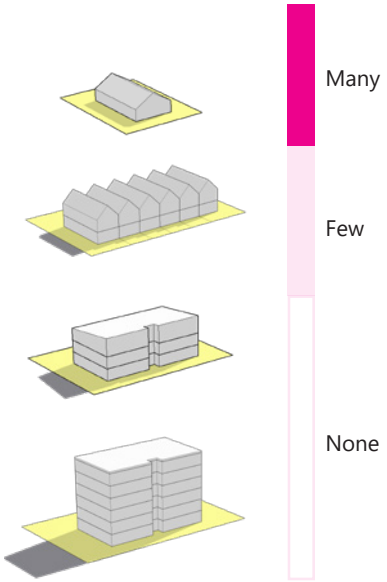
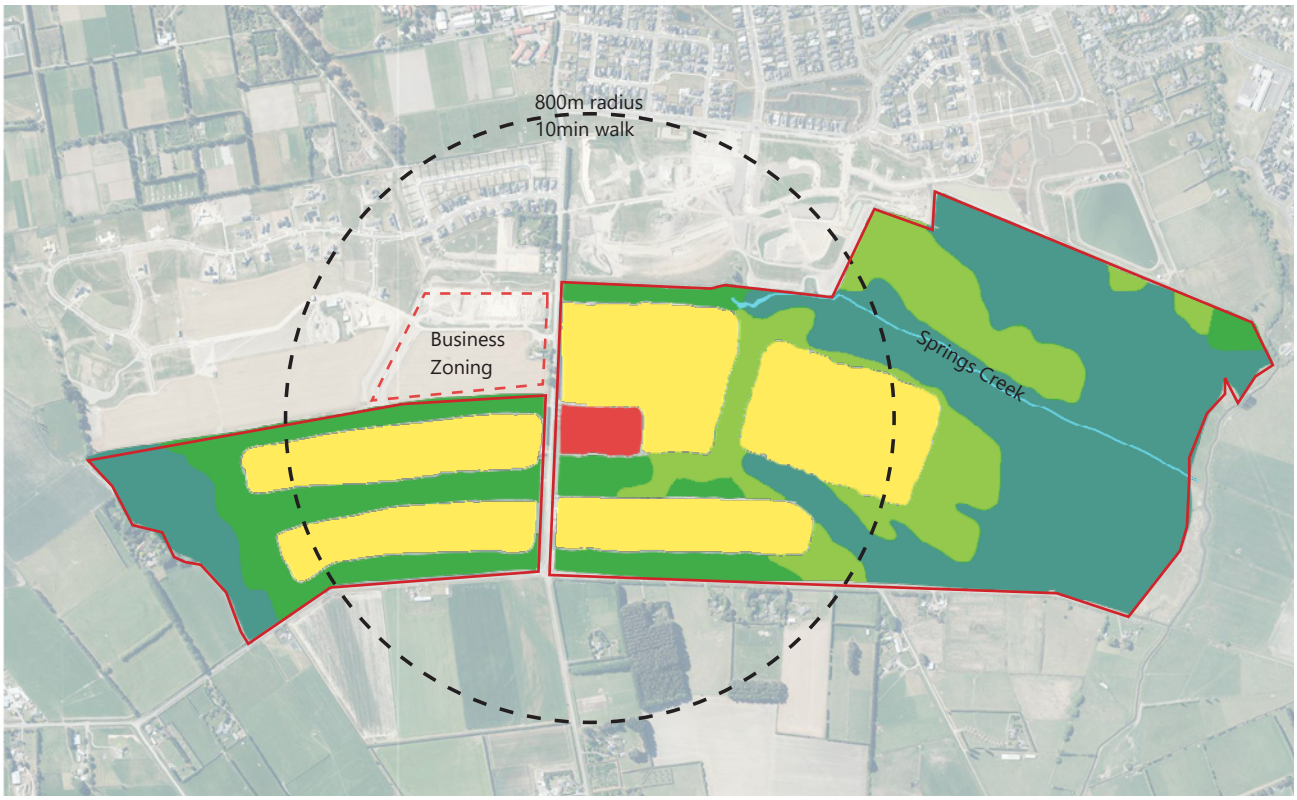


Figure 51. Simplified PC69 proposal (Adapted by permission from DCM Urban Design Ltd (2021). Contains data sourced from the CanterburyMaps and partners licensed for reuse under CC BY 4.0. Retrieved from https://mapviewer.canterburymaps.govt.nz/

8.3 Scenario A: Housing Variety

This scenario prioritises housing, with a focus on variety and access (Figure 52). Allocating 30 percent of the site to residential means that the required density is still relatively low, allowing for a variety of typologies and therefore choice for future residents. This scenario also allows for a reasonable proportion of stand-alone houses which the developer has experience in taking to the market, potentially lowering their risk. The housing also connects well to the surrounding open space, and is located outside of flood risk areas for the most part.

There is one single node sited adjacent to Springs Road, giving it good access and is mostly within 800 metres of the community it supports. It is large enough to provide a variety of commercial and community functions, such as convenience stores, community centre and even a primary school and kindergarten. Around 16 percent of the site is available for food production on Class 2 soils, and while this is not a large area, there are some good opportunities to integrate this between and around the housing clusters.



Land use

30% Residential

16% Food Production

15% Reserves

37.5% Stormwater Management

1.5% Node

Potential typology mix

Some

Few

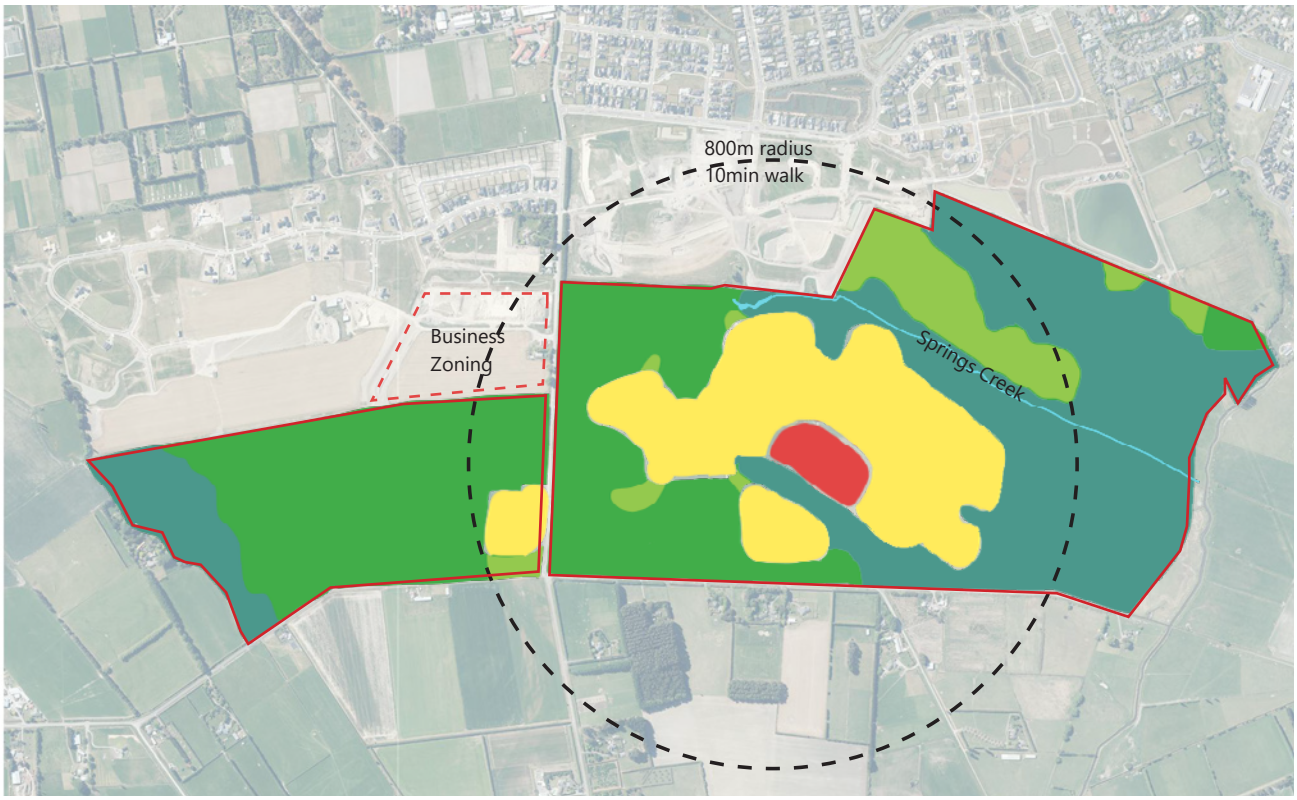
Figure 52. Scenario A: Housing variety (Author, 2022).
Contains data sourced from the CanterburyMaps and partners licensed for reuse under CC BY 4.0.
Retrieved from https://mapviewer.canterburymaps.govt.nz/

8.4 Scenario B: HPL Focus

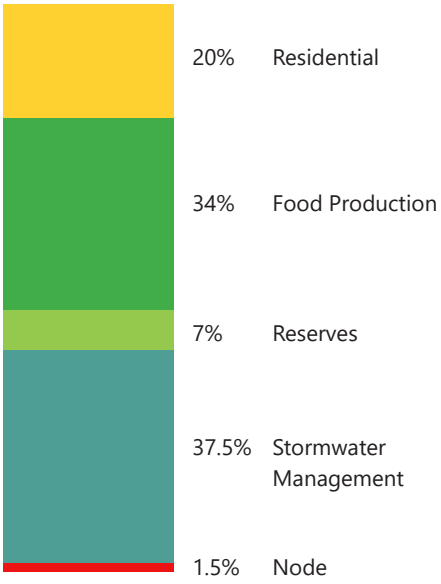
This scenario, illustrated in Figure 53, prioritises highly productive land by conserving as much Class 2 land as possible. This results in 34 percent of the site being available for food production on Class 2 soils, with most of this in a large contiguous parcels on the west of the site.

Residential site coverage is reduced to 20 percent, resulting in a density that requires more higher density housing typologies. This could be achieved by having many of the two and three-storey dwellings or, by utilising six storey apartments to offset a larger proportion of stand-alone houses. Most of the housing is in one big cluster, with limited opportunities to bring open space in between housing, but with an edge condition which allows for some interactivity between these elements.

The node is located centrally to the main housing cluster and within 800 metres of the community it supports, however it is sited away from Springs Road, making it less accessible from outside the development. There are large areas of open space for stormwater management, and a moderate amount which could be used for recreational purposes.



Land use



Potential typology mix

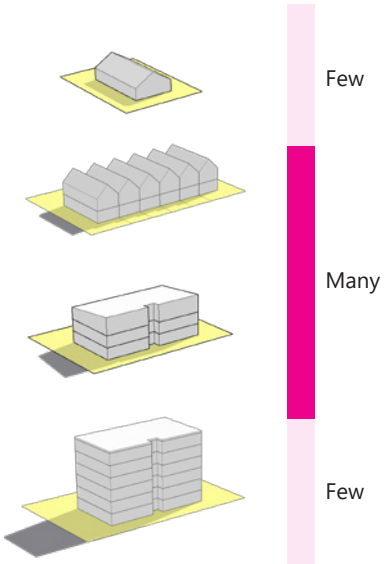


Figure 53. Scenario B: HPL focus (Author, 2022).
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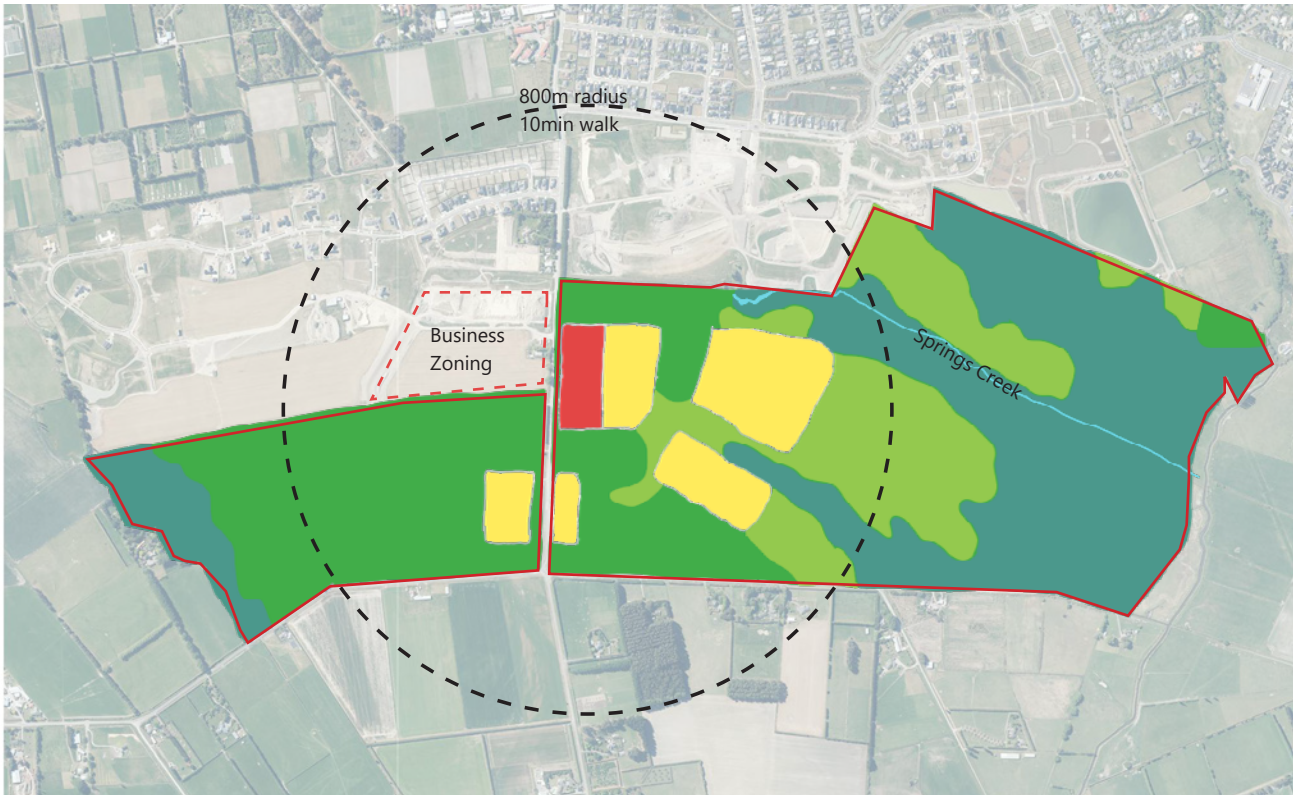
Retrieved from https://mapviewer.canterburymaps.govt.nz/

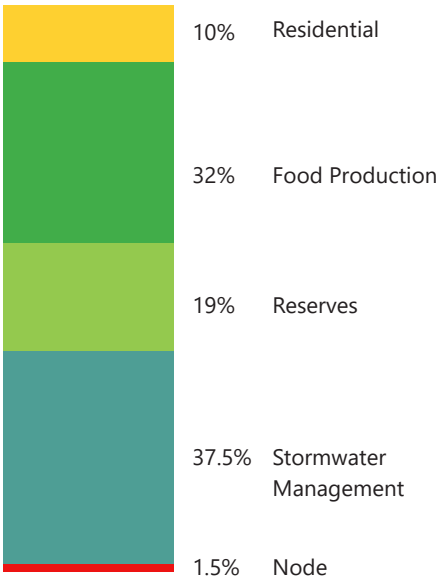
8.5 Scenario C: Compact Neighbourhood

This scenario prioritises a compact walkable neighbourhood with accessibility as a key focus (Figure 54). Only 10 percent of the site is allocated for residential, which results in a density that requires mostly apartment housing and potentially less units than other scenarios. This would likely be less favourable with developers. The benefits are that there are large amounts of open space to mitigate the visual impact and also with a lower future population many of the community concerns are mitigated to some extent.

The node is in very close proximity, well within the 800 metres walking catchment of the community it supports, and is sited directly alongside Springs Road, making it very accessible from outside the development. Most of the site is retained as open space, with the majority of Class 2 soils also spared. Large areas of open spaces are integrated between residential clusters giving residents excellent access to areas of food production, recreation and other open space activities.



Land use



Potential typology mix

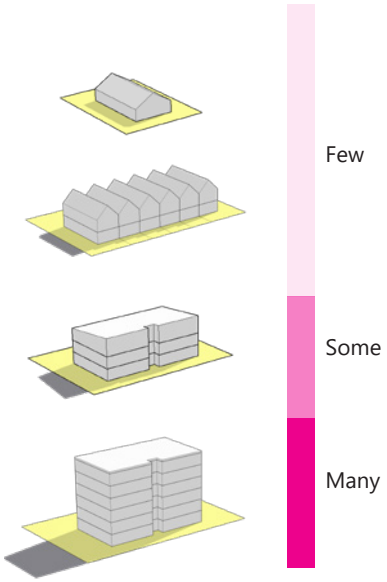


Figure 54. Scenario C: Compact neighbourhood (Author, 2022).
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9 Conclusion

Aotearoa's Highly Productive Land has recently come under increasing threat from residential sprawl. The National Policy Statement on Urban Development (NPS-UD), has enabled and supported this expansion of our urban areas to deal with unprecedented housing demand, and modernist planning has entrenched this with monofunctional zoning. Given our future demands for housing, the research question asks, '*What is the potential for integrating housing and food in peri-urban Aotearoa?*'

I have explored this question using Plan Change 69 (PC69) as a case study and applying a design thinking model as a research framework. This process started first with developing an understanding of the community sentiment, which was achieved through the analysis of submissions made during the private plan change request process. During this stage I found that there were nine key themes, including *transport, community infrastructure, environment, planning, food, housing, social, character,* and *context*. The community submissions revealed that people were strongly opposed to the loss of Highly Productive Land, and, that there is some support for alternative models of housing development. I proceeded to analyse the themes further to understand key spatial design opportunities which might address the community concerns. Through scenario modelling, I identified three possible alternative futures to compare with the PC69 proposal. These highlighted that there might be potential to integrate both housing and food using different residential models.

9.1 Limitations

Within the design thinking model, the *empathise* mode usually constitutes face-to-face interviews with specific questions related to the design problem. Due to the small scope of the dissertation, this stage was limited to generalised public submissions related to the PC69 proposal, and therefore was not targeted directly towards potential future residents of the project or their specific needs.
At the time of undertaking this study, the NPS-HPL had not been gazetted, therefore its content has not been taken into consideration within the community submissions nor within the wider research project.

9.2 Future research

The purpose of this study was to provide a discussion piece, opening up possibilities and potentials for the future. As the scope of this research did not include the *test* mode of the design thinking model, future research could test the scenarios developed in this study with the community, through workshops, interviews and surveys. This could be useful to understand if the concerns with PC69 had been remedied or mitigated in some way, as well as discovering which models of future development might be preferred. Key questions for further research include:

- *How willing are people to live in a community centred around food production?*
- *What are acceptable densities in peri-urban environments, and would people live in them?*
- *What are the models of smaller scale farming that would work in these locations?*

9.3 Final Thoughts

Another possible solution, which was not explored in this study, is to retain all of the highly productive land and grow Lincoln Township vertically to support future population growth. There is support for this in the literature and by many councils who are promoting the concept of a 10-minute neighbourhood. The greater the population living in close proximity to the amenities, the more vibrant the urban environment can be, and the less reliant the community is on private motor vehicles for transportation. However, preference studies show that Aotearoa still has some way to go before concepts like this will be acceptable to the general population.

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