Preserving a green space network for a regional Auckland
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Abstract

As the largest urban region of New Zealand, Auckland is well known for its unique lifestyle with a clean, green environment. However, rapid urban growth and horizontal urban sprawl is threatening the very lifestyle that the world and Aucklanders value so much. This paper discusses the development of a green space network along State Highway One, the growth corridor of the Auckland region. The authors established two sets of criteria, environmental and social, to drive the development of the network. Three case studies were developed to test the proposition, ranging in scale from the regional to the local. Research findings suggested that preserving and enhancing a green network in the greater Auckland Region could not only offer a new regional park system, but also provide more land for sustainable urban growth and enhance the quality of life for future citizens.

1. Introduction

Compared with other major cities in the world, Auckland has a unique urban-nature relationship and a high quality lifestyle. One of the most distinctive features of Auckland is the balanced interaction between the urban and natural environments, which involves decentralized urban districts integrated within a large range of green networks (Duder, Winstone, & Warren, 1969; Palmer, 2002). Another element of Auckland's identity is the traditional kiwi lifestyle dream, characterised by separate dwellings with their own gardens. Although Auckland has some serious urban challenges to face which include high house prices and worsening traffic congestion, the current green network still provides Aucklanders with a foundation of a high quality urban life with relatively limited crowding, minimal pollution, scenic beauty and easy access to outdoor spaces.

However, the increasing population and on-going urban expansion is challenging these advantages. Firstly, Auckland's population is expected to grow significantly in the mid-term. According to the proposed Auckland Unitary Plan, the city's population will grow from the current 1.4 million people to 2.4 million by 2040 (Auckland Council, 2015). This will cause more pressure on both environmental and urban structures. Secondly, the urbanization will last much longer than 2040 and may continue to about 2100 (Burdett, 2011). This will mean that Auckland and its surrounding towns will keep growing after the current Auckland Unitary Plan expires, which could potentially result in greater pressure on green spaces.

From a recent observation, cities and towns from Whangarei to Hamilton and Tauranga have strong tendency to grow along SH1 and the coastal areas (Bogunovich & Bradbury, 2012). If this cluster of cities and towns could be organized into a city region with the aim to absorbing the increasing population, then Auckland city would not have to take on so much pressure to

increase its density and hence, would not dramatically change its residents' lifestyle. To rethink the compact city model, it is necessary to adopt macro regional thinking beyond the current Auckland region's administrative boundaries and the current planning timeframes. This means we have to conceptualise Auckland as a linear city from Whangarei to Hamilton and Tauranga (Figure 1). The research structure is outlined in the following diagram (Figure 2).

2. Rethinking of Auckland's regional development

This research provides a review of recent international research on preserving green networks from an environmental and social perspective. Three themes were reviewed around the research question; regional city forms, green networks and lifestyle urbanism.

2a. Macro regional scope of Auckland

As part of the urbanization process, the scale of cities tends to grow, meaning larger cities can become regional cities in their structures. A regional city is a cluster of cities and towns surrounding one or more influential major cities; the former are spatially separated but functionally connected with the central city (or cities) and one another (Hall & Pain, 2006). Regional city forms - like the linear city, the polycentric metropolis and the megaregion city - dominate most economically active areas in the world (Calthorpe & Fulton, 2001; Champion & Hugo, 2004; Hall & Pain, 2006; Soja, 2014; Weller & Bolleter, 2013). The framework of a city-region is a network of different-sized settlements. The development of a city region is a process of decentralization.

In the framework of a city region, studies on individual city or town are not enough to understand or plan Auckland development. In order to adapt to the significant changes in terms of urban theory and practice, Auckland's development needs to be studied as a macro regional conurbation instead of within the territorial limits of Auckland Council. Bogunovich and Bradbury drew a regional structure for Auckland's future - "the regional polycentric city" (Bogunovich & Bradbury, 2012). They argue that Auckland and its surrounding cities and towns have become a "Linear City Region" or a "Linear Conurbation" along SH1. This paper expands their study area and emphases on how green space systems influence urban spatial structures from the ecological and social perspectives.

2b. Importance of Auckland's green space

Green space and regional development complement each other. Green spaces are not only natural resources for an entire city region, but also essential elements to shape the urban spatial structure and social order. In order to minimize the impact on the natural environment, green space networks play an important role, especially in shaping urban form and enhancing resilience to threatening changes (Bruegmann, 2005 ; Calthorpe & Fulton, 2001; Newman, Beatley, & Boyer, 2009). Green space also plays a critical role in enhancing the quality of individual life, especially acting as sub-centre dividers, development direction guides, retrofitting tools, and green infrastructure (Bosselmann, 2008) (Calthorpe & Fulton, 2001) (Hall & Pain, 2006) (Weller & Bolleter, 2013).

Due to its long geological isolation, New Zealand's plants and animals have developed in a unique evolutionary way. This means many of the native species are endemic but defenceless against attack. As such, preserving the natural environment is much more important for New Zealand than for other countries in the world. The natural environment of Auckland is not only home to many endangered wildlife species; it also offers spectacular scenery for the people of Auckland. Moreover, the accessibility of green spaces is one of the three key elements of the kiwi lifestyle, including relatively low urban density and mixed dwelling types (ASB, 2010, August 26).

2c. Elements of Auckland lifestyle
Auckland lifestyle differs not only from most big cities in the world; it also differs from other cities in New Zealand. The uniqueness of Auckland's lifestyle is not only because it accommodates the "kiwi dream" dwelling type, but also because it provides ready access to green space. Firstly, a single family dwelling with a garden, cars and pets are a critical part the of kiwi dream. Secondly, accessibility to outdoor green space is usually within a short 10-minute drive from most homes. Thirdly, pathway systems and cycling routes are built to link the natural environment and open space within the city.

The New Zealand lifestyle is widely praised by and is a key attraction for overseas people. Although flats and medium-rise apartments are emerging in recent years, the single family houses still dominate people's mind in terms of residential options. Bogunovich and Bradbury argue that Aucklanders' lifestyle will affects the development of a regional urban structure. They suggest that Auckland will become the "world's lifestyle capital" (Bogunovich & Bradbury, 2012).

Since the growth of cities and towns around Auckland has already threatened the natural environment, maintaining a green framework is urgent and very necessary before further urban development. Given the current and future pressures on Auckland's public space, the preservation and expansion of Auckland's current green space network could provide a key to protect Auckland's high quality environment and lifestyle.

3. Methodology
To facilitate this research, a specific methodology is employed. Data was collected and analysed through GIS (Geographic Information System) software. Through site visit, mapping and analysis, two sets of criteria were established to guide the following design work.

3a. Environmental criteria
Environmental criteria were developed from a combination and revegetation of existing green space and potential green space (Table 1). Land identified from these criteria can be enhanced as a green space network through a set of design strategies (Figure 3 – 5). Existing green spaces can be classified into three main categories: public conservation sites, native forests and waterbodies. Potential green spaces can be identified from three landscape features, namely exotic forests, steep lands and flood plains. Through a rezoning and revegetation process, these potential green spaces could be established as part of future green space

network.

Reserve size, reserve shape, reserve network are the main criteria to measure a green space system. Use of buffer zones, connections and corridors are key strategies to enhance the green space network. Larger reserves can support richer species than smaller ones (Donnelly & Marzluff, 2004). Compared with patches without corridor connections, corridors can significantly increase wildlife movement between different habitats by around 50% (Gilbert-Norton, Wilson, Stevens, & Beard, 2010).

Reserve buffer zones: According to Meurk and Hall, in a matrix of urban green space, 50 m buffer zones outside the reserve can increase population and sensitivities of wild species (Meurk & Hall, 2006).

Green space connection: In order to build an effective network, patch sizes and their distance are both important. A patch pattern is suggested with a range of sizes from 5 ha, 1 ha to 0.02 ha. Connections are suggested at 5 km, 1–2 km, and 0.2 km away from similar sized patches (Ignatieva, Meurk, Roon, Simcock, & Stewart, 2008).

Green space corridors: Green space corridors can use landscape features such as rivers, streams, roads and field boundaries. These linear features are pathways for plant dispersal or wildlife movements. The width of river corridors should equal to approximately six times of their bank channel widths (Kline & Cahoon, 2010).

3b. Social criteria
Social criteria were developed through an investigation and research of an Auckland suburb; Remuera. Based on analysis of census data and maps of Remuera, three main features were identified; population density, dwelling types and green space accessibility. These features were later used as standards to shape a potential urban area.

Population density: The average population density in Remuera is 23 people/ha (Figure 7). The vast majority of areas have a density between 20 and 40 people per hectare. A number of areas have a higher density of 40 to 60 people per hectare. Areas with densities between 0 and 20 are usually reserves and sport fields. Only very few blocks have a density above 60.

Dwelling types: Remuera has mixed types of dwellings, with medium-to-high rise apartment around the community centre and low-density housing in other areas (Figure 7). The major dwelling type in Remuera is the stand-alone house, comprising about 66% of total dwelling (Table 2). The second type is attached houses and apartments, which is almost 30% of the total dwelling.

Green space accessibility: The types of green spaces in and around Remuera vary. According to their size and function, green spaces fall into two categories, i.e., regional and local greenspace. Regional green space includes volcanic fields, coastal basins, parks and sport fields (Figure 8). Local green spaces mainly consist of reserves and walkways (Figure 9). The

following table (Table 3) shows their accessibility through different modes of transportation.

4. Case studies
To carry out the research work, three case studies were chosen and analysed at various scales ranging from regional to local. They are Regional Auckland, the Warkworth-Silverdale Greenbelt and the Puhoi village.

4a. Green space network in regional Auckland
The Regional Auckland study area covered Auckland, part of Northland, Waikato and Bay of Plenty. The study particularly focuses on a10 km buffer zones along SH1. Among hundreds of environmental maps, five main features were chosen for further study: public conservation areas, forests, land use, steep land, flood plains and water. At the same time, a map of motorway buffer zones was chosen as the most relevant feature among various infrastructural maps. Each environmental map was combined with the motorway maps to become five regional maps, and then the five maps have been combined based on their natural value.

From Whangarei to Hamilton, six possible greenbelts were identified as potential buffers between future urban developments (Figure 10). Existing green spaces, including public conservation sites, native forests and waterbodies, are limited and fragmented; it is difficult to link them into a network. However, through a GIS analysis, a large number of potential green spaces were recognized as having the potential for extending existing green spaces. These areas are zoned: exotic forests, steep land, flood plains and corridors along rivers and streams.

The six greenbelts identified would become a new regional park network along either side of the SH1, with a length from 3 to 15km. Five of these new greenbelts would be forest parks, and one would be a water park. Through a purchase and revegetation programme, the suggested parks could expand to two or three times their current size. The largest proposed forest park would provide a green regional park from Warkworth to Silverdale, which would be nearly 15km along SH1. The shortest park would be made up of parks from Silverdale to Auckland, with a length of about 2.7km. The water park would be located from Tuakau to Huntly, including Lake Whangape, Lake Waikare and a small amount of forest.

The regional green space network could not only provide more opportunities for people to access the natural environment, but could also identify more spaces for smart urban growth in the greater Auckland region. Instead of allowing urban sprawl to worsen, existing and potential urban settlements could expand or development between these greenbelts.

4b. Greenbelt between Warkworth and Silverdale
The second case study explored the potential development of the Warkworth – Silverdale Greenbelt (the W/S Greenbelt) where environmental criteria to maintain and develop a green space network can be used at a local scale. In addition to the criteria developed from the first case study, a set of green space design strategies were used to shape an ecologically effectively green network between Warkworth and Silverdale. The key strategies used in this case study include; buffering existing greenspaces, revegetating potential greenspaces,

planting existing river/road corridors, and rezoning land use.

Combining maps through different strategies, the resulting map (Figure 11) shows the potential green space network in the W/S Greenbelt. Green spaces include two main categories: public green space and green space on private land. Both of them have important environmental values for preservation of native species. Public spaces can also be social spaces that provide people opportunities for hiking, camping, boating or fishing. Bush corridors connect many of the green spaces and enhance both social activities and wild-life movements.

The total potential public green space is 10 km long from west to east, and 3.3 km wide from north to south (Figure 11). This public area would connect the hinterland with the coast. Divided by the Puhoi River and SH1, four areas of green spaces can be seen on the following map. Each piece has a carpark on the entry of local roads. Lookouts are designed on the top of hills. Some places for fishing and boating are designed along the coastal line. Camping grounds are located close to river on relatively flat sites. Pathway systems are designed along river banks, water edges and mountain ridges, connecting most of the facilities.

This case study suggests that through careful purchasing and a revegetation process, more land could be converted for use as public green spaces. At the moment, potential land for a green network is not valuable because of excessive slope or the potential for flooding. Careful purchasing of identified sites and/or persuading land owner to gift land now would be more cost effective than buying the land in 20 years.

4c. Master plan of Puhoi Town
The Puhoi village case study focused on a smaller scale to show how urban development could happen within a proposed greenbelt. On the one hand, the outside contours of potential urban areas of Puhoi were determined by the green space network in the W/S Greenbelt. On the other hand, social criteria from the Remuera study were used to shape Puhoi's future urban structure. A Puhoi master plan (Figure 12) was then carried out to show how environmental and social criteria could be integrated, and how this integration could preserve natural environment and further enhance the high-quality lifestyle.

To maintain the local history and culture, the historic town is preserved with its original buildings and landscape. At the same time, trees could be planted along the Puhoi river corridor and Puhoi road. No more new buildings are proposed within this area. Based on the social criteria, the new town will be rezoned and intensified. Through subdivision and intensification in the new town, the population in Puhoi could increase 6 fold while maintaining the historic town centre.

The potential regional park will expand the existing conservation area from 23 ha to 73 ha. It will also link the new town with the existing historic town and soften the contrasting characters. Through a revegetation strategy, most of the land will be transformed to native bush. Spaces for social activities are designed within the regional parks. Through a

revegetation strategy, most of the land will be transformed to native bush. Spaces for social activities are designed within the regional and local parks. These activities include play-grounds, look-outs, tracking, fishing and boating.

Three green corridors are proposed to cut through the entire length of the urban area, from the north to the south, and connect the natural environment with the urban space. The width of these corridors varies from 50 m to 100 m. Through walkway systems inside the urban area, green networks are easy to access. The master plan suggests that residents can walk to a variety of green spaces within 12 minutes from each home.

The master plan of Puhoi town suggests that new urban development could happen harmoniously within the green network. Integrated with the new park system, the revised Puhoi urban area and could accommodate a larger population and yet maintain a high-quality lifestyle with great green space accessibility.

5. Conclusion

Given the current and future pressures on Auckland's public space, the preservation and expansion of Auckland's green space network is critical to protect Auckland's high-quality environment and lifestyle. Findings from this research suggest that a green network can offer the growing population a new regional park system, and provide more urban lands for the growing Auckland. The research further suggested that this would result in an increase in the number of people having access to a high quality lifestyle. This research outcome also implies the following points.

Firstly, green networks can dramatically increase green space accessibility for new suburbs, towns and villages. Current towns around Auckland lack public spaces because they are mostly surrounded by private farmland or forests. By purchasing some of the private land and using a revegetation process, a regional park system can be created. Residents in new towns and villages would be able to easily access public green spaces within 5 km. Even with the growing population of Auckland and its surrounding satellites, this new park system can still offer people a variety of outdoor activities, passive recreation and satisfy other social needs.

Secondly, preserving natural features can provide habitat for native species and help them move and migrate. Through the protection of public conservation sites, native bush and water bodies, plus the linkage of native corridors from hills to the sea, the amount of wild plants and animals can be increased. Moreover, their movement can enhance the resilience of ecosystem.

Furthermore, a green space network in the greater Auckland area can prevent urban sprawl effectively. Facing the continual urban growth along SH1, suburbs and towns to the north of Auckland, like Albany and Silverdale, have almost become connected. The proposed green space network will contain some of the new settlement more or less in their existing sites, while allowing new developments within the new but still limited peripheral space. Urban sprawl traditionally has won over the green space because the development agenda is better formulated than the conservation agenda, if we have a clearly defined green network system,

then the conservation agenda can be more assertive.

Preserving green spaces in the greater Auckland region is not anti-development but rather will result in a better development by identifying suitable spaces for smart urban development thus prevent urban sprawl. At the moment, potential land for a new regional park system is not valuable because they are steep or in flood-risk areas. Buying this land would be more expensive in the next 20 years, so it makes better sense to buy it now. Through careful purchase and a revegetation process, these new green spaces would be integrated into a new ecological system, while at the same time maintain a high-quality living environment for next generations of Aucklanders.

Figure 1 A regional cluster of cities from Whangarei to Hamilton and Tauranga

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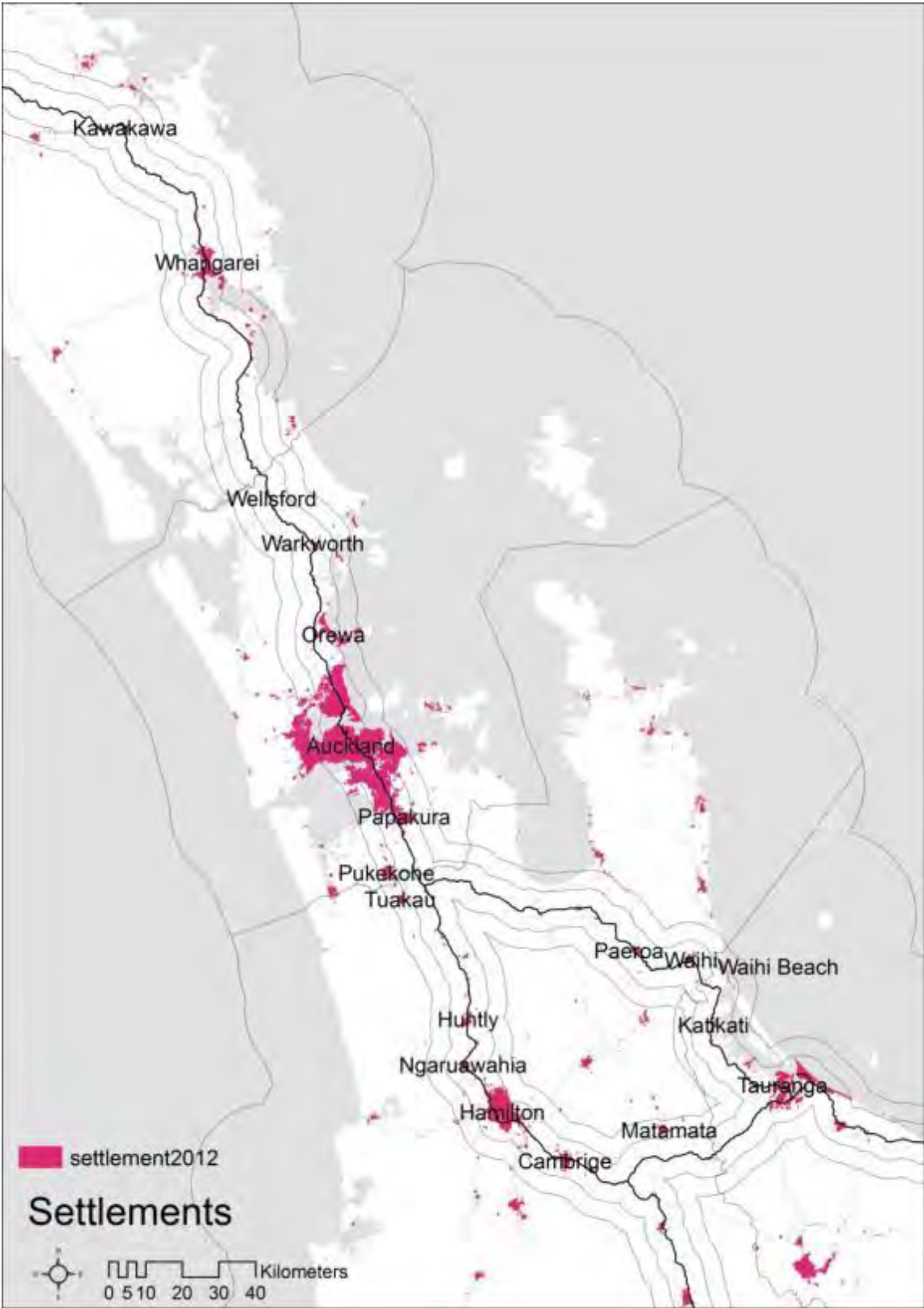
Figure 2 Research framework
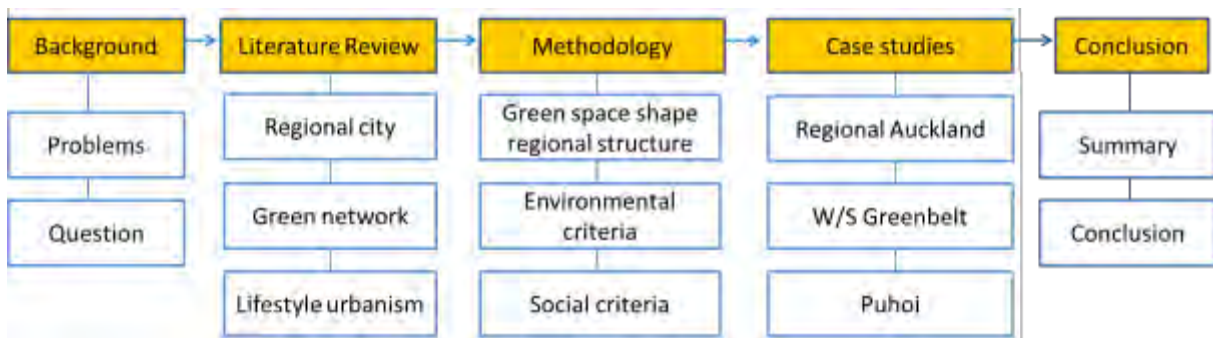
Figure 3 Reserve path design (Meurk & Hall, 2006, p. 140)
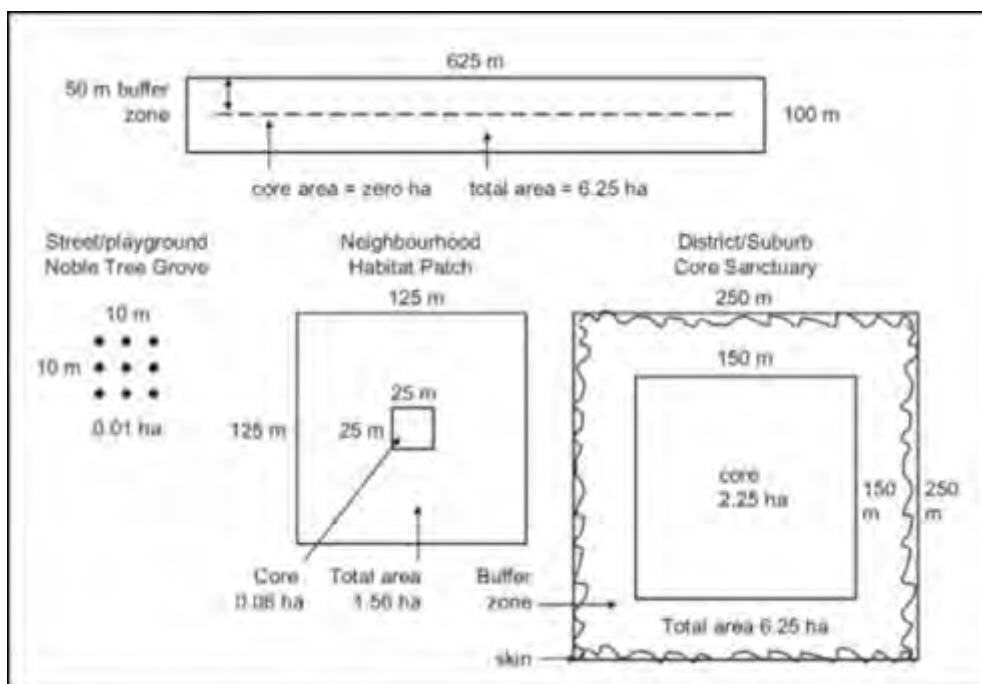
Figure 4 Optimal stepping stone distances for wildlife and accessibility for people (Ignatieva et al., 2008)
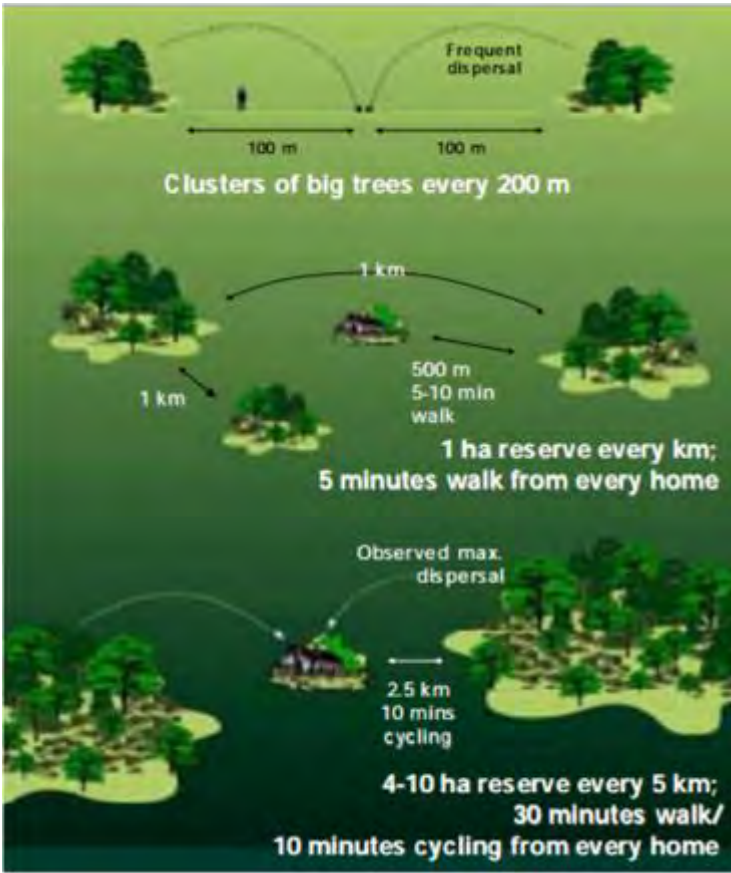

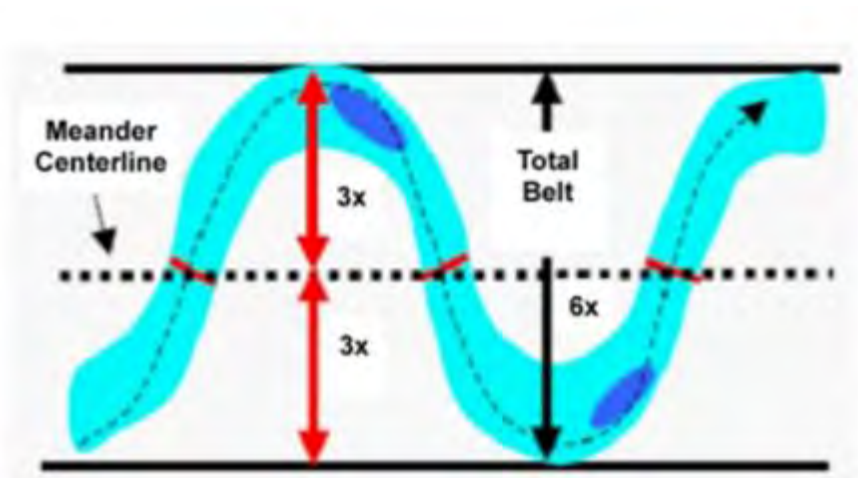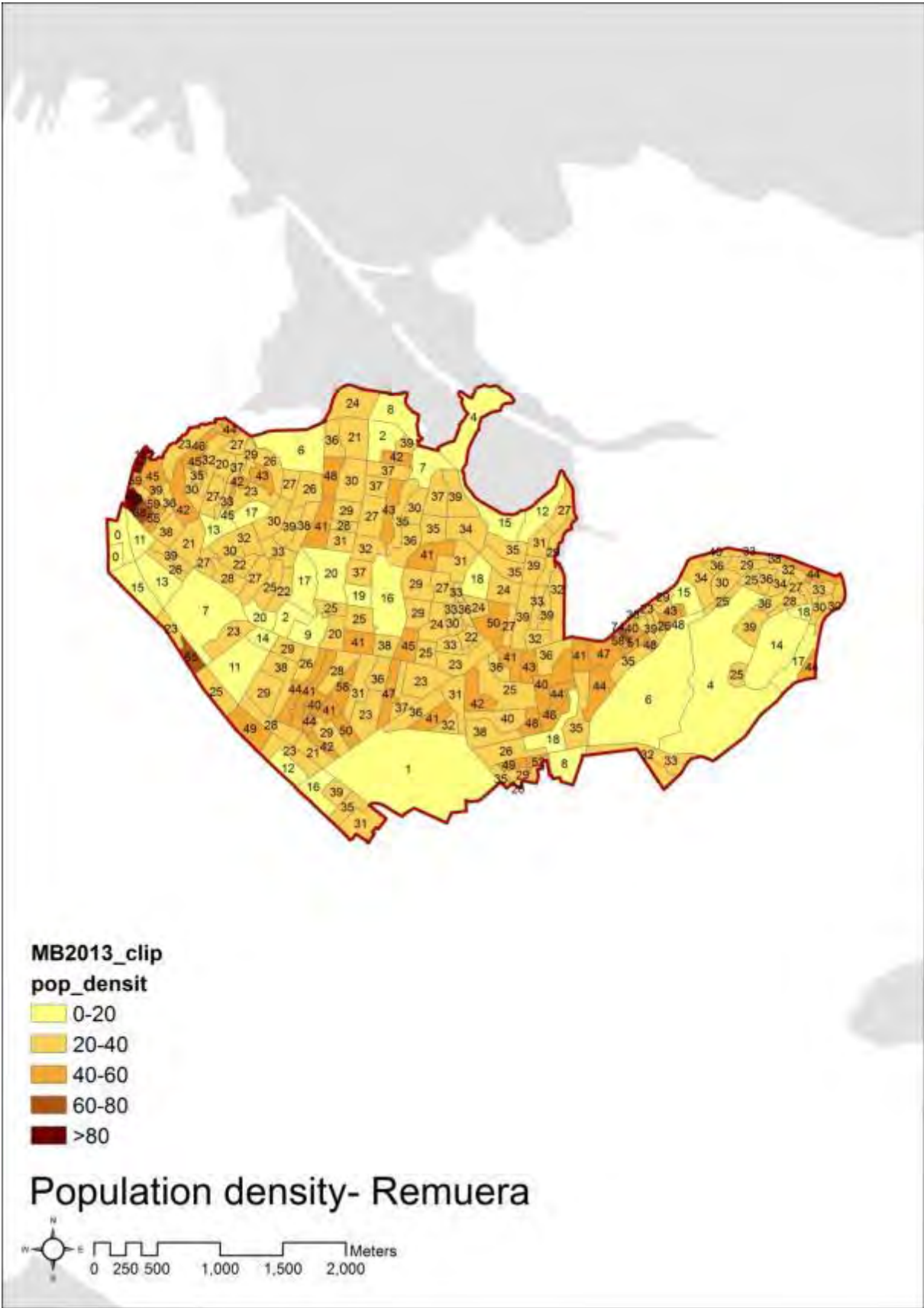**Figure 5 The Width of river corridors** (Kline & Cahoon, 2010, p. 232)

Figure 6 Population density of Remuera

Population density- Remuera

Figure 7 Dwelling types of Remuera

Dwelling types- Remuera
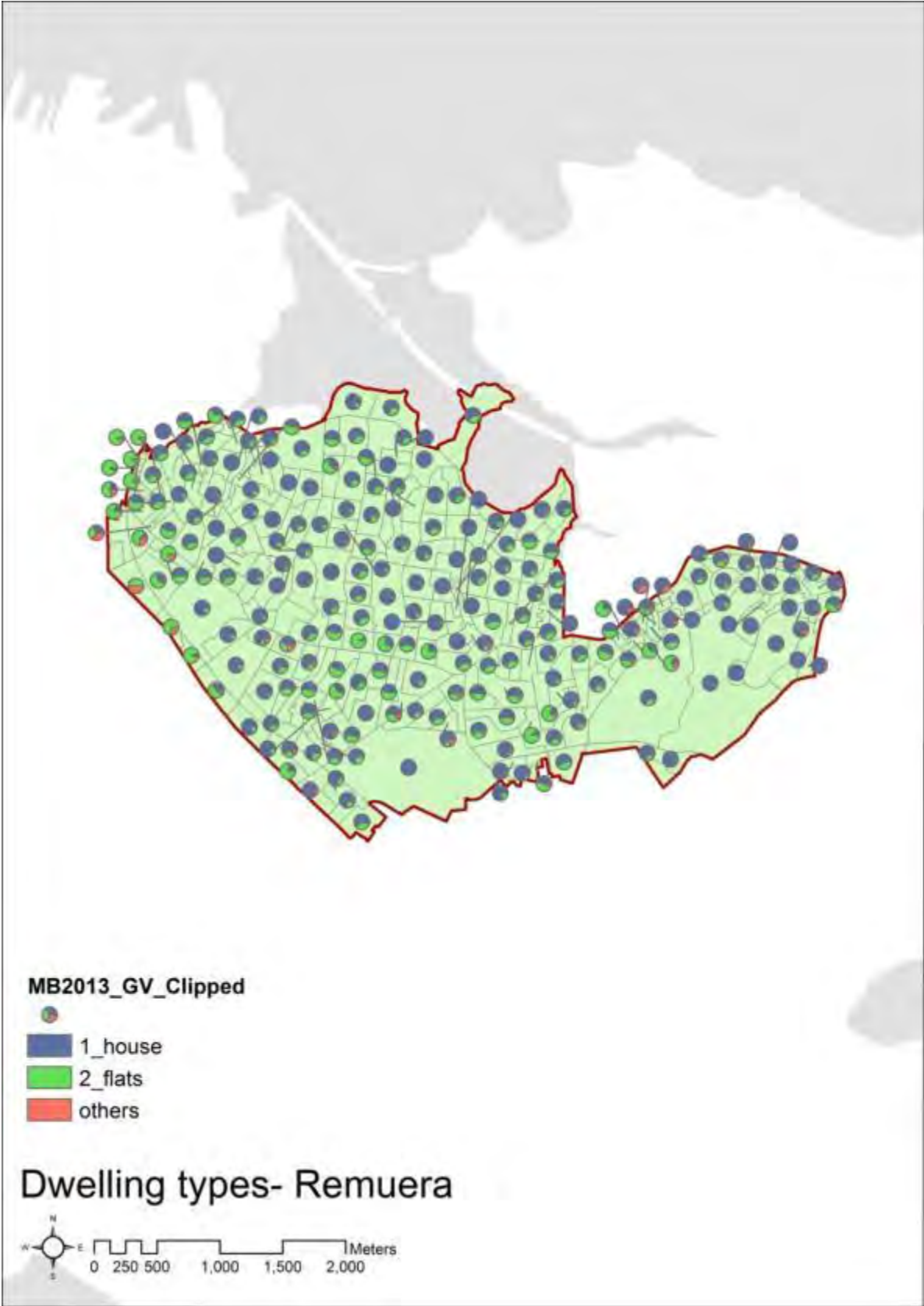
Figure 8 Regional green spaces in Remuera

Green space accessibility-Remuera

Figure 9 Local green spaces in Remuera
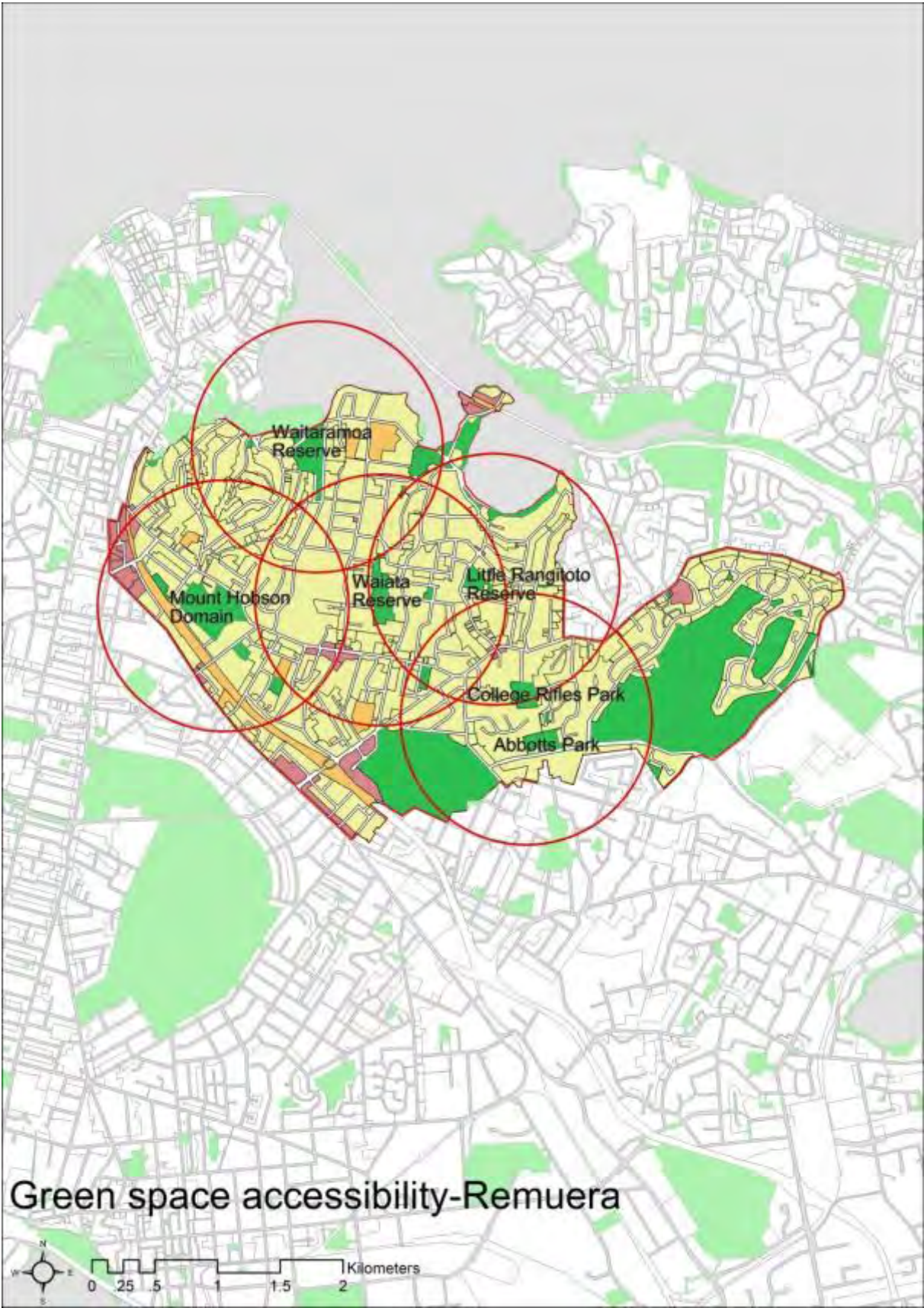

Green space accessibility-Remuera

Figure 10 Green space network in Regional Auckland
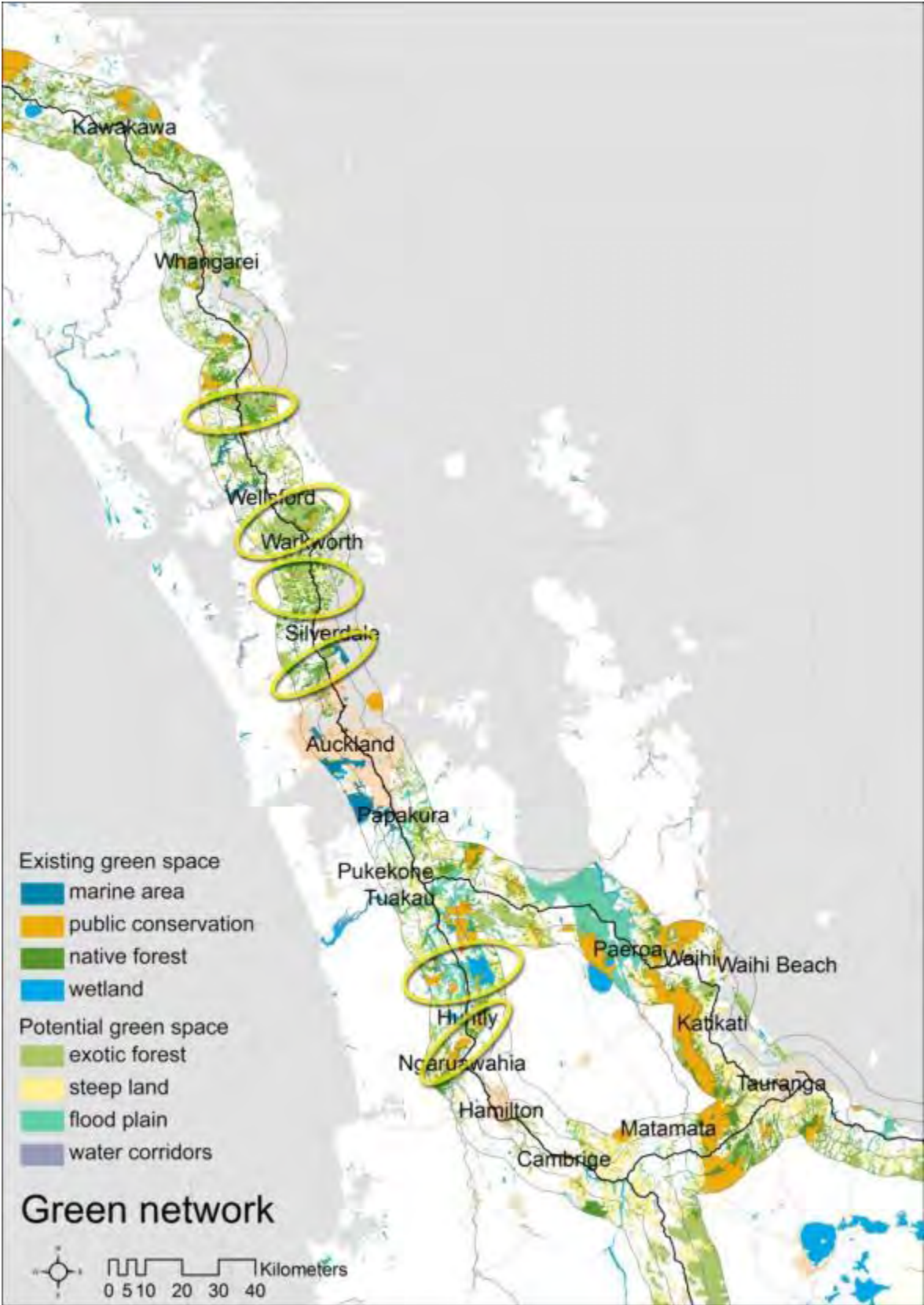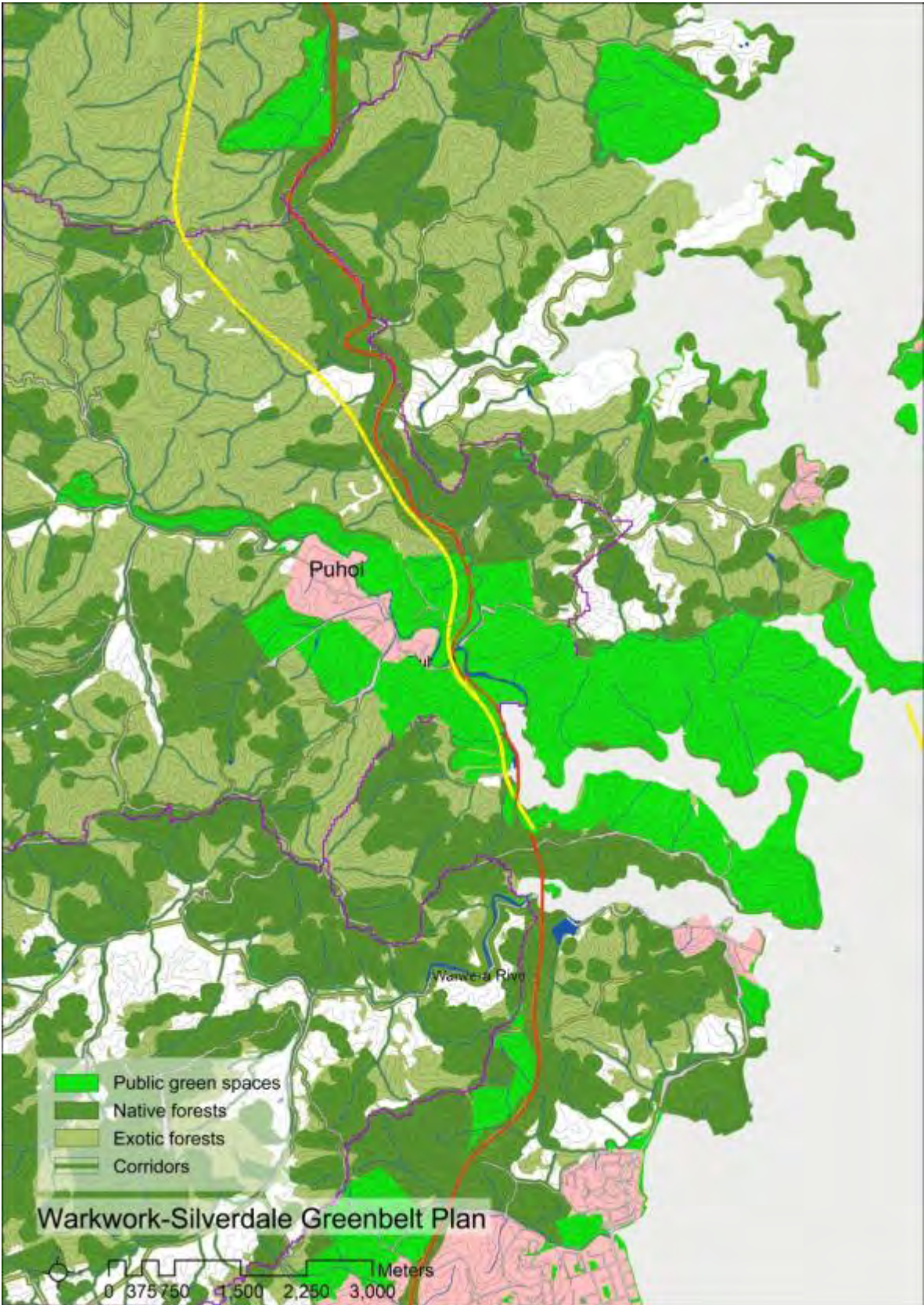
Figure 11 Greenbelt between Warkworth and Silverdale

Figure 12 Master plan of Puhoi

Table 1 The components of a green space network

Category	Sub- category	Urban suitability
Existing green space	Public conservation sites	Prohibit construction
	Native forests	
	Waterbodies	
Potential green space	Exotic forests	Limit construction
	Steep lands	
	Flood plains	
	Water / Road corridors	

Table 2 Dwelling types in Remuera

Dwelling type	Amount	%
Separate House	6885	65.93
Two or More Flats/Units/Townhouses/ Apartments/Houses Joined Together	3093	29.62
others	465	4.45
Total occupied private dwellings	10443	100.00

Table 3 Green accessibility in Remuera

	Categories	Distance	Driving time	Cycling time	Walking time
1	Regional green space	2 km	3	8	24
2	Local green space	1 km	-	4	12

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