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Land-use suitability analysis for urban development in Regional Victoria: A case study of Bendigo

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Selection of suitable areas for urban development is a complex process and needs many diverse indications on the basis of which decision may be assumed. The aim of this study is to examine the GIS-based land-use suitability analysis and its application in urban planning decision making, using Bendigo, a regional city in Victoria as a case study. The objective of this study is to provide evidence-based solutions to urban growth management issues in regional Victoria. Bendigo is a major regional municipality of Victoria, including Bendigo city and surrounding rural hinterland, with six smaller townships scattered across the region. Greater Bendigo boasts of large areas of national parks, reserves and bushland, as well as agriculture land, which is the major land use of the area. This region has been earmarked by the Victorian Government's Initiative Urban Development Plan for future development as one of Victoria's regional centres for increased development and new homes. Geophysical, socio-economic and cultural data are used to assess future urban growth suitability in Bendigo based on key goals such as Connected and Compact City (transport and connectivity), City of Equality (education, health services), Ecological City (environmental conservation), and Safe City (risk of disasters). The resultant suitability map indicates primary suitable lands for future urban growth are located adjacent to the established urban areas. Reflecting the current urban development in Bendigo, the paper concludes with several recommendations aimed at improving the long-term urban development plans for the Greater Bendigo area.

Key words: Land use, suitability analysis, Victoria, Bendigo

INTRODUCTION

Sustainable development has been embedded into the global agenda of urban and landscape planning since Rio Summit in 1992 (Graymore et al., 2009). One specific challenge facing sustainability in the built environment sector is the global increase in urbanization (Childers et al., 2014). Despite continuous efforts of generations of planners, designers and developers, building sustainable communities remains a challenge to academics and practitioners in the urban and regional planning discipline. The increasingly interlinked political, military, economic,

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technological, cultural, ecological and social issues across all scales have only exacerbated the already highly fragile and fragmented habitat for sustainability, physical or intellectual, on the planet. On the one hand, there are no acknowledged tools or approaches that can guarantee sustainable outcomes of urban development projects, on the other hand, numerous houses and communities are being built every day. This dilemma calls upon a sound approach to guide urban planning and development practice so that societal sustainability would not remain a dream. This study aspires to examine the potential of land-use suitability analysis in support of sound and rationale decision-making in urban planning and development aiming at more sustainable design outcomes.

More than 90% of Australia's population lives in cities and urban population in Austria keeps growing (Trading Economics, 2014) and is predicted to grow in the future. From 2011 to 2016, Victoria in Future 2008 projections indicate that the average annual dwelling demand across the municipal area of Greater Bendigo will be 999; from 2016 to 2021, increasing to 1,009 per annum. Victoria in Future 2008 based demand projections over the next 5 years for Greater Bendigo indicate that the current levels of dwelling construction activity are insufficient to meet potential demand. These demand projections are 29% greater than recent building approval activity (average 775 dwellings per annum between 2005/06 to 2008/09) and 92% greater than recent residential lot construction (average 518 lots constructed per annum between 2005/06 to 2008/09). In total (excluding existing vacant residential lots), there is a residential lot supply of approximately 18,500 (Department of Planning and Community Development (DPCD), 2010a). As a relatively small and self-contained city, Bendigo makes a good case study to understand the interplay of the pressure to provide quality housing for citizens and the challenges to deliver sustainable development. Using Bendigo as an example, the aim of this study is to explore opportunities for innovate planning approaches, by examining the GIS-based land-use suitability analysis approach and its application in urban planning decision making. The objective of this study is to provide evidence-based solutions to urban growth management in Bendigo. It is hoped that the experience of Bendigo could also provide useful reference for other rapid urbanising cities and towns in Victoria.

LITERATURE REVIEW

Land-use suitability analysis integrating Geographical Information Systems (GIS) and multi-criteria decision analysis to evaluate the potential of converting current land use to urban development according to special requirement is one of the most useful applications for sustainable urban development and planning (Malczewski, 2004; 2006) by minimising negative impact of urban development on the land system. In association with multi-criteria decision analysis (MCDA), GIS is used as a powerful tool in the process that integrates and transforms geographic data (input criteria) and value judgments (decision makers' preferences) to obtain an overall assessment for choosing between alternative actions or ranking prioritised suitable lands for proposed land uses (Malczewski, 2004). Recently, spatially explicit land-use suitability modeling using GIS has been increasingly used as a technique for landscape evaluation and planning (Girvetz et al., 2008), regional planning and environmental impact assessment (Marull et al., 2007; Rojas et al., 2013) and identification of potential locations for renewable energy generation (Angelis-Dimakis et al., 2011; Ramachandra and Shruthi, 2007), and evaluation different sites for future urban development (Joerin et al., 2001; Steiner et al., 2000). This study pays special attention to the use of land use GIS and multi-criteria decision analysis methods for developing maps of urban development priorities in the City of Greater Bendigo.

The City of Greater Bendigo

Located 150 km northwest of Melbourne (Figure 1), Bendigo's initial rapid expansion, both economically and socially, was fuelled by the discovery of gold deposits in the 1850s. The wealth generated from the mining of gold was considerable, resulting in an architectural legacy that is reflected in the number of historic buildings that characterise the inner city area. With an existing population of 110,579 and an expected growth of 41.21% between 2015 and 2036 (Forecast.id, 2015), Bendigo is considered one of the key regional centres to accommodate future population growth and progress within the state of Victoria (DPCD, 2010b). However, history reveals that growth in Bendigo has not been constant. The first European settlements in Bendigo were mainly induced by the Gold Rush era in the 1850s which contributed to the state and the nation's development and influenced migration from countries such as China, India, Indonesia, Malaysia, Japan, and Germany (Carthew and Allan, 2005). On the one hand, the rich history of Bendigo stimulated the emergence of industries and alternative economic activities in the city and broader urban region from the mid-19th century to the mid-20th century (City of Greater Bendigo, 2005). On the other hand, from the 1960s to 1980s Bendigo experienced a slow growth satisfying the requirements of a rural area (Carthew and Allan, 2005). In the twentieth century the manufacturing sector developed as the gold deposits were depleted, but in more recent years the service sector, particularly retail, health, education and tourism, has become more prominent and brings new vitality to the livelihood of the

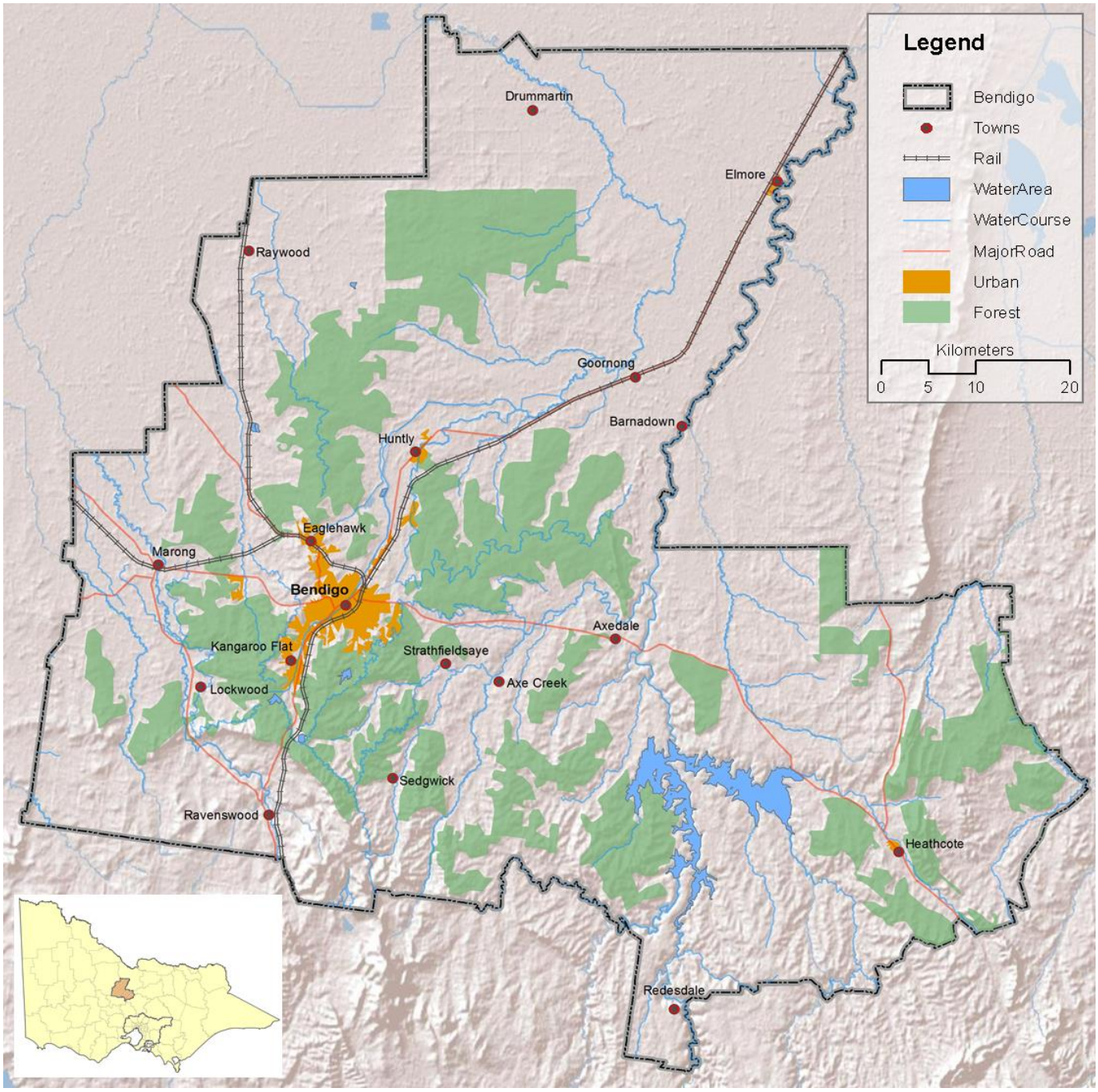

Figure 1. Location, context, and geophysical condition of City of Greater Bendigo.

region (DPCD, 2010b). Needless to say, sustainability integrating economic development with the characteristics of the local geography and vernacular landscape is the key to maintain and enrich the long-term liveability and prosperity of the Bendigo region.

The City of Greater Bendigo has recently adopted the Greater Bendigo Residential Strategy as a key strategy for managing urban growth from 2014 to 2034. This strategy has been drafted in response to projected urban growth and on-going diversification of Bendigo's economy (City of Greater Bendigo, 2015). Importantly, there is increasing community support and desire for planning goals and strategies towards diverse healthy communities and transit-oriented development alongside increased demand for smaller lots and infill development in established areas (DPCD, 2010b; City of Greater Bendigo,

2015). The Greater Bendigo Residential Strategy contains a number of key policy directions mirroring these goals, of several which are significant, such as the strengthening of the Bendigo Urban Growth Boundary (UGB) - underlining its mandate within the community of Greater Bendigo. On a practical statutory level, the Greater Bendigo Residential Strategy will be implemented through the Greater Bendigo Planning Scheme Amendment C215 (City of Greater Bendigo, 2015).

Despite all these visions and aspirations aimed at transforming City of Greater Bendigo towards a contemporary model community of sustainability and a regional centre in the State of Victoria, there is little effort being made in terms of a systematic evaluation of the capacity of the physical landscape in the Bendigo area. A literature survey reveals that so far no comprehensive urban development land suitability analysis has previously been undertaken for the whole of Greater Bendigo area other than some brief restrictive zone analyses presented in the literature (DPCD, 2010a, b; City of Greater Bendigo, 2015). While we inherit the legacy and excellence in urban planning, community development, and place making in Victoria and Australia, which could be possibly attributed to the legacy of Howard's 'Garden City' (Freestone and Hutchings, 1993; Hall, 2009) idea centuries ago, it is essential to bring new ideas, new technologies, new approaches for gathering and analysing data to support decision making in city and town planning practice. The emerging geodesign field is arguably the best evidence for this new trend in urban and landscape planning today (Steinitz, 2012; Bishop, 2013; You, 2013; Moura, 2015). Therefore, using a GIS-based weighted overlay analysis, this study aims to generate a complete land-use plan for urban growth covering the whole of Greater Bendigo area based on which guidance recommendation can be made to assist long-term urban development planning in Bendigo.

METHODOLOGY AND DATA COLLECTION

The estimated increment of 45,572 persons by 2030 in Greater Bendigo (Forecast.id, 2015) has encouraged Planning Authorities to initiate a series of plans that help to determine an adequate provision of housing, services and infrastructure in the area. According to the Department of Transport, Planning, and Local Infrastructure 18,900 new dwellings are required in Bendigo to satisfy the upcoming population growth (Department of Transport, Planning and Local Infrastructure (DTPLI), 2015). In order to identify the most suitable areas to allocate this amount of dwelling units, social, economic and environmental factors should be considered. Bendigo has experienced a notable development during the past decades; education, health, commerce and professional services represent a significant contribution for the community as well as important sources of employment (City of Greater Bendigo, 2005). The presence of roads and rail facilities contributes to the connectivity between regional cities providing opportunities for growth in Victoria (DTPLI, 2014). Transport infrastructure, education and health, represent significant facilities and are used as anchors for growth. Through complementing and enhancing what has been already built, the benefits from the investment that has been made in the past will increase. Moreover, it will locate people in proximity to one another, and influence the generation of jobs. Additionally, natural resources and geographical characteristics provide the city an extra value.

Of all spatial explicit modeling approaches, overlay mapping is easy to undertake and has been applied in land-use suitability analysis for urban development from before the GIS technology was invented and many landscape architects used transparent overlay by hand-drawn techniques (Steinitz et al., 1976). McHarg (1969) created enormously sophisticated overlay maps combining multiple thematic maps using hand-drawn overly. McHarg's spatial overlay approach in parkway planning along with his other projects that were documented in his book *Design with Nature* (McHarg, 1969) has been quoted by researchers today as evidence of spatial thinking and foundations of the modern GIS technology (Steiner, 2013). Suitability analysis has been widely used in site selections (AbuSada and Thawaba, 2011; Perpiña et al., 2013; Jelokhani-Niaraki and Malczewski, 2015). Today highly complicated GIS applications across time and space are proposed to inform physical landscape and urban planning strategies (Miller, 1993; Steinitz, 2012; Chen and Lee, 2015) or broader urban issues relevant to suburbanization and urban planning management at city and regional scales (AbuSada and Thawaba, 2011). Most recently, the land-use suitability approach has been applied to highly densely populated Beijing to seek the most desired city planning and management strategies for best design outcomes (Liu et al., 2014).

The most common spatial models used in GIS-based suitability studies fall into two fundamental classes of multi-criteria evaluation (MCE): Boolean overlay or weighted overlay (Malczewski, 2004). In Boolean overlay models, each criterion is classified into two subsets delineating whether or not a particular area is suitable. Criterion maps are then layered using logical connectives (i.e. AND, OR). One primary shortcoming of Boolean analysis is that criteria can only be TRUE or FALSE, which creates discrete boundaries between variables. This imposes artificial precision on mapped results and fails to model more nuanced degrees of suitability. In contrast, models that use weighted overlay combine each criterion into categories; these categories are then weighted based on their importance as decided by professionals in the field, so when combined, one criterion with relative low suitability can be recompensed by the high score of another (Lewis et al., 2014). On one hand, the strengths of weighted overlay approach lie in the fact that it allows expert knowledge to play a role in the planning decision making so that the vision of City of Greater Bendigo is not lost during the process, considering the nature of the question (i.e. broader policy-level urban planning strategies) under investigation. Therefore in this study weighted overlay approach is used to assess the land-use suitability for urban growth in Bendigo. On the other hand, weighted overlay may introduce subjectivity to the decision-making process since the weight (%) is assigned arbitrarily to each set of criteria. In this study, a balance between the two is sought by using mainly key criteria that are relevant to each planning goal at the broader urban landscape scale. Other planning or design details are not included in the analysis in order to avoid weakening the reliability of the outcome from the analysis.

Five objectives are established as priorities for the selection of suitable areas as follows.

1) A connected city: The first planning goal is to consider the benefits and opportunities that the existing infrastructure offers to the city and the community. The first objective is focused on sustainable transport and connectivity between Bendigo and the regional cities and activity centers, encouraging growth along transport corridors.

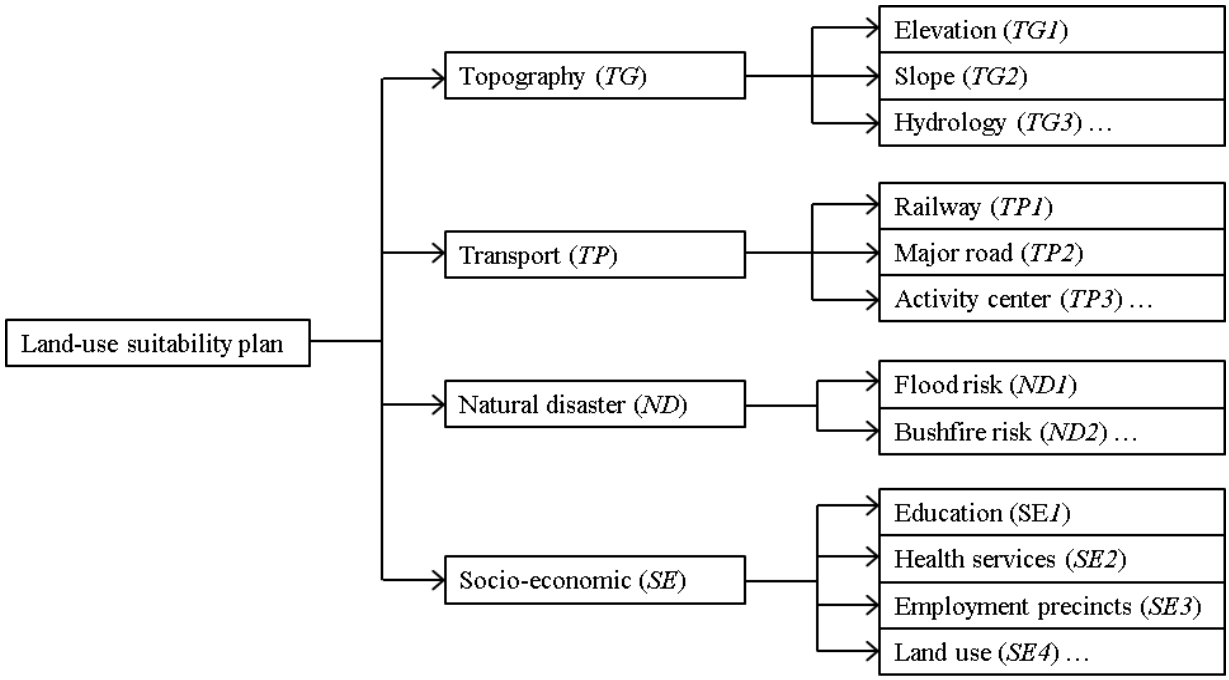

Figure 2. Geophysical and socio-economic factors considered in this study.

2) A city of equality: The second planning goal is to locate areas for future growth in proximity to education institutions and health services which are two basic requirements in every person´s life. This goal is of particular significance for a city like Bendigo which has been renowned for its health care facilities and services.

3) An ecological city: This planning goal supports the protection of reserved forest and native vegetation acknowledging the importance for flora and fauna considering biodiversity is one of the most important visions for the sustainable growth of the city.

4) A safe city: This goal recognizes that the area can be affected by natural threats and disasters; therefore future developments should avoid certain areas which are vulnerable to flood and bushfire risks which are held as the two greatest dangerous risks for the city in the past couple of decades.

5) A compact city: The last goal emphasizes the importance of proximity between urban developments in order to take advantage of existing resources, infrastructure, and facilities in the urbanized city core of the city thus to reduce the total cost for housing development (and safeguard housing affordability) to accommodate increasing urban population in the city.

Data corresponding to each of the planning goals are collected, compiled, and integrated in a GIS using the methodological framework as follows (Figure 2). ESRI ArcGIS 10.2.2 is used for data analysis.

Input data

The planning language for each planning goal is translated into spatial/geographical/GIS language so that it can be put into the GIS models for analysis. For example, for the Transport (TP) planning goal, the criterion 'Proximity to major roads' is translated to 'creation of a Euclidean distance raster layer based on the major road vector layer'. Therefore, for data collection concerns, the 'major road' dataset has to be identified and edited if necessary (in many occasions only a general 'road' layer is available, thus GIS-based process has to be taken (e.g. select by attribute, export data, etc.) to extract only the major roads from all roads feature in the dataset). Similarly, all required data are collected from reliable sources are collected to address each of the planning goals established in 3.1. The type, source, and usage under planning criteria of each dataset are given below (Table 1).

RESULTS

A connected city - Accessibility to existing infrastructure

A well-developed public transport network, structured roads, and a linked bike network are some aims established by Plan Melbourne which will improve the connectivity between regional cities (DPTLI, 2014). Bendigo is served by high capacity urban transport and roads and train facilities which represent an opportunity for growth and densification and act as attractors of investment; whereas the presences of roads increment the possibilities of public transport provision. The Euclidean distance analysis indicates the areas located in proximity to roads infrastructure and train stations are also better connected with key regional cities in Victoria

Table 1. Input data for the land-use suitability analysis.

Layers	Criteria	Layers	Data source
Connected City	Proximity to train stations	Train station point feature class	Vicmap (land.vic.gov.au)
	Proximity to major roads	Major road	Vicmap
City of Equality	Proximity to health services	Hospital, health service, and aged care shape files	Vicmap; ABS (Australia Bureau of Statistics)
	Proximity to educational institutions	Primary, secondary and tertiary institutions	Vicmap; ABS
Ecological City	To protect environmental and landscape significant areas	Environmental Significance Overlay (ESO), Significant Landscape Overlay (SLO) and Vegetation Protection Overlay (VPO)	Victorian Government Data Directory (data.vic.gov.au)
Safe City	To avoid LSIO, watercourse and water area buffers, bushfire prone areas	Land Subject to Inundation Overlay (LSIO), Bushfire Management Overlay (BMO)	Victorian Government Data Directory; Vicmap; Geoscience Australia
Compact City	Proximity to established neighborhoods	Built-up land	Geoscience Australia

thus have higher development potential (Figure 3). The reclassification determines potential areas of growth along transit corridors as well as the zones that can be served by an efficient road and public transport network.

A city of equality - Accessibility to education and health services and jobs

Future development is considered to be located in proximity to education and health precincts which additionally represent a significant source of employment within Bendigo. St. John of God, Bendigo Base Public Hospital, Regional Institute of TAFE, La Trobe University and Bendigo Senior Secondary College are part of the infrastructure that supports the presence of professional and skilled labor contributing to the enhancement of the area (Figure 3). Education and health facilities represent an important source of employment and services within Bendigo. The reclassification of Euclidean distance indicates the areas that are benefited from the mentioned amenities. On the other hand these districts are considered core development areas (City of Greater Bendigo, 2012), reinforcing the accommodation o diverse housing types and mixed use developments.

An ecological city - Conservation of ecosystem and natural resources

The uniqueness of Greater Bendigo can be its complex urban system integrating with 'green' ecosystems' (City of Greater Bendigo, 2014). This requires more strategic, innovative, and forward-looking approaches to create a livable, resilient, ecological and sustainable city with retaining its valuable ecology and unique culture. The surrounding linear and continuous natural systems (Environmental Significance Overlay: ESO) are key reasons that people choose to live in Bendigo and tourists choose to travel there (City of Greater Bendigo, 2014). Forests represent a valuable natural resource within Bendigo which accommodates a wide range of recreational activities that benefit locals and visitors. During the last years initiatives such as "City in the Forest" have been implemented involving different stakeholders and the community in order to protect the forest and natural areas (City of Greater Bendigo, 2005). The present objective aims to protect and conserve the ecosystem and natural resources. Consequently, future developments must not be located in the conserved areas (Figure 4).

A compact city – Proximity to established neighbourhoods

Due to abundant land available and a relatively small po pulation in Australia, many Australian cities, especially regional cities, are suffered from the adverse effect from urban sprawl such as increased traffic and demand for mobility and increased investment on infrastructure (Ewing et al., 2002; Cameron et al., 2004; Kahn, 2000), traffic congestion, landscape fragmentation and loss of biodiversity (Alberti, 2005), reduced landscape attractivity and attachment to places (Sullivan and Lovell, 2006) and alterations of the hydrological cycle and flooding regimes (Bronstert et al., 2002; Carlson, 2004; McCuen, 2003). Bendigo's urban area offers a wide range of services and activities including retail, education health, and business. Future growth areas will be located in proximity to consolidated urban zones (Figure 5) in order to increment the

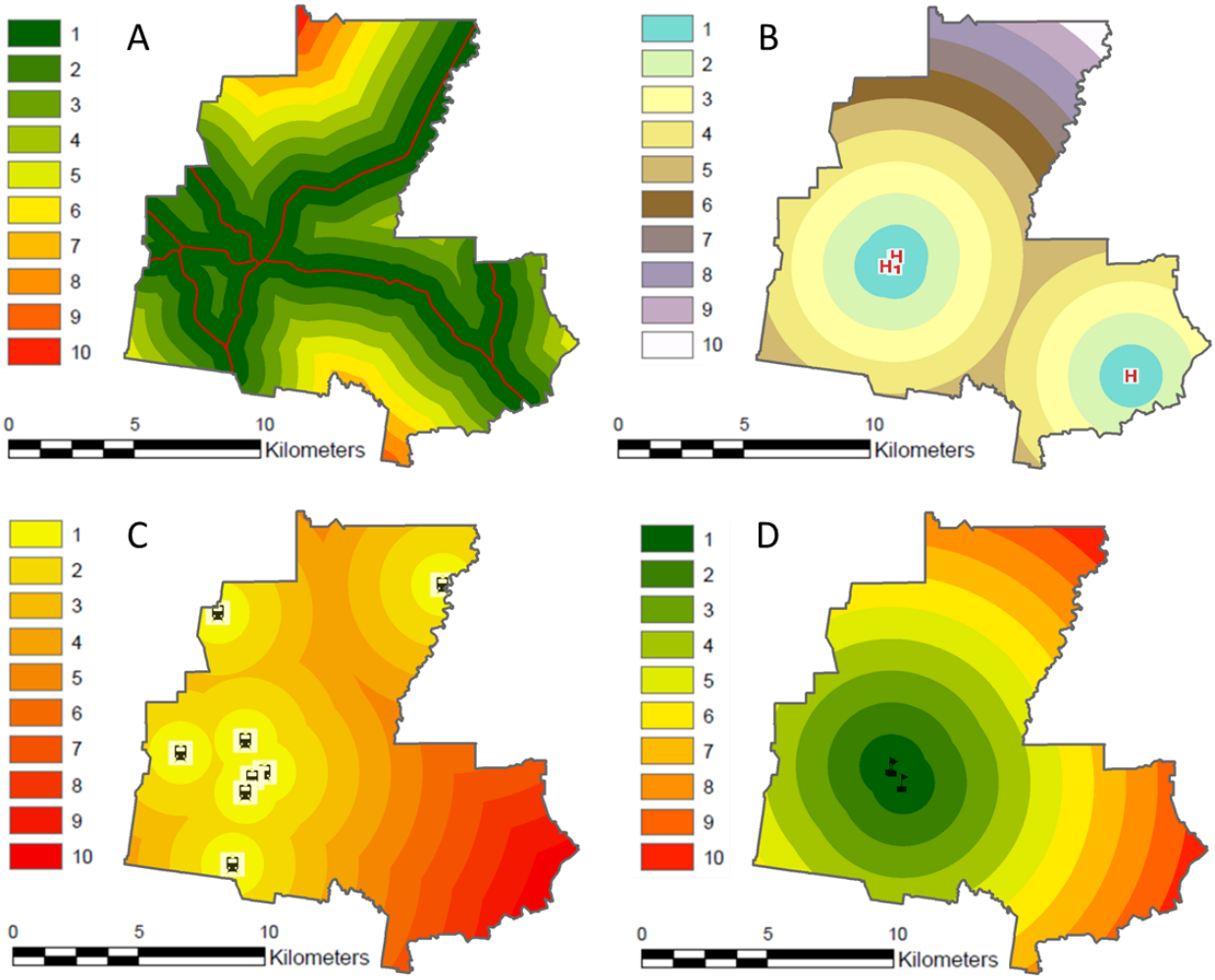

Figure 3. The Euclidean distance to major roads (A), health services (B), train stations (C), and education (D) is reclassified into 10 classes; class code 1 means highest development potential and 10 lowest development potential.

provision of accessible facilities and employment, and reduce the negative impact from urban sprawl.

The weighted overlay

Based on all reclassified input layers, a weighted overlay analysis was conducted in ESRI ArcGIS package (version 10.2). In weighted overlay, the preferred criteria are processed and input with different weighting (%) applied to each criterion (Table 2). The weighting is drawn from the Greater Bendigo Residential Strategy (City of Greater Bendigo, 2015) and its emphasis on "Complete Neighbourhoods" and "integrating sustainable transport with changing land-use patterns". However safety issues are of utmost importance thus the *Safe City* goal is given primary weighting (20%) in the analysis (Table 2), with *Compact City* and *City of Equality* given secondary weighting (15%); and the weight for remainder is 10%. After the application of the Weighted Overlay, several levels of suitability for future growth were identified in greater Bendigo. The obtained land-use suitability map is reclassified using the suitability value (code = 10 as "primary suitability") and levels 0 to 9 as "secondary or restricted". The result of the weighted overlay analysis is presented in Figure 6.

As urban population growth projections indicates that the current levels of dwelling construction activity in Bendigo are insufficient to meet potential demand, and these demand projections are 29% greater than recent building approval activity. Under this scenario, the total (excluding existing vacant residential lots) new dwelling units expected to be supplied by 2030 is 18,500 residential lots (Department of Planning and Community Development, 2010b). Under the conventional

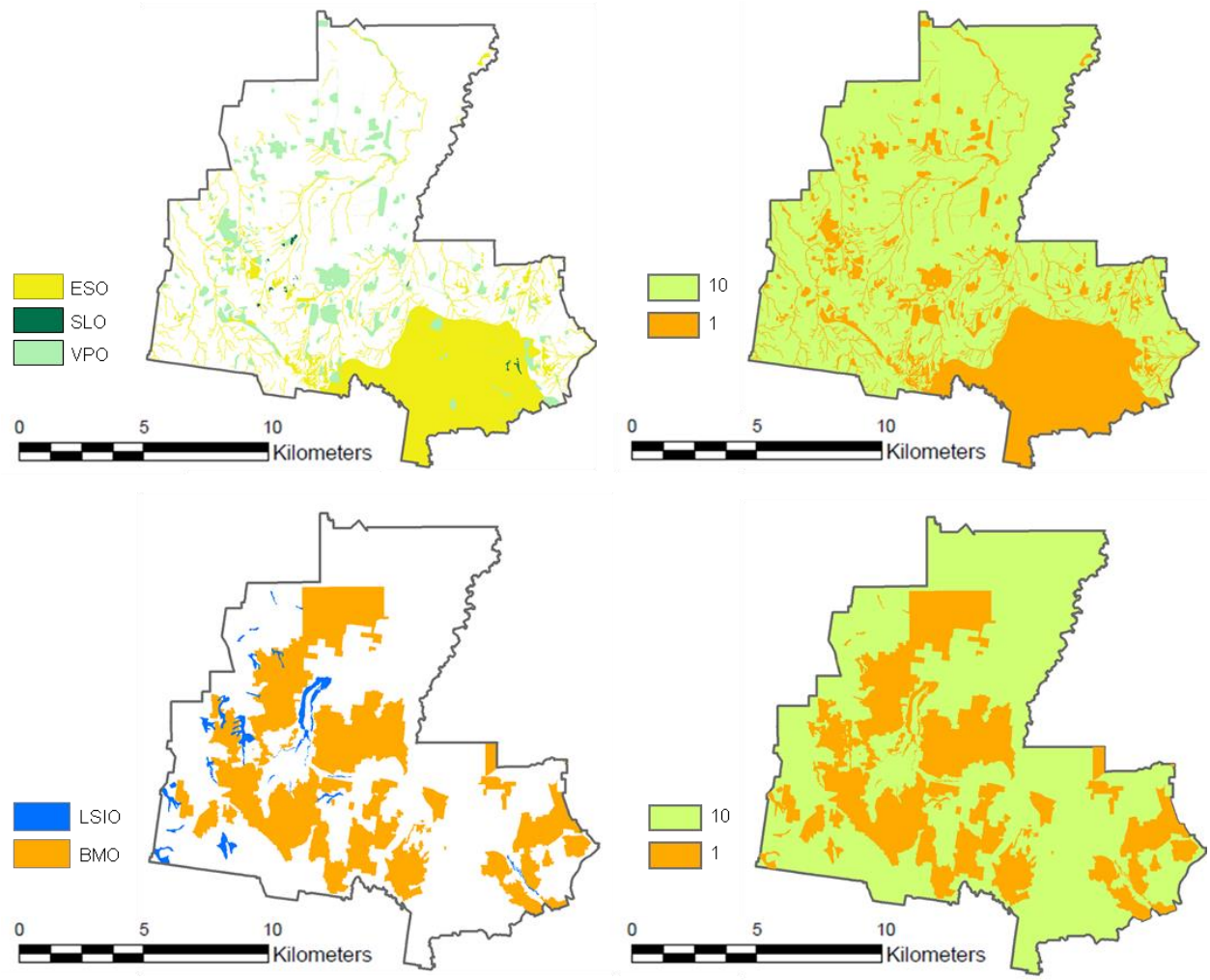

Figure 4. Reclassification of reserved land (top) and flood- and bushfire-prone areas (bottom) which are restricted for development (Class code 1 means restricted and 10 suitable).

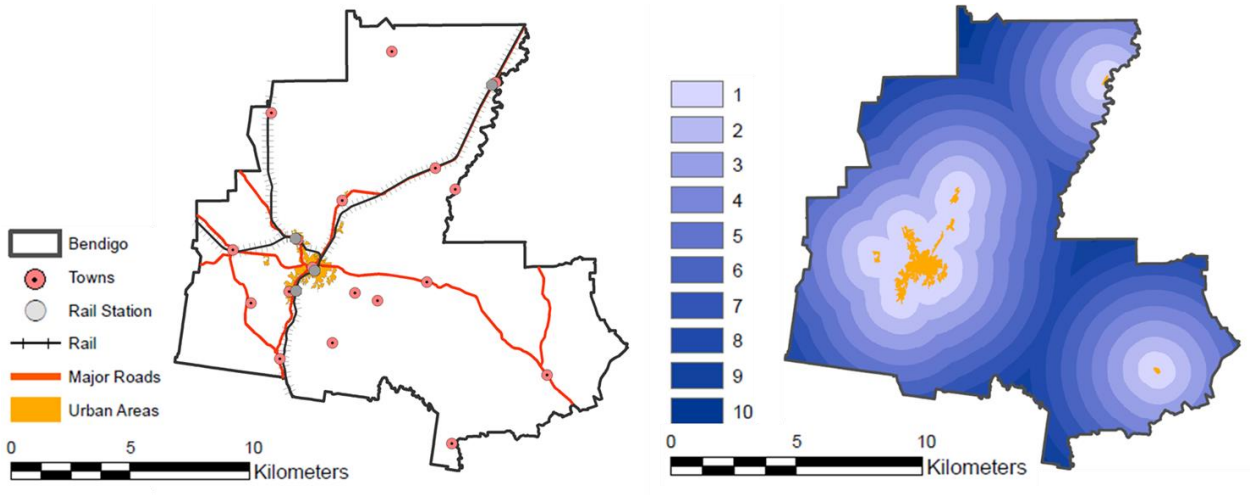

Figure 5. The Euclidean distance to established urban areas is reclassified into 10 classes; class code 1 means highest development potential and 10 lowest development potential.

Table 2. Contribution (%) of different input layers in the weighted overlay analysis.

Planning Criteria and Goals	Raster Layers	Influence (%) in Overlay
Connected City	Proximity to train stations	10
	Proximity to major roads	10
City of Equality	Proximity to health services	15
	Proximity to educational institutions	15
Ecological City	ESO, SLO, VPO	15
Safe City	LSIO, BMO , watercourse and water area buffers	20
Compact City	Proximity to established neighbourhoods	15

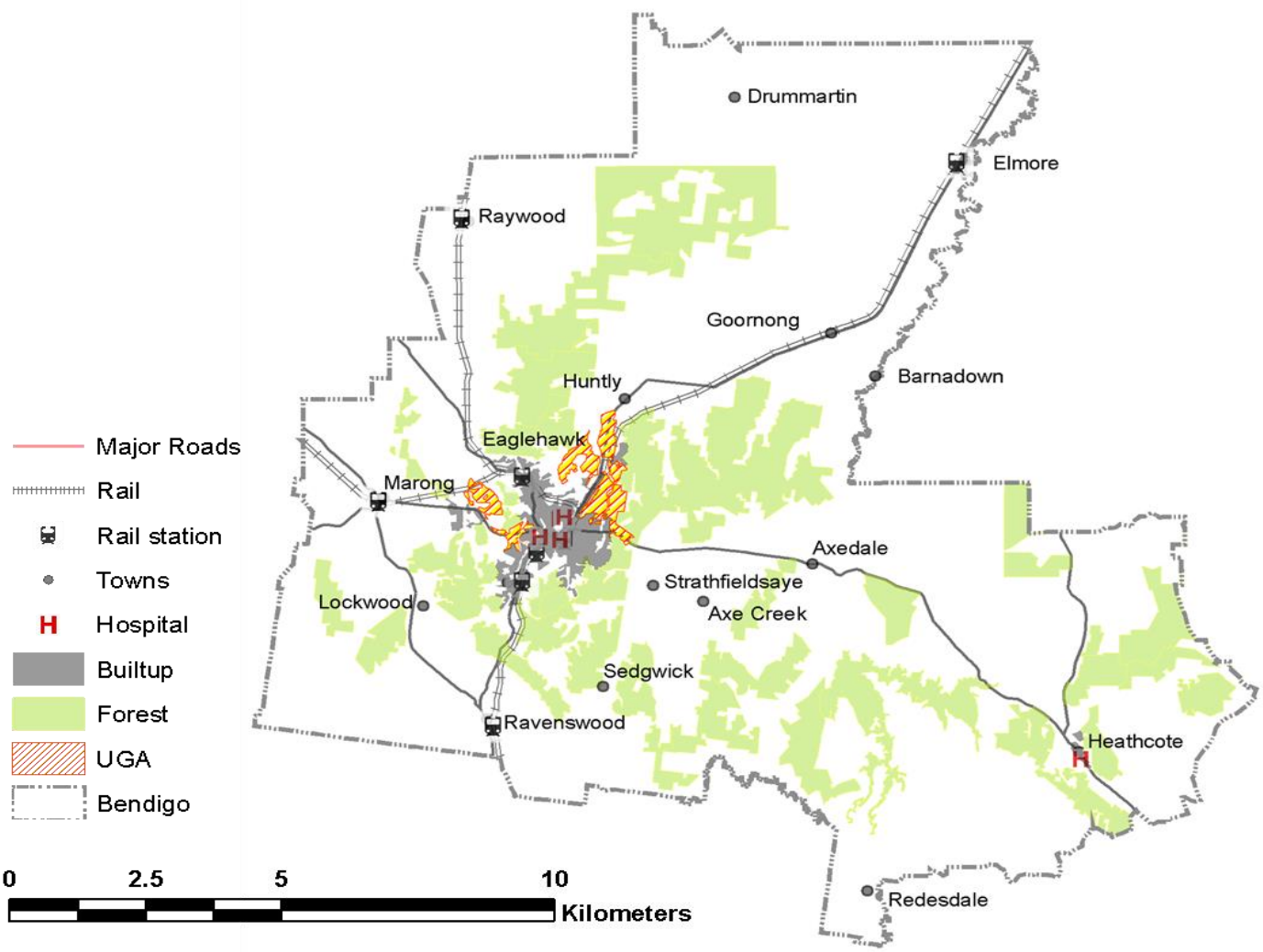

Figure 6. Two areas suitable for urban development are identified using the land-use analysis based on weighted overlay for Bendigo.

development density (1 ha = 10 dwelling units), adequate land that satisfy the requirem ents to accommodate 18,500 dwelling units would be 1,850 ha. In GIS, the weighted overlay raster layer is converted to polygon and the resultant vector layer allows calculating the geometry (in hectares) of the potential sites. As the suitable land is

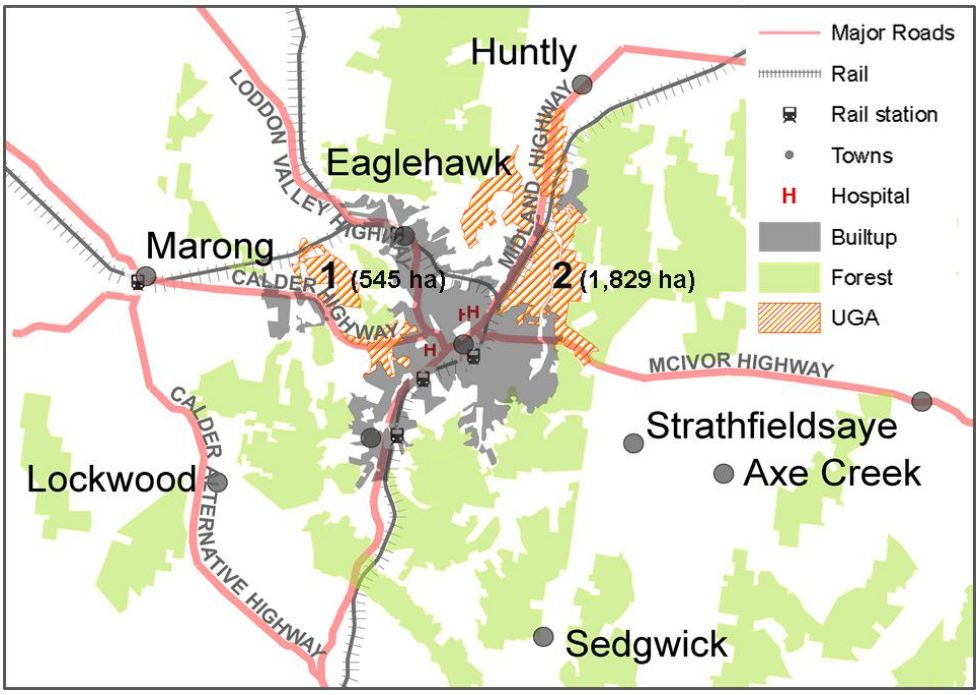

Figure 7. The identified suitable Urban Growth Areas (UGAs) for Bendigo.

larger than required, this analysis could be used to create a longer term urban growth plan which is discussed below.

Through the Bendigo case the following strengths of the GIS-based land use suitability analysis has been demonstrated: 1) The suitability analysis makes urban planning decision-making more rational, thus the planning outcome is can be easily communicated, understood, and accepted by the public, which means less resistance in the implementation process; 2) the overlay analysis includes data from multiple sources and aspects including geographical, social, economic, etc., and 3) the weighted overlay allows manipulation of the overlay process by assigning different weights for different input layers, so that the factors playing a more important role will have larger influence in shaping the result of the overlay analysis. This is the uniqueness of weighted overlay compared with other overlay methods such as binary overlay, fuzzy overlay, or ranking overlay. However there are also weaknesses when using weighted overlay. One of the critical issues is the defined scales applied to the input data (normally 1 to 9; 1 to 10 used in this study) and it assumes that more favorable factors result in the higher values in the output raster, therefore identifying these locations as being the best. The discrete nature of this transformation of data may compromise the information of continuous nature in the original dataset. The data preparation and analysis processes are also time-consuming and computing-intensive.

DISCUSSION

Planning for urban sustainability in longer terms

A comprehensive assessment of land-use suitability for urban growth in City of Greater Bendigo is carried out in this study. The selected areas are located in areas not prone to natural disasters and in proximity to established neighbourhoods, jobs, education and health services, and major roads and train facilities. Current plans such as Greater Bendigo Planning Scheme (DTPLI, 2014) and the Bendigo Residential Development Strategy (City of Greater Bendigo, 2015) have considered the presence of transport infrastructure for future growth within these areas. For instance, improvement of rail services to Eaglehawk is a confirmed requirement that will contribute to enhance the connections between regional cities in Victoria (DTPLI, 2014).

As urban growth planning are to make plans to accommodate predicted future changes (housing for predicted urban population increase by 2030 in this study), it may be useful to plan for the far future. The final result covers 2,424 ha divided in two different sites of land (Figure 7). The first site, composed by three areas along the Midland Highway is close to Huntly and Eaglehawk (total land 1,829 ha). This site is coincidentally considered an area of new development (DTPLI, 2015) by the local government and it is located within the urban growth boundary. The second site is

located in proximity to Eaglehawk and covers 545 ha land. As the first site is almost big enough for the 2030 urban growth targets thus the 2nd site could be used for longer term growth plan such as Bendigo 2050 or 2060. Both sites can be attributed to the *Compact City* and *Connected City* goals.

GIS-based land-use suitability analysis to support urban planning decision making

GIS is a crucial tool used by this study to gain an understanding of the existing spatial composition of the City of Greater Bendigo. In this regard, the maps generated as part of this study, not only provide a visual representation of the Municipality's existing features, but also provide additional knowledge regarding the way in which these features interact, thereby influencing the City's future urban growth prospects. The generation of such additional knowledge is an invaluable characteristic of GIS, exploited by all levels of government in Victoria to effectively manage the State's existing assets, as well as to prepare future planning initiatives at the State, regional, and local levels. The study demonstrates that the application of spatial overlay is efficient in land-sue suitability analysis for urban development.

As a final note, although this study's focus is the identification of land on a municipal-wide scale, this represents only the first stage of the strategic planning process. In order that the identified areas of land can successfully contribute to Greater Bendigo's sustainability attainment goal, it is important that the key principles of the "Compact City" model also resonate into the detailed urban design phase of the planning process. In this regard, GIS will continue to play an important role in the creation of communities that contribute to the City's overarching sustainability and livability objectives – particularly in relation to their walkability (including the provision of connecting footpaths), diversity (including the provision of varying lot sizes and affordable housing options), resilience (ensuring the appropriate development and ongoing management of flood prone areas), and accessibility (including the provision of local services and facilities to complement those already provided within nearby towns).

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Conflict of Interests

The author has not declared any conflict of interests.

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