Defining a Well-Functioning Urban Environment.

A systematic literature review in response to the National Policy Statement on Urban Development

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Executive summary

This discussion paper forms part of the response to the requirements for tier 1 regional and territorial councils to implement the NPS-UD, as gazetted by the New Zealand Government in August 2020. Auckland Council has divided the response to the NPS-UD into a series of workstreams, with this literature review falling under workstream 1 (WKS1) – Well-functioning urban environments (WFUE).

The overall aim of WKS1 is to determine what is included in the definition of well-functioning urban environment, above the minimum, as set out in NPS-UD Policy 1.

Policy 1 of the NPS-UD describes a well-functioning environment as a planned environment that as a minimum *have or enable a variety of homes that* serve the following functions:

- meet the needs, in terms of type, price, and location, of different households
- enable Māori to express their cultural traditions and norms
- have or enable a variety of sites that are suitable for different business sectors in terms of location and site size
- have good accessibility for all people between housing, jobs, community services, natural spaces, and open spaces, including by way of public or active transport
- support, and limit as much as possible adverse impacts on, the competitive operation of land and development markets; and support reductions in greenhouse gas emissions
- are resilient to the likely current and future effects of climate change.

This discussion paper aims to test this definition for completeness using a systematic review of international academic and grey literature. The output of the review then recommends expanding the definition considering the findings.

Four main domains were identified as critical to a WFUE. The built environment, the social environment, the natural environment and the cultural environment. Within each domain both processes and products were identified as indicative of or intrinsic to a WFUE and used as recommended criteria to be included in the implementation of the NPS-UD. The literature highlighted that a WFUE reflects the context and purpose of its development, meeting the practical, economic, physical, social and cultural needs of all the citizens it serves today and into future generations. WFUEs reflect the diversity and disparity in society and aim to address social justice and inequity through engagement, accessibility, transferral of power, ownership and informed transformation or protection of land and services.

Informed engagement with citizens is paramount, using tools that provide ownership of decision-making through interactive and meaningful platforms relevant and usable by the target group.

Inclusion of circular waste strategies, localised energy production, water conservation and green buildings standards will reduce resource use associated with the escalating climate crisis. Whilst long-life loose-fit designs will enable flexibility of use, reflecting the changing nature of population needs over time.

Varied housing typologies and tenures close to employment, amenities and accessible affordable transport will increase social justice and human rights, provided the services and opportunities reflect the needs of more than an 'average user'. Whilst infrastructure and civic spaces built to meet the needs of diverse communities of varying ethnicities, genders, income levels, age groups, and abilities will help improve health, environmental, social and cultural outcomes for all, whilst reducing negative ecological externalities.

Social and green infrastructure critical to urban environments will enhance community health and well-being, create social interaction, reduce negative externalities, and increase resilience. Embedding mātauranga Māori perspectives in the design of urban space, will lead to a more holistic view of the intrinsic value of natural system of which all systems depend upon. Valuing ecosystem services offered by natural environments in the urban and peri-urban areas will reflect the proportionate contribution that non-asset or land-based attributes offer to the environment and society, including contributions of provisioning services, regulating services, habitat or supporting services and cultural services.

Māori design principles – embedded as the platform from which all development stems – will create spaces that value the distinctive cultural identity, principles and aspirations of Māori to shape the built environment. Whilst multiculturalism will be recognised and enhanced through the provision of cultural infrastructure representative of the wider community.

The systematic literature review builds upon the NPS-UD definition with the following additional priorities:

1. Maximise inclusion and belonging of citizens, through actions to address the barriers for citizens of all ages, genders, ethnicities, incomes and abilities to engage in both planning and use of the urban environment.
2. Use creative placemaking and appropriate innovative technology to gain insights and inform development opportunities for all citizens to acquire 'full right' to use, appropriate and shape their cities.
3. Meet the human rights of the incumbent and future city residents in terms of economic, social and cultural rights, including the right to affordable safe housing.
4. Create residential and commercial buildings designed to minimise resource consumption and negative externalities. Using long-life loose-fit designs, universal design standards, low carbon construction and entire lifecycle and end of life material use considerations during construction and occupancy.

5. Promote vitality and safety through informal surveillance and connectivity opportunities, created with active frontages of mixed use residential and location appropriate commercial premises.
6. Enable high density, compact, human-scale buildings for mixed uses to generate vibrancy and visual interest.
7. Maximise equitable access with a range of housing choices (typology and tenure), near active or public transport links connecting education, recreation, health and employment opportunities. With access available for all citizens regardless of wealth, physical health, gender, age or ethnicity.
8. Access to a range of employment options, both within the central business district (CBD) and inter-local centre or out to main employment hubs, such as airports, hospitals, and industrial centres using affordable efficient public transport. Recognition of the requirements for trip chaining, off-peak transit demands, and non-linear routes to access work and amenities. Particularly relevant for women and low-income groups.
9. Public transport design inclusive of accessibility features from multiple user perspectives including varying gender, mobility, age and income levels.
10. Enable resilient and renewable community energy production, water use and secure electric vehicle charging infrastructure. Minimise waste through reduction and re-use. Promote net zero energy buildings and communities.
11. Prioritise pedestrianisation of city blocks using highly connected permeable routes and legible streetscapes to encourage walking, social interaction and visual complexity, e.g., laneways, human-scale buildings, pocket parks and plazas. Ensure pedestrian access routes reflect the needs of multiple users, including those with physical and mental impairments.
12. Enhance social capital with inclusive neighbourhood designs which are safe, comfortable, and convenient for people of all ages and abilities to play, thrive, and have social and cultural interaction in the public realm.
13. Incorporate health impact assessments (HIA) in development plans, to identify and mitigate immediate and cumulative health impacts, reflecting that health is complete physical and mental well-being and not just the absence of disease and injury.
14. Classify social, green and cultural infrastructure as critical infrastructure and ensure the timely implementation and phasing of its development to maximise community use.
15. Integrate high quality accessible green infrastructure within, upon and adjacent to the built environment, with a focus on high-quality amenities, social interaction and biodiversity, using contiguous green infrastructure corridors, retention and enhancement of tree canopies particularly in areas of current deficit.
16. Create opportunities to enable regenerative food production using urban agriculture at a range of scales including within and between building envelopes, alongside transport

corridors (where safe to do so) and within open space to address social inequities and enhance social capital.

17. Integrate water sensitive design, which minimises use and enhances water receiving environments. Minimise potable water use for non-potable services and integrate greywater systems into new build and retrofit designs.
18. Value ecosystem service (ESS) reflecting the contribution of green infrastructure (in all its forms) to health, climate resilience, amenity value and cultural value.
19. Prioritise the principles of kaitiakitanga to restore and enhance marine and freshwater aquatic environments using a high threshold for quality, e.g., the collection of kai moana / seafood.
20. Protect prime soils at the city fringe to meet the food supply needs of future generations whilst shortening supply chain length and minimising climate emissions.
21. Design buildings and neighbourhoods that are resilient to the likely current and future effects of climate change whilst addressing and not exacerbating social inequities.
22. Enhance opportunities for people of all cultures to enjoy pleasure, creativity, advancement and education through the equitable provision of cultural infrastructure.
23. Respect the mana of Māori and create the conditions for Māori to practise rangatiratanga, with the power to control and influence the use of resources in line with Article II of Te Tiriti o Waitangi.
24. Use smart technology data in concert with more nuanced citizen participation to improve systems.
25. Preservation of significant natural and built cultural heritage (both colonial and Māori).

In conclusion, despite separating this review into four main domains built, social, natural and cultural, a WFUE depends on the enhancement of elements in all domains. The intrinsic connections between each of these elements mean that no one aspect should be elevated above another, as a well-functioning urban environment is the sum of its parts.

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1.0 Introduction

This discussion paper forms part of the response to the requirements for tier 1 regional and territorial councils to implement the National Policy Statement on Urban Development (NPS-UD), as gazetted by the New Zealand Government in August 2020. A series of workstreams divide the work, with this literature review falling under workstream 1 (WKS1) – Well-functioning urban environments (WFUE).

1.1 Review aim

The overall aim of WKS1 is to determine what is included in the definition of WFUE, above the minimum, as set out in NPS-UD Policy 1.

The definition will influence strategic planning and development decisions through:

- spatial planning and the future development strategy (3.13)
- plan-making, including Auckland Unitary Plan (AUP) changes to intensification locations (building heights) (3.11, 3.33)
- responsive planning and the consideration of out-of-sequence proposals (3.8)
- planning decisions, including resource consent decisions (Policy 1, Policy 6).

Policy 1 of the NPS-UD describes a well-functioning environment as a planned environment that as a minimum:

- Have or enable a variety of homes that serve the following functions:
    - meet the needs, in terms of type, price, and location, of different households; and
    - enable Māori to express their cultural traditions and norms.
- Have or enable a variety of sites that are suitable for different business sectors in terms of location and site size.
- Have good accessibility for all people between housing, jobs, community services, natural spaces, and open spaces, including by way of public or active transport.
- Support, and limit as much as possible adverse impacts on, the competitive operation of land and development markets; and support reductions in greenhouse gas emissions.
- Are resilient to the likely current and future effects of climate change.

To test and potentially expand the definition of WFUE presented in the NPS-UD policy, a literature review of the academic and grey literature[1] is required.

[1] Grey literature – OED definition: documentary material which is not commercially published or publicly available, such as technical reports or internal business documents.

2.0 Systematic literature review methodological approach

The literature review is compiled using a systematic review method. A systematic literature review is an established research method, allowing for a greater understanding of terms and concepts by inductively[2] scanning a broad-ranging academic and grey literature.

2.1 The four-step methodological approach

The research identifies common concepts to inform the definition of what constitutes a WFUE. A broad search strategy helps to identify relevant literature with the goal of undertaking terminology analysis. The work collates the most cited and validated definitions of WFUE to identify similarities, differences or overlaps between concepts. The data sources are reviewed in a series of systematic stages to test the relevance and robustness of the research source and its contribution to the understanding of the concept.

The systematic review followed a four steps process:

Stage one included the development of a search strategy using general terms relevant to WFUEs. The generation of search terms used, brainstorming, review of existing policy keyword searches (including the Regional Policy Statement), and existing literature review sources developed by Auckland Council. The list of search terms was also expanded inductively as the process of review progressed.

Use of the JSTOR digital library identified the research sources for the systematic review. JSTOR collections include peer-reviewed scholarly journals and respected literary journals, academic monographs, research reports from trusted institutes, and primary sources.

An initial relevance assessment based on the title name and abstract content informed which data to include in the study. The inclusion criteria used are as follows:

- published since 2010
- published in English
- the paper described a developed western urban context
- the paper title or abstract included identifying critical elements of well-functioning design and proxies for measurements of these factors
- the work was independently peer-reviewed.

[2] Inductive research – Collation and review of a broad body of evidence to reveal a view or theory.

The search terms enabled the collection of a broad and representative subset of papers about WFUEs. This phase identified as many potential sources of literature as possible.

The second phase of the method used a more in-depth review of each data source. The subset of relevant papers added to the database formed the basis of the literature review. The purpose of the second stage was to refine and sift through the comprehensive data source, identifying and classifying relevant research papers that assisted in the understanding of the components of a WFUE.

In the third stage of the method the data was imported into NVIVO software. NVIVO is a qualitative research tool that allows the systematic coding of standard terms – followed by the thematic analysis of the sources to develop a deeper understanding of the concepts.

This fourth and final stage allowed the extraction of key terms and definitions. Therefore, the literature review is founded on quantitative and qualitative data that describe what constitutes a WFUE.

2.1.1 Summary of search terms and returned citations

The following high-level search terms and functions were input into the JSTOR search engine; this uncovered a broad range of articles providing insights into the elements of a well-functioning urban environment. Table 1 below indicates the total number of items found, followed by those judged as relevant to the study based on the article title and abstract.

Table 1: Database search terms

Search terms and functions entered in JSTOR	Number of citations – JSTOR	Screened for by title, abstract and availability (deduplicated)
“well-functioning” AND urban AND environments	312	17
liveability or liveable AND urban	86	30
walkability AND urban planning	441	53
planning AND “affordable housing” AND connectivity	171	13
“urban design” OR “place making” AND “well-being”	64	12
“sustainable cities” AND “well-being” AND infrastructure	197	24
"social equity" AND "accessible housing" AND planning	4	0
resilient AND "healthy cities"	27	4

Search terms and functions entered in JSTOR	Number of citations – JSTOR	Screened for by title, abstract and availability (deduplicated)
“planning equality” AND equality AND access AND employment OR housing OR transport	170,209 (viewed first 250 articles)	13
“cultural well-being” AND “urban planning”	1	0
"climate adaptation" AND "urban planning" AND "resilience"	148	34
“universal design” AND “urban planning”	28	13
“social justice” AND “urban planning”	270	74
quality AND “compact city"	270	37
Total articles screened	2269	
Total articles reviewed-included based on title abstract	336	
Total articles included following full read	322	

2.1.2 Initial evaluation of the characteristics of a well-functioning urban environment

The NPS-UD offers an opportunity to enhance the urban environment holistically. To look beyond pure development objectives, and interrogate a chance to improve our urban environments, and achieve less tangible goals that fall outside of the usual regulatory framework.

To identify these opportunities, a WFUE is conceived as having several interacting domains; these include, the built environment, the social environment, the cultural environment, and the natural environment. Supporting infrastructure is also identified as an essential component to a WFUE. Infrastructure is included across the domains and captures hard or utility infrastructure, as well as social infrastructure, including medical and educational facilities, green infrastructure and cultural infrastructure. The following table details an initial list of the characteristics of a WFUE. The characteristic list drawn from a review of the literature outputs found in JSTOR, existing knowledge on the subject, as well as a review of strategic Auckland Council documents, Auckland Plan, the Auckland Development Strategy, the Auckland Regional Policy Statement, literature databases and informed discussion with colleagues and peers.

The following characteristics are not weighted and are not exhaustive. The second phase of synthesising the literature permitted more analysis into relative weights and impacts of the different concepts.

2.1.3 NVIVO data organisation and thematic development

Table 2: Characteristics and key terms of a WFUE

Domain	Characteristics and key terms of a well-functioning urban environment
Built environment	Accessibility, connectivity and safe access to good quality facilities, public transport
	Accessible parking for mobility restricted
	Active frontage
	Age-friendly
	Character protection and sympathetic to vernacular
	Climate adapted to flood, drought, heat, storm, energy security
	Community space
	Compact city
	Crime prevention
	Health, resilience, climate change and cities
	Health equity
	Heritage architecture protection
	Human scale
	Investors and developers – and the role of off-plan sales

Domain	Characteristics and key terms of a well-functioning urban environment
	Land space utilisation
	Low carbon design
	Mixed tenure
	Mixed typology housing
	Participatory planning
	Passive surveillance
	Pedestrian priority street
	Permeability/ legibility
	Placemaking
	Preconditions for new settlements
	Resilient communities and housing
	Universal design • Inclusionary design-age friendly
	Urban sustainability
	Walkable/ Active transport
	Waste management
Social environment, social infrastructure and health	Affordable (relative to household incomes, not market)
	Age-friendly
	Belonging and participation
	Civic space (indoor and outdoor)
	Collectivism
	Community garden
	Diverse communities
	Empowered communities
	Equity
	Food as a planning issue
	Fair distribution of externalities
	Food production, access and security
	Fun, joy, hope
	Gender and Planning
	Health, well-being and urban form
	High amenity public realm
	Inclusive and diverse communities
	Play (safe play areas)
	Recreation
	Resilient
	Social capital
	Social infrastructure, inc. but not limited to churches, marae, mosques, synagogue, community centres, play centres, sports clubs, libraries
	Social interaction – a cross-section of society
	Social justice
Cultural environment	Aligned to Te Tiriti o Waitangi
	Inclusive
	Arts and creativity
	Representative
	Ownership
	Sense of belonging

Domain	Characteristics and key terms of a well-functioning urban environment
	Enhanced and not degraded cultural landscapes
	Improved outcomes for Māori and other minorities
	Founded on mātauranga Māori
	Protected taonga
	Protected heritage architecture
	Recognition of the needs of other diverse ethnicities
	Māori identity embedded and culturally appropriate design
Natural environment	Air pollution reduction
	Biodiversity
	Carbon sequestration
	Ecosystem services
	Green infrastructure
	Urban forest
	Natural capital
	Parks and open space
	Public open space
	Soundscapes and reduced noise pollution
Infrastructure, utilities and transport	Active transport
	Accessible parking for mobility restricted
	Aged care retirement homes
	Education and childcare • Day-care centres • Early childhood centres • Schools – years 0-13
	Employment access
	Green energy infrastructure
	Hospitals, medical centres, complementary therapies
	Infrastructure planning and investment
	Mobility
	Public transport
	Resilient energy networks
	Renewable energy infrastructure
	Reduced dependency on private transport
	Smart cities, data, and human needs in the city
	Three waters – • Improved and protected water environments • Potable water • Sewerage • Stormwater
	Waste management – including construction waste disposal

3.0 Elements of a well-functioning urban environment

A WFUE is the sum of its parts. No one element creates a WFUE, nor is there a measurable standard to demonstrate such an environment's achievement. Instead, there are common elements identified in sociology, environmental science, health, planning and urban design literature that reportedly meet the needs of the society they serve. These include, but are not limited to, access to affordable housing, with a range of typology and tenures (Armitage, Rogerson, & Pease, 2013). New developments located within easy access to employment opportunities, transport and social infrastructure, and mechanisms to ensure delivery. WFUEs should also enhance social, economic, cultural, and environmental outcomes, whilst not assuming a specific type or scale, but instead reflecting the architecture and landscape in which a development sits (Armitage, et al., 2013; Bowie, 2017, Morgan, 2012). Compact, higher density, well connected mixed-use developments are the hallmark of WFUEs, as opposed to sprawled single land uses (Garnett, 2017). Connected, inclusive, safer streets encourage active transport modes, such as walking and cycling, benefitting health and well-being (Bambrick, et al., 2011).

The careful weaving of greenspaces into the urban fabric is linked to improved human health and well-being, with greenspaces providing opportunities for recreation, conservation, cultural identity, environmental quality and natural mitigation for some of the negative externalities of urban life, such as waste, pollution and human induced climate change (Cvejić, et al., 2015; Boyce, 2010).

A WFUE's definition moves beyond an anthropocentric view and includes ecocentric perspectives. As noted by Sheppard (2006), in Newman & Dale (2013), 'The WFUE must minimally function well as a habitat for multiple species,' this reminds us that we are not apart from the ecosystems we inhabit. Instead, we profoundly impact upon, and in turn, are affected by the environments we inhabit and modify (Bentley, 2015). As nature lives between the gaps we leave in the urban landscape, we need to protect and enhance other species' opportunity to thrive. WFUEs should enhance the less obvious contribution nature has to our cities' resilience, equipping us to face the contemporary challenges of resource shortages and climate change (Simon, 2016).

This summary briefly describes some of the components of a WFUE, but these are subject to contention. For example, the broad nature of this summary does not clarify whether the proposals meet only the majority of the community's needs but not the minority. Or whether there is a variable experience of an environment dependent on age, ethnicity, cultural context, economic and social background, personal preference, or any other variable factor that constitutes a diverse and complex societal profile. To dive more deeply into the definition, a more nuanced review of the components of a

WFUE is explored. The literature drawn is systematically reviewed and organised into subcategories or domains. The domains were developed by the author following an evaluation of the texts for common themes. Under each domain, the components, which together create a WFUE, are detailed, where appropriate measures and indicators are identified to monitor the impact on the functionality of the urban environment.

3.1 The process of creating a well-functioning 'built' environment

Observing the principles of good urban design allows for the creation of well-functioning built urban environments. Urban design principles go beyond the aesthetic concern of building masses and the spaces between buildings, expanding the focus to include the enjoyment and use of urban areas by people. Carmona, Heath, Oc, & Tiesdell, (2003) stated that 'good design meets both the people's physical and socio-cultural needs.' In effect, good urban design is both a product and a process, reflecting both the function and form of developments. It also captures who influences the design and how they are engaged in the process (Carmona et al., 2003).

3.1.1 Public life studies

Designing a WFUE starts with an understanding of the community that inhabits it, how they use their space and the history of the land it will stand on. Where a development anticipates an influx of new population into an established area, care is needed to meet both the incumbent and future populations' needs. With recognition, these might not necessarily be the same, and that the potential negative consequences of gentrification should be avoided (Anthony, 2017; Bates, 2018; Banister, 2012). As Jane Jacobs (1961) espoused, a community cannot be created, only destroyed. Jacobs also believed that the best way to understand a community was to go out to the street and study public life (Gehl & Svarre, 2013). Observing public life, how space is used, and by whom allows an understanding of how a place can be enhanced, or in the case of new developments, planned to best serve the end-users. Universally termed 'placemaking', the approach recognises that homogenised blueprints designed by external specialists cannot be transferred between urban settings. Instead, placemaking should build on local knowledge, culture, and preference to create a bespoke inclusive vision for useable spaces (Dayaratne, 2016; Markusen and Gadwa, 2010).

Gehl, another thought leader in placemaking, promotes public life public space studies in regeneration, notably his methods provided clear evidence about place use in the regeneration of Melbourne (Gehl & Svarre, 2013). A public life public space study does

not enact regeneration alone, but instead provides knowledge of how public space is used, or not used. The findings of which can inform urban designs that enhance desirable experiences. For example, places to socialise, prevention of places that create avoidance due to fear of crime and places that enhance opportunities to walk and integrate with the environment, rather than pass through without engagement.

Key observations from both Jacobs and Gehl are that successful urban renewal comes from mixed-use and the encouragement of vitality in existing neighbourhoods by focusing on local movement, small scale shops and businesses and quality open spaces (Banister, 2012, Gehl & Svarre, 2013). In addition to passively observing place use, as promoted by Jacobs and Gehl, for the built environment to successfully reflect the community's needs and desires, the community must be fully engaged and have ownership of the design. Placemaking, which builds a design led vision for an area, requires the broad engagement of communities, businesses, and agents of social change to reflect on current use, meaning and sense of place and expand this to enhance future development (Dayaratne, 2016; Markusen and Gadwa, 2010; Marques, Grabasch, & McIntosh, 2018; Vaajakallio & Mattelmaki, 2007). Notably, placemaking informs the physical space and incorporates social relations and subjective human experiences in the design itself (Schofield & Szymanski, 2011). In summary, the process by which a 'well-functioning urban environment' is conceived is as important as the measurable outcomes.

3.1.2 Public participation

Public engagement in planning and community development gained traction in the 1960s and 70s, most notably conceptualised by Sherry Arnstein in her participation ladder (Arnstein, 1969). The ladder demonstrates that citizen participation ranges from manipulation, therapy and informing (non-participation), through to consultation and placation (tokenism) up to partnership, delegation (citizen control). Non-participation, or arguably worse, tokenistic engagement, leads to distrust in the development process, perceived negative externalities and poor social and cultural outcomes (Blomkamp & Lewis, 2020; Boyce, 2010; Cinderby, 2018, Ford, Dawson, Blythe, & Barr, 2018; Howden-Chapman, Early & Ombler, 2017). The empowerment of citizens to engage in the design and development of their own environments has been articulated in both the United Nations' New Urban Agenda (NUA) and the United Nations Sustainable development goals (SDG) (Perry & Russell, 2020). An extract from the SDG states the following commitment which New Zealand has agreed to implement:

> "… promoting institutional, political, legal and financial mechanisms in cities and human settlements to broaden inclusive platforms, in line with national policies, that

> allow meaningful participation in decision-making, planning and follow-up processes for all, as well as enhanced civil engagement and co-provision and co-production" (UN – Habitat, 2017: 14)

Effective and inclusive participatory planning, representative of the whole community's input, is critical to meeting the objectives of the NPS-UD, and more broadly, the United Nations Sustainable Development Goals.

3.1.2.1 Tools to achieve social justice and equity planning

An outcome of inclusive, participatory design can be social justice improvements. Social justice and equitable planning are contingent on broad representation and removing barriers to engagement, avoiding professional jargon, and practices that result in power imbalances between technical and laypersons. Practices that exacerbate inequities within the community due to minority status and other impediments also need to be avoided. Understanding who to consult with and how to do it, is essential to appropriate engagement strategies. Blanket approaches to consultation rarely lead to successful community representation in planning.

Placemaking is a softer approach to planning and design which 'animates public and private spaces, rejuvenates structures and streetscapes, improves local business viability and public safety, and brings diverse people together to celebrate, inspire, and be inspired' (Markusen & Gadwa, 2010:3). It encourages tools such as play, narratives, art, the use of digital tools and social media platforms to entice a more diverse representation in urban development processes (Mallach, 2017; Markusen & Gadwa, 2010; Marques, et al., 2018; O'Sulivan, O'Connell & Byrne, 2017, Webb 2014).

Research undertaken by Markusen and Gadwa (2010), reviewed a series of placemaking case studies to identify common components in successful placemaking initiatives. Although the cases studies were particular to arts initiatives, they are transferable to the local community development context. They concluded that successful placemaking has a series of elements many of which are common to community development more broadly. The first, is an individual or small group that act as the 'creative initiators', this group establishes a vision for change which can be a development, revitalisation, change of use or activation of latent space. The second step requires, 'designing around distinctiveness', which in the urban context can involve designing around an existing sense of place, based on economic and social history as identified by the inhabiting community. The third element is 'public will', which they primarily identify as the support given from the public sector, through mayoral or councillor support for initiatives who in turn mobilise public will. The fourth element is 'private sector support'. The private sector is seen as the primary investment source.

Businesses and philanthropist who see potential benefit from regeneration and developments fund placemaking initiatives driving visions into real outcomes. The fifth element is the buy-in from not-for-profit groups; these groups are often well connected to the community and can coordinate initiatives for placemaking across their established networks. The sixth and final components are building partnerships across all the groups, using the skills each provides and building alliances across sectors.

3.1.2.2 Representative community participation

Although community inclusion is essential to successful placemaking, treating laypeople as partners and active co-creators in the design process is not straightforward (Marques, et al., 2018). Furthermore, the diversity of communities must be recognised and responded to, to ensure the best design outcomes. This can mean carefully balancing the views of multiple groups and in some cases affording some perspectives greater weight.

Collaborative and interdisciplinary participatory processes require sustained interaction and relationship maintenance with all communities, but particularly indigenous communities (Muriwai, Houkamau, & Sibley, 2015). For Māori, culturally appropriate engagement does not merely mean being included (Porter, et al., 2017). Instead, it is giving rangatiratanga: (the right to exercise authority and self-determination within one's own iwi / hapū realm). Article II of Te Tiriti o Waitangi supports this equitable restoration of planning authority and development rights to Māori (Livesey, 2017). This should be the objective of any endeavour to plan and develop a well-functioning urban built environment. To achieve this requires relinquishing power and control by planning authorities and enabling Māori tino rangatiratanga based on the principles of Te Ao Māori (Māori world view).

Care is also required to avoid overrepresentation and the privileging of opinion from outspoken and influential stakeholder groups. Bates (2018) and Jacobus (2019), illustrate how well resourced interest groups can influence the adoption of planning interventions, such as inclusionary zoning (IZ), at the expense of less vociferous groups such as rental tenants.

A growing area of focus in city design is the importance of gender equality as a design criterion for access and mobility. It is widely accepted that city designs are not gender neutral (Beebeejaun, 2017; Gauvin, et al., 2020). Purposeful engagement of women and other groups such as the rainbow community, who report a heightened fear of physical or sexual violence in public spaces are important perspectives to include in the design of urban spaces and public transportation (Beebeejaun, 2017; Gauvin, et al., 2020; Golan, et al., 2019). In addition to fear of crime limiting access to the city,

gender also influences the way women travel between destinations. For example, women engage in more multi-purpose, multi-stop trips ('trip chaining') in order to do household chores, as well as other gender differentiated roles making their experience of everyday life in an urban context quite different to men (Gauvin, et al., 2020).

Creating public spaces that are inclusive and safe for all citizens requires gendered perspectives to be entrenched in professional planning and design practise. The social dynamics of space have clear implications for gender relations (Beebeejaun, 2017). Beebeejaub, (2017), noted the continued binary distinction of gender, into males and females in the city context conflates the experiences of multiple perspectives (Osbourne, 2015). Indeed, the solution to this 'gender mainstreaming' may be as simple as to design for 'others', capturing all those that do not fit the profile of a heterosexual male. Osbourne (2015), contests this approach, noting that individuals can be regarded as being both within privileged and subjected subgroups simultaneously. She also notes that intersectionality can result in variance of social position, lived experience, and thus affect vulnerability. Opportunities to enhance inclusive spaces require a move beyond vague abstract notions of inclusivity, access, and safety in city plans (Beebeejaun, 2017), and require specific focus on how both built and green spaces can achieve these characteristics in practice and improve the lived experience of the space for all.

Consideration of the needs of the non-average citizen is critical to providing a well-functioning environment for all users, therefore representation of different age groups and disabilities also need consideration (Stubbs, Storer, Lux, Storer, & Ireland, 2017). (Austin, Collins, Scanlen & Smith, 2019). A commonly used solution to age-friendly and disabled-friendly city design is the use of universal design principles (Kendig, Gong, & Cannon, 2018). Successful inclusion strategies require focus on the design process and the product, to make design and composition of different environments, products, communication, information technology and services accessible, usable and understandable (Bjork, 2014).

Handler (2018) challenges the use of universal design as a 'total' solution to the age-friendly city, seeing the implementation of generic age or disability-friendly design interventions as a reductionist approach. Universal design without user engagement plays into the 'bio-medicalised models of ageing' and downplays older people's agency in urban space production. Handler (2018) notes that although there is clear value in providing discreet universal design interventions in the urban landscape, such as age-friendly benches, this only addresses part of equitable access to the city.

Buffel, Handlers, & Phillipson (2018) endorse engagement of older people in community development and neighbourhood renewal schemes. They highlight that

age-based discrimination and older people's 'full right' to use, appropriate and shape their cities can be improved through inclusive practices and engagement. Enabling older demographics to inform the solutions that allow them to move freely around the city and to continue to access work and leisure activities.

An example of place-based engagement and user-friendly city design is illustrated in the Portland, Oregon case study reported by Howe (2015). Portland is recognised globally as a hub of planning design innovation. In 2006, Portland was invited by the World Health Organization to participate in an age-friendly city project. The resulting initiative engaged representatives of older adults, caregivers, and service providers who advocated for an ageing perspective to be incorporated into the design of the city outdoor spaces, transportation, and housing. The objective being to improve social participation, communication, and health outcomes for older residents. The result was the development of the Action Plan for an Age-Friendly Portland. Despite this progressive plan and elevation of ageing as an equity issue, subsequent strategic documents have failed to place ageing as an equity issue, instead focussing on disability and ethnicity (Howe, 2015). This case study demonstrates that even where there is a clear mandate to include the perspectives of older users in city design, implementation challenges remain.

At the other end of the age spectrum, there is an increasing call to engage younger demographics, including children, in participatory planning and design outcomes focused on their development and well-being. Children's access to the city is contingent on the provision of safe, accessible, and nurturing environments that allow them to play, explore and develop skills required in adulthood (Breen, Dosemagen, Blair, & Barry, 2019). Car dominated environments lead to anxiety and a reluctance to allow children to walk between locations independently (Austin et al., 2019). Whilst, limited active transport options for children stymies development and social inclusion and exacerbates health issues such as obesity (Boyce, 2010; Chandra et al., 2016; Davoudi & Brooks, 2016; Derr & Lance, 2012).

Adolescent youths are some of the most marginalised city residents (Wilson, Rose & Colvin, 2010). Groups of youths are often dissuaded or barred from congregating in areas that bridge the public-private divide, such as shopping malls. Consequently, they are often forced to congregate and socialise in playgrounds designed for much younger children or in open spaces where they can be perceived as a public nuisance. Collins (2018) undertook an extensive evaluation of playground use by children in Auckland. She found that adolescent girls are particularly underserved in public space, often too old for the playground and intimidated to use more male-dominated skate parks. Young females have limited options for safe, age-appropriate social interactions

and spaces in the city. Collins (2018) recommended the active engagement of youth in planning inclusive environments for children of all ages and genders.

There is also a social justice element to engaging children in planning due to the existential threat of climate change, which will disproportionately impact younger generations (O'Sullivan, O'Connell, Byrne, 2017). The rise of the 'School Strike 4 Climate' movement, demonstrates the growing engagement of youth in civil action to demand change for future generations.

Using more creative methods and tools familiar to younger demographics, such as social media platforms, can encourage better engagement outcomes (Bach and Loibl, 2016).

Another consideration when engaging with the community is including representation from a range of tenures. The perceived transience of rental tenure can result in tenants' alienation in participatory planning opportunities (Raymond, Gottwald, Kuoppa, & Kyttä 2016). This can be due to tenants feeling less proprietary over an area's future development or due to engagement processes that privilege land and property owner engagement. Evidence has shown that where more directive methods of tenant engagement in homes and community design are used, social capital and community cohesion can increase and provide an opportunity for personal development (Boyce, 2010; Visković Rojs, Hawlina, Gračner, & Ramšak, 2019). As with the climate crisis, the growing housing crisis in New Zealand is having a profound impact on younger generations and those with socio-economic disadvantages (Joynt & Hoffman, 2021). This further demonstrates the need for proactive engagement of younger demographic groups in any design solution.

3.1.2.3 Participatory planning tools

Alternative planning engagement routes for communities, such as creative placemaking initiatives, should provide authentic opportunities for all community members to express their relationship with their physical, social and cultural environment (Walker, Wehi, Nelson, Beggs, & Whaanga, 2019; Webb, 2014).

Recent advances in virtual reality and more user-friendly GIS platforms can allow citizens greater access to planners' tools and visualise how environments could look (Granberg, Nyberg, & Modh 2016; Raymond, et al., 2016). One way of making these tools accessible is through urban living labs (ULLs) (Breen et al., 2019). ULLs offer opportunities to bridge professional and lay perspectives on community development. By including all stakeholders in placemaking, the transition to more sustainable buildings, neighbourhoods, transportation and energy systems is more inclusive and reflective of community needs (Bach & Loibl, 2016). ULLs devolve power to local

communities, enabling them to share their relationship with the existing landscape and infrastructure, how it makes them feel, how it works or does not meet their needs and offer suggestions for improvements. The focus on experimentation and exploration in ULLs encourages more artistic and creative engagement techniques and can unearth the less tangible elements that create a WFUE.

3.1.3 Smart technology

Big data is omnipresent in cities, from building use to transport routes to microclimates. Data is continuously captured and provides a macro picture of a city system creating the opportunity to evaluate trends under varying conditions (Grayson, 2020). This so-called 'smart technology' can enable planners and city architects to holistically view a city's interlinked system which can be tweaked and refined to aid efficiency (Barbar, 2012, Hodgkins, 2020). Furthermore, smart cities can enhance the connection between urban systems and citizen-centred environmental sustainability, economic advancement and social justice (Grayson, 2020).

As a cautionary note, technocentric smart city visions, can assume easy technological fixes for complex urban problems, however too much reliance on smart technology can result in technocratic solutionism at the expense of the agency of 'smart citizens,' (De Lange, 2019). Using quantitative smart technology data together with more nuanced citizen participation can create a more holistic picture when endeavouring to improve systems and society. This should be explored in the visualisation of WFUEs (Barbar, 2012; De Lange, 2019; Bach & Loibl, 2016).

3.1.4 Developer engagement

Participatory public engagement in planning is essential to WFUEs, and so too is the engagement of stakeholders that will deliver the built environment. Developers have significant control over the form and function of urban landscapes (Turner, 2017). Through engagement with property specialists and infrastructure providers, developers understand market demand, feasibility, funding, build sequencing and community need (Carmona et al., 2003). Varying motivations influence developer priorities, this impacts on land-use, socio-ecological impact, affordability and design quality (Turner, 2017). For example, developers representing supply-side actors tend to focus on maximising profit with a relatively short-term view over the management of development, i.e., developments are built as a financial commodity. The type of development generated on a specific piece of land is influenced strongly by maximising profits within the planning context for example, if planning controls introduce minimum lot sizes and open space requirements, developers focus on the incorporation of 'luxury' amenities and larger homes to increase sale price at point of sale (Turner,

2017). This approach to housing development leads to inefficient use of land and housing development which does not meet the needs of groups struggling to access affordable housing.

The supply-side approach does not necessarily create a poor quality design, as high-quality design can increase saleability. Still, it can limit considerations such as affordability measures and connectivity with community infrastructure (Carmona et al., 2003), as supply-side development favours greenfield development, migration, ex-urban development, and the promotion of private delivery of public services (Heid 2004, Tilt & Cerveny 2013, Turner, 2017).

In contrast, demand-led developers tend to have a long-term view (i.e., the development is an environment to be used) (Carmona et al., 2003). Demand-led developers include those delivering outcomes that are a not-for profit focussing on less quantifiable social, environmental or community goods.

Community housing developers demonstrate a focus on good community outcomes such as affordability, community cohesion and the provision of wraparound support services (Joynt, 2019; Bates, 2018). For demand-led developers to meet their social objectives, they require access to affordable land near existing amenities. This type of development is reflected in the 'compact city' approach (Dempsey, 2010, Davies & Atkinson, 2012; Vallance, Perkins, Bowring & Dixon 2012). When available, this type of land often demands a high price in brownfield urban locations, or where land is more affordable it requires significant remediation. Demand-led developers, therefore, benefit from alternative land access opportunities, such as inclusionary zoning, crown land exchange, lease land or philanthropic donation (Joynt, 2019).

Additionally, practical assistance such as introducing planning and consenting assistance can enable smaller, non-commercial developers to gain an equal footing with commercial developers, and increase the viability of their endeavours (Bates, 2018, Joynt, 2019). Allowing a range of developers to contribute to the urban landscape increases the diversity of design outputs (Boeing, 2018). For example, allowing both supply-side and demand-side actors opportunities to develop can create more affordable or specially adapted housing, as well as more creative design solutions and architectural finishes, making the city both more inclusive but also visually exciting and appealing (Carmona et al., 2003; Boeing, 2018). Developers and infrastructure providers also need to work cohesively due to their crucial role in building resilient zero-carbon societies (Bach and Loibl, 2016). Thus, engaging developers with a range of motivations and customers, leads to community outcomes that better reflect diverse needs.

3.2 Outcomes of a well-functioning 'built' urban environment

The characteristics of a well-functioning built urban environment are based on the efficient and creative use of land, allowing multiple users to meet their day-to-day needs and desires in a compact yet human-scale sustainable urban environment (Boeing, 2018). The following section outlines critical design outcomes identified in the literature.

3.2.1 Quality compact city approach

The 'compact city' approach to urban design has long been touted as a solution to the negative externalities of urban sprawl. The compact city is characterised by relatively high residential density with mixed land uses. Compact cities, or quality compact approaches (as defined by the Auckland Plan), are designed to connect residential, commercial and other amenities within easy access to efficient public transport systems whilst offering opportunities to walk and cycle and dissuade private transport use. The approach demonstrates good design that maximises the efficient use of land and allows efficient coordination of infrastructure to support growth (Auckland Plan, 2018; Dempsey, 2010).

Although widely accepted as resource efficient, there is no actual international consensus on what high-density means or how to measure it. For example, during the regeneration of Melbourne, Australia, in the late 2000s, the drive for intensification set a target to move to 15 dwellings per hectare (Newton, 2010). Whereas, in the City of Toronto plan, Canada, the targets are set by people and jobs per hectare. The target for the downtown and central Toronto waterfront area is set at 400 people and jobs combined per hectare (City of Toronto, 2017). In comparison, targets in the London Plan were less explicit. Reported in a 2016 density comparison study (CBRE, 2016), The London Plan devised a density matrix[3], which allowed the consideration of access to services, using habitable room per hectare as a metric to account for site utilisation. According to a review of the use of the London Plan density matrix, it has been 'honoured in the breach rather than the observance', much of the breach being at the lower threshold even within the inner city (Gordon, Mace & Whitehead 2014).

The variance in perception of optimum density and the point at which optimised high-density tips over to over-crowding and damaging to community and environmental health is determined to some degree, by socio-cultural norms (Dempsey, 2010).

[3] 'The matrix is not static as it provides a tool for increasing density in situations where transport proposals will change the public transport accessibility ranking' (Mayor of London. The London Plan, 2004: 176)

Direction 1 of The Auckland Plan recommends the 'development of a quality compact urban form'. Listing the benefits of the quality compact approach to growth in Auckland as:

- Higher productivity and greater agglomeration benefits (both in production and consumption).
- More efficient use of existing infrastructure.
- Supports more frequent public transport and enables greater travel choice.
- Maintains rural productivity and the productive capacity of rural land.
- Improved environmental outcomes, including reduced emissions.
- Greater social and cultural cohesion and vitality.

In contrast, to international jurisdictions that have rules limiting maximum dwellings per hectare. Auckland's city centre zone, terraced housing and apartment building zones and the Business Mixed-use zone, have no maximum dwelling per hectare rule. As such, there is potential for considerably high-density development. However, in Auckland, density is contained within areas identified for compact urban development. Discretionary powers are used to prevent exceedance of infrastructure capacity or breach of amenity, cultural or environmental constraints. In addition, design recommendations state that the minimum floor area of the smallest possible dwelling (studio) should exceed 35m^2, which further prevents overcrowding.

Fundamentally, a quality compact city is achieved by using more granular level interventions that dictate the use and amenity of the urban landscape, as presented below.

3.2.2 Permeable, legible, connected and visually complex streetscapes

The city's permeability (or connectivity) and legibility determine the ease by which a person can navigate a streetscape. Permeability being the presence of multiple route options allowing easy transition across the urban landscape, and legibility, being the ease by which a person can navigate through the city using landmarks and views to orientate themselves. Short blocks characterise permeability, allowing pedestrians ease of transition across a city using a choice of routes both through and within it (Carmona, 2003). Options for improving permeability include introducing laneways through the ground floor of buildings or breaking up single-use structures along city blocks using pathways and pocket parks. Increasing permeability also enhances visual interest and fast linking routes for pedestrians (Boeing, 2018). Connectivity represents the fewest number of nodes (intersections and dead ends) or edges (street segments between nodes) that will disconnect the network if they are removed (Boeing, 2018:10). A highly permeable urban system will have many possible routes to connect nodes.

Legibility (or structurability) (Gehl & Svarre, 2013) is created by organising an environment within an imageable and coherent pattern (Lynch, 1960 in Koseoglu & Onder, 2011). Good legibility helps easy navigation through urban space; it is measured by the complexity of a spatial layout and space landmarks (Akagi & Adachi, 2015; Koseoglu & Onder, 2011).

Achieving permeable and legible greenfield development is less complicated than achieving this through retrofit in brownfield development. Multiple landholders and existing land covenants can create complexity; for example, boundary fences, private gardens, and private driveways are the most common barriers to walking routes and neighbourhood permeability (Davies and Atkinson, 2012).

Complexity is also touted as a desirable attribute to a WFUE. Complexity entails greater connectivity, diversity, variety, and sustainability (Boeing, 2018). Visual complexity is one of the desired outcomes of good design; it depends on variety in buildings types, design details, street furniture, clear signage, opportunities for varied human activity, sunlight patterns, and the rich textural elements of street trees and urban forests (Boeing, 2018; Foord, 2010) In broad terms, complexity makes urban environments more resilient and robust, providing greater opportunities for social encounter, mixing, and adaptation through social learning (Fisher, et al., 2016). The retention of character and local vernacular architecture can aid visual complexity, particularly when combined with a quality new build (Blomkamp & Lewis, 2020, Council on Tall Buildings and Urban Habitat, 2017).

3.2.2.1 Streetscapes for the ‘non-average’ citizen

The urban form needs to be inclusive of all user needs, not just the average user. For people living with complex needs, such as dementia, comprehension of the urban landscape can be challenging, particularly where there are no clear pathways and familiar landmarks to aid orientation (Koseoglu & Onder, 2011). Designing legible environments for the broad spectrum of users can ultimately increase independence; as such, legibility is an essential aspect of universal design (Akagi & Adachi, 2015; Hamraie, 2017). Universal design also includes creation of barrier-free design using disability anthropometrics as a basis for understanding how less able-bodied citizens navigate the environment (Hamraie, 2017). For those with mobility issues, the following interventions can increase access:

- Conveniently placed street furniture, such as benches and seats at bus stops.
- Wider pathways, ramps.
- Properly designed handrails
- Intermediate landings within/between flights of stairs.

- Clear signage and wayfinding aids.
- Lighting.
- Consideration of gradients.
- Availability of alternative routes/thoroughfares to bypass difficult terrain.
- For low vision/blind users of space and those with auditory impairments, tactile/auditory elements to improve legibility designs.

Inclusive design can include both function and form to urban spaces whilst being inclusive of people mobility issues.

Active transport refers to the use of walking and cycling. Urban design influences active transport uptake. Permeable and legible pedestrian priority street networks radiating from a transport node encourage active transport. As with engagement, representation of all society's needs (rather than a nominal average person) addresses social inequality and equitable access to the city (Ansaloni & Tedeschi, 2016; Buffel, et al., 2018). Inclusive designs support roads that are safe, comfortable, and convenient for people of all ages and abilities to walk, bike, ride public transportation, and drive on (Chandra et al., 2016, Clarke & Gallagher, 2013; Hamraie, 2017,). In practice, this would mean designing city blocks with laneways and smaller buildings that aid shorter access routes, as large, single-story buildings that encompass whole city blocks contribute to land consumption and undermine walkability (Turner, 2017).

3.2.3 Transport, accessibility and connectivity

Careful choice of development location is imperative to achieving accessibility, and a useful measure of urban design outcomes is transportation and land use.

Good accessibility and connectivity concern proximity, mobility, and social interaction within the public sphere (Boeing, 2018). Through construction above or immediately adjacent to an interchange, users can walk to their destinations. Thus, centring development around public transport nodes should allow access to various activities (e.g., offices, shops, social and recreational facilities). Public transport interchanges also offer an opportunity to create a civic space to meet and spend time and money, rather than spaces to pass through as quickly as possible (Banister, 2012; Gehl & Svare, 2013). Freewill must be considered in the successful development of the compact city. Individuals have the agency to choose not to use amenities within walking distance if they fail to meet their needs regarding service choice, price point, or mobility. As such, accessibility, housing and transport equity and walkability can be essential matters of distributing spatial resources and design quality (Buffel, et al., 2018; Cook, Bose, Marshall & Mai, 2013).

Accessibility of (access to) resources and amenities is also a determinant of social equity in a city (Chen & Akar, 2016; Clarke, 2012; Donovan, 2010; Niedzielski & Boschmann, 2014). The inclusion of the end-user in the design of an urban centre is imperative. Understanding the demographic of an area and communicating directly with communities helps ensure services and amenities meet community needs (Bannister, 2012). Likewise, access to a range of employment options, both within the central business district (CBD) and inter-local centre or out to main employment hubs, such as airports, hospitals, and industrial centres, must be considered. To be genuinely accessible public transport systems need to work for all (Chandra et al., 2016; Niedzielski & Boschmann, 2014). Consideration must be given to off-peak travellers or people who undertake multi-point trips due to part-time work and caring responsibilities. Access opportunities for these groups, which include low-income persons, is currently insufficient (Gauvin, et al., 2020; Manatū Wāhine | Ministry for Women, 2021; Subeh, 2019). The notion that travel is a linear experience between home, and a CBD located office is outdated and gender-biased (de Madariaga, 2013; Niedzielski & Boschmann, 2014). Reviewing accessibility from multiple user perspectives with varying abilities and demands will result in greater uptake of non-private transport modes.

3.2.4 Density and human scale

Complexity which entails greater connectivity, diversity, variety, and sustainability (Boeing, 2018) and legibility are also impacted by scale. Human-scale architecture and dense organic urban fabric add to the sense of connectivity and contribute to lively, enjoyable, walkable, healthy, and vital neighbourhoods (Boeing, 2018; Gehl & Svaree, 2013). Orientating buildings to aid the connection between the street and the adjacent urban fabric also improves city dwellers' experience (Cardia, 2013). Active frontages with mixed uses of residential and commercial premises create a sense of vitality and safety due to informal surveillance and connectivity between the street activity in ground floor shops and buildings with balconies on the first floor (Victoria State Government, 2017). Foord (2010:49) noted that mixed-use could have varying degrees of success depending on the mixed-use type. Desired vitality outcomes are only delivered when 'uses visibly activate(d) the ground floor level of buildings and the street environment in a positive and integrated way'. For example, frosted office windows on the ground floor would not create a sense of connectivity between pedestrians, ground floor occupants and first-floor residents, and use may only be during weekdays. Whilst cafes and bars may create vitality through the week and weekend; they may also create nuisance if late-night noise impacts surrounding residencies (Foord, 2010). So, care is required to create the right kind of mixed-use, which reflects the community's

needs and incorporates careful mitigation strategies to reduce negative externalities such as car parking issues and noise.

Top-down planning is sometimes criticised for missing the nuance of community needs and perceptions of acceptability in density (Boeing, 2018). For some, density may not always promote a sense of safety and well-being (Dempsey, 2010). Perceived acceptable density needs to be measured both with hard spatial elements and softer cultural norms to create density in urban living, which will enhance human well-being (Howden-Chapman, et al., 2017; Waters, 2016). Determining this requires careful evaluation and consultation with the target community.

3.2.5 Infrastructure

All built environments are dependent on infrastructure provision. Infrastructure is composed of the technological and utility networks that support urban life and a city's functionality (Latham & Layton, 2019). Above ground, this includes the public space network and landscaping framework; public transport networks and green, cultural and social infrastructure; public facilities (e.g., shops, parks), and services (e.g., schools and hospitals). Sometimes referred to as the 'capital web', this infrastructure helps support citizens' day-to-day social experience. While below ground, the sewerage, cable, utility networks enable the above-ground infrastructure to function. Therefore, access to utility infrastructure dictates the feasibility of the built environment. Whilst, capital web infrastructure determines the amenity and liveability of the built environment, development is not contingent on its immediate availability but may make new housing more desirable (Howden-Chapman et al., 2017).

The phasing of infrastructure is critical to WFUEs. Still, developers may be reticent to commit funds to social infrastructure or even large housing numbers until they know their homes are marketable. Often, developers prioritise profit-making elements of developments and infill additional non-profitmaking features later (Czamanski, Malkinson & Toger 2014; Carmona et al., 2003). Purchasers may also be unenthusiastic about buying homes in the middle of a building site with no public transport access, no school, no health facilities, and no shops (Basso 2018). Options to prevent housing from being built without timely phasing of critical social infrastructure include enforcement strategies by planning authorities. A co-benefit of enforcing the development of social infrastructure is the initiation of desirable behaviour changes. For example, provided positive alternatives are established early in a community's inhabitation of an area. Reduction in private vehicle use can be achieved by delivering well-connected, accessible public transport or walking and cycling lanes between residential areas and workplaces and education.

Copenhagen in Denmark represents a successful case study in the delivery of active transport, with one in four trips undertaken by bicycle. The success of cycling in Copenhagen is largely attributed to the adoption of a 'Cycle Superhighway', initiated in 2009, the super highway was opened in 2012 and now links a network of 28 routes, equalling approximately 500km (PASTA Consortium (eds) 2017). A critical element of continued use of the cycle network throughout the seasons is a maintenance program that prioritises the safe clearance of obstacles such as snow, ice and glass on cycleways equally to the main trunk road infrastructure (Cycling Embassy of Denmark, 2018).

In Oulu, Finland, winter maintenance of cycle infrastructure is prioritised over street clearance, and cyclists can access real-time data on pedestrian and cycle route conditions. The result is that one in five trips are taken by bike in the city of Oulu, despite the city spending five months of every year blanketed in snow with minimal daylight (Steensig, 2021).

Therefore, a WFUE requires co-location or phased development of nearby capital and social infrastructure (Carmona et al., 2003). The proximity and accessibility of services should reflect the primary users; for instance, healthcare co-located with age care facilities or education centres that are accessible with well-maintained active transport routes.

3.2.6 Quality amenities, housing choice and land utilisation

People-centric design is implicit in WFUEs. Understanding who communities are and how and where they work, live and play, [or would like to], is central to liveability (Blomkamp & Lewis, 2020). Placemaking is a powerful tool for understanding then transferring community needs into the practical provision of quality amenities for commercial and civic activity and housing (Dayaratne, 2016).

In addition to community-scale design, housing typology, function and form are also important areas for non-expert user-led design. Goodchild (1997) (cited in Buckenberger, 2012:72) encouraged the following considerations in housing design: access, control, space and time use, flexibility, the economy of use of a house, privacy, security and the visual appearance of the home. Another consideration is that preferences on function, form and housing affordability vary amongst different demographics (Waters, 2016; Levitt & Gray, 2017).

Housing choice and land space optimisation can also enhance the experience and add to a neighbourhood's visual complexity and equitable use. Housing choice is achieved by allowing a range of housing scales and typologies reflecting demographic and cultural preferences (Hamraie, 2017). Universal design principles further enhance

housing choice incorporating the option for physical adaptations. Easily adaptable designs, sometimes referred to as 'long-life loose-fit', can meet an occupant's changing physical needs or the change in the number of occupants residing in a dwelling over time. Incorporating universal design principles is particularly salient with both an ageing demographic and changes in the household constitution, with multi-generation or non -related multiple owners requiring more flexibility in housing choice (Bjork, 2014; Bjork, 2015; Buffel, et al., 2018).

Intrinsic character, the unique identifiers of place (Sepe & Pitt, 2014) and genius loci, the spirit and sense of oneness with place (Dayaratne, 2016: Sepe & Pitt, 2014) are also important factors in a WFUE. The subjective value and identity assigned by communities to an urban forms, intrinsic character and landmarks, impacts on the social, natural and cultural experience of urban spaces. Due to their unique and subjective nature, intrinsic character and genius loci are not elements that can be established unnaturally or identified through objective evaluation, instead these more idiosyncratic characteristics of place are identified through engagement with communities in placemaking exercises.

3.2.6.1 Affordable housing

The provision of warm, safe and affordable housing was highlighted as a fundamental human right by the United Nations Special Rapporteur on Housing in Aotearoa, New Zealand (Fahra, 2020). Secure tenure in warm, safe housing has a demonstrable effect on positive health outcomes, but rising affordability issues have deteriorated housing quality and experience (McKee and Soaita 2018; Joynt & Hoffman, 2021; Joynt, 2019). Therefore, it follows that a citizen's ability to house themselves securely, with dignity and without harmful impacts on their mental and physical well-being should be the most basic tenet of a WFUE. Kushner (2010) goes further to suggest that affordable housing is an essential infrastructure element comparable to the provision of adequate schools, streets and industries etc.

Despite the link between affordability and well-being, a standardised definition of affordable housing still eludes policy discourse, including the NPS-UD. There are two commonly understood definitions of affordability. Relative affordability – housing sold or rented at a discount (usually 75%) relative to the market price or retained affordable (sold or rented at a price where a household on the median regional income would spend less than 30 per cent of their income of mortgage repayments or rent (Ministry of Housing and Urban Development (MHUD), 2020)).

Land-use planning has a limited role in housing affordability. Most of the influence focuses on supply-side interventions, such as zoning for higher density and

inclusionary zoning. Enforcement of efficient land use can be achieved using density controls, the licensing of development and or occupation, and financial controls, including taxation measures that disincentivise the underuse of land and residential property (Bowie, 2017). These opportunities demonstrate the broader role of regional planning authorities and would require interventions under legislative frameworks other than the Resource Management Act 1991. Directive land-use controls also require careful implementation to avoid negative impacts, such as loss of quality or affordability.

Varied housing typologies do not necessarily equate to housing affordability. Housing affordability, however, may be achieved through varying tenure types and landholding models. Examples include inclusionary zoning jointly with rent-to-buy and shared equity schemes (Fernandez, Hu, Joynt & Martin, 2020; Jacobus, 2019) or leasehold land and community land trusts. Examples of the use of community land trust in Britain and the United States demonstrate improved access to housing and recreational land which benefits well-being in communities (Milligan & Gilmour, 2012; thelandtrust.org.uk, 2017).

In summary, WFUEs include the provision of affordable housing and achieving that requires multiple complementary planning, process and fiscal levers.

3.2.7 Climate adaptation of the built environment

One of the most critical elements to a WFUE is future sustainability in the face of anthropocentric induced climate change (Smith, 2010). Even the acute impacts of the current global pandemic are anticipated to be dwarfed by the effects of climate change (Perkins, Munguia, Ellenbecker, Moure-Eraso, Velazquez, 2020). As a result, climate change is more commonly referred to as a climate crisis (Klinenberg, Araos & Koslov, 2020). Transport, energy, sanitation – and how cities meet the human needs of food, health and equity in infrastructure planning are critical considerations in addressing the climate crisis, particularly as New Zealand has the sixth-highest per capita greenhouse gas emissions in the OECD (Hoicka, & MacArthur, 2017). The built form we create and adapt now will, by and large, remain the same in the future, making decisions about urban development critical to future resilience (Bishop, 2017).

The development of WFUEs contributes to two roles in connection with the climate crisis. The first is to meet obligations under the Paris Agreement to limit global warming to within 1.5 degrees of pre-industrial levels and reduce net emission of all greenhouse

gases[4] to net zero emissions by 2050 (Climate Change Response (Zero Carbon) Amendment Act 2019). The second is to adapt the built and social environment to offset the worst of the projected impacts of increased extreme weather events, food insecurity and resource reduction.

3.2.8 Mitigating climate change

At the city level, transport, land-use and energy systems are closely connected to climate change impacts, making strategies that improve efficiencies in these domains a priority. One of the most significant impacts on mitigating emissions is making work opportunities accessible by public and active transport modes. Research has demonstrated that creating the opportunity for a modal shift away from private transport to employment locations can reduce energy use more significantly than by building the workplace to modern energy codes (Howden-Chapman, et al., 2017). Transport modal shift is particularly important in New Zealand as transport energy dominates the greenhouse gas emissions profile. Therefore, transport related emission reductions offer one of the most significant opportunities to limit climate change emissions (disregarding the highest emitter, agriculture) [5].

To maximise the impacts of accessible public transport systems, the provision of medium to high-density housing should be co-located with public transport (Howden-Chapman, et al., 2017). The transport network also needs to connect multiple locations, not just a residential area, to the central business district. Understanding a community's access needs and creating non-linear journey options connecting numerous employment and amenity locations, can make a much more significant impact on transport energy emissions whilst addressing social and gender inequalities (Subeh, 2019).

3.2.8.1 Net zero-carbon design and energy generation

Supporting passive architectural solutions in a new development can reduce the built environment impact on the climate crisis (Council on Tall Buildings and Urban Habitat, 2017). Quick wins for energy efficiency include using smart building design, such as orientating buildings to capture passive gains of air flow and light, maintaining ventilation in buildings, and reducing the need for artificial lighting, mechanical cooling, or heating solutions (Eley, 2016). A zero-net energy (ZNE) building uses no more

[4] Except biogenic methane which will be kept to 24-47 per cent below 2017 levels by 2050, including to 10 per cent below 2017 levels by 2030 (Climate Change Response (Zero Carbon) Amendment Act 2019)

[5] Transport energy contributes 17.3 Mt CO_2-e in emissions in New Zealand in 2020 (Ministry for the Environment (MfE), 2020)

energy annually than it produces (Eley, 2016:4). Using innovative design, low carbon construction material use, and insulation can improve a building's impact on emissions. Low carbon construction material use can also produce co-benefits of improved air quality, improved thermal comfort and drier, healthier environments that reduce physical health effects and improve overall mental well-being (Bennett et al., 2014, Council on Tall Buildings and Urban Habitat, 2017). The densification of housing in cities also impacts positively on domestic energy use (Howden-Chapman, et al., 2017).

Stationary energy use (domestic and commercial) accounted for 16 Mt CO_2-e in emissions in New Zealand in 2020, which is considerably less than that produced by transportation energy emissions (Ministry for the Environment (MfE)), 2020). Despite stationary energy use contributing less than transportation energy emissions, a reduction in stationary energy can still positively contribute to the overall objectives of the Climate Change Response (Zero Carbon) Amendment Act 2019. Options for domestic energy use reduction include improvements in thermal performance and energy use within buildings through insulation and low-energy fittings for water heating and light (Bambrick et al., 2011; Caputo, 2012).

Renewable home energy generation in the city context is primarily limited to solar thermal for water heating and photovoltaic for power generation. Solar systems can be complex to establish for apartment buildings or buildings with small footprints, i.e., townhouses, or where covenants restrict height limits (Caputo, 2012). A less commonly used solar solution is local community renewable-energy options, where residents can buy part shares in an off-site solar energy system (Eley, 2016). Within this model, a building owner achieves ZNE by purchasing the equivalent power generation capacity, removing the complexities of building individual systems. This model can also open solar energy generation to non-homeowners or space-restricted owners. The model is contingent on partnerships between developers and utility providers (Caputo, 2012; Eley, 2016).

Long-life, loose fit is also an adaptive measure that improves buildings overall energy performance by designing buildings beyond the needs of the first occupant. Long-life, loose fit buildings are easily reconfigured to alternate uses reducing embodied energy required to demolish, dispose and replace existing buildings (Eley, 2016). Adaptive structures in the residential context can also improve social outcomes by creating opportunities for residents to age in place or accommodate multiple generations or co-living arrangements (Williamson, 2015). Scenario analysis at the programming phase can assist in anticipation of changes in technology, regulations, and economic competition, which can affect future building use (Eley, 2016).

ZNE may be achieved at the district level, particularly where several buildings are associated on a campus or within a locality with a common owner. For example, schools within a district with some capacity for power generation could share a virtual meter across sites. Schools with lower capacity for power generation could share with schools that create a surplus. This model may also be used across mixed-use developments with shops, restaurants, and residential dwellings across a wider community area (Eley, 2016).

Community/ district heating and cooling systems are another tool to minimise domestic and commercial power demands (Hoicka and Macarthur 2018; Werner, 2017). District heating and cooling systems can utilise the latent capacity of combined heat and power systems, waste to energy plants and industrial processes, or use renewable sources such as geothermal wells, solar collector, and biomass fuels (Werner, 2017; Caputo et al., 2012). Examples of district heating are available in New Zealand, particularly within geothermal energy source access (New Zealand Geothermal Association, 2021). The Pita Te Hori District Energy Scheme, Christchurch, is New Zealand's first purpose-built district energy scheme that utilises a ground-source heat pump solution and redistributes waste heat and cold from adjacent buildings across a development precinct (Aurecon, 2021). In creating new WFUEs, the potential for connecting systems and utilising latent heat and power in a district system is currently underutilised. It offers potential for reducing climate emissions.

3.2.8.2 Climate adapted buildings, neighbourhoods and infrastructure.

Despite global commitments under the Paris Agreement to limit global warming to 1.5 degrees above pre-industrial levels by 2050, global carbon emissions' adverse effects are already measurable. The 2018 Intergovernmental Panel on Climate Change (IPCC) report concluded that human-induced warming reached approximately 1°C (likely between 0.8°C and 1.2°C) above pre-industrial levels in 2017 and is projected (with high confidence) to increase at 0.2°C (likely between 0.1°C and 0.3°C) per decade (Masson-Delmotte, et al., 2018). This locked-in warming means that some impact of climate change is inevitable. However, the severity of the future effects will be contingent on the success of global mitigation strategies.

In New Zealand, NIWA used projections from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report to model the likely climatic impacts at the national and regional scale under four representative concentration pathways (RCPs). Commonly identified key risks under all RCPs are heat exposure, flooding and drought due to projected changes in temperature and precipitation regimes. Other accepted hazards include emerging diseases, threats to nature, water supplies for people and farming, and food price spikes (Pearce et al., 2018).

As New Zealand will inevitably feel the effects of global warming, adaptation is a critical component of the climate crisis response (Rouse, et al., 2017). Adaptation requires two main elements, reduction in hazard exposure and vulnerability reduction (Agard, et al., (eds) 2014; Joynt & Golubiewski, 2019). The physical adaptation options available for the built environment to reduce exposure to hazard are detailed in this section. Reducing vulnerability through increasing adaptive capacity and reducing the population's sensitivity are captured in more detail in the social section below. This approach is reductive and does not exhaustively illustrate the interdependence of the built, social, cultural, and environmental spheres.

3.2.8.3 Flood risk and resilience

Increased intensity and frequency of precipitation and flooding associated with static sea-level rise and increased storm surges are projected to be the most significant climatic risks to Auckland (Pearce, et al., 2018). Erosion of land is also anticipated to increase under climate change conditions impacting coastal and estuarine areas (Rouse, et al., 2017; Roberts, Carpenter, & Klinac, 2020). The most effective means of reducing exposure to flooding hazard and erosion is avoiding building in hazardous areas such as flood plains and flood-prone areas or areas subject to land erosion (Cabannes & Marocchino, 2019). Adaptation options for existing settlements include protecting, accommodating, or retreating from the hazard (Rouse, et al., 2017; Dieperink et al., 2018). All these potential solutions require a multilevel governance strategy as well as the presence of institutionalised mechanisms for learning (e.g., learning-action alliances, strong knowledge institutes) and evidence of the capability of (local) actors to adopt new flexible policies (Dieperink, et al., 2018). Finally, flood resilience requires the complete understanding of risk by communities (Rouse, et al., 2017). To engage effectively, skilled flood resilience managers are needed to organise engagement in a mutual learning environment so that those affected are 'kept at the table' and remain interested in finding a solution that increases resilience (Dieperink, et al., 2018).

Protect strategies assume stationarity of climate, which may leave communities at higher risk of climate change as hazard impacts worsen. Thus, accommodation or retreat solutions are more appropriate to address multiple potential emission pathway outcomes (Rouse, et al., 2017). Accommodation strategies in the built environment include physical adaptation options for infrastructure, buildings and neighbourhoods to withstand flood risk exposure. These include barriers to protect against water ingress and careful configuration of buildings to ensure non-habitable, low sensitivity purposes are located on ground floors.

Other options to prevent water ingress can be implemented at the neighbourhood scale and can include the use of water-sensitive designs (e.g., swales), providing space for water, redirecting floodwater through overflows onto playing fields, and reed beds to slow flood water into stormwater systems (Dieperink, et al., 2018; Chandra et al., 2016). A co-benefit of this type of integrated design and master planning is the enhancement and protection of green spaces and associated ecosystem services, cumulative flood risk protection, and the adoption of macro approaches to resilience (Afeworki, Judson, Ndoko & Teferra., 2017 Bach and Loibl, 2016; Everett, Lawson & Lamond, 2015).

Green roof installation on buildings can also slow the transmission of water through the urban system. As a last resort and more reactive option, temporary physical flood barriers can be erected during flood events at the neighbourhood scale (Afeworki, et al., 2017; Cvejić et al., 2015; Williams et al., 2012).

In summary, flood resilience requires an understanding of exposure to hazard, likely impact both economic, physical and social and coordinated multilevel governance adaptation strategies (Diepernick, et al., 2018).

3.2.8.4 Heat risk and community resilience

Heatwaves (or excess hot days) are anticipated to intensify due to the climate crisis (Pearce, et al., 2018). Urban areas are significantly impacted by increasing hot days due to the underlying existence of the urban heat island effect[6] (Oke, 1973). Projections by NIWA using four potential RCPs in the Auckland region indicate that under RCP 8.5, equivalent to a business-as-usual scenario, hot days (consecutive days where the daily maximum temperature exceeds 25 degrees Celsius), will increase by between 10-15 days by the year 2040, rising to 90 extra hot days by 2110 (Pearce, et al., 2018). Essentially, Aucklanders will be exposed to three months of extra hot days, which will considerably elevate the risk of heat-related morbidity and mortality (Joynt & Golbiewski, 2019; Pearce, et al., 2018; Royal Society/Te Apārangi, 2017).

Examples of adaptations to minimise heat risk include, social interventions, such as early warning and vulnerable community buddy systems, addressing underlying health and socio-economic factors associated with heightened sensitivity to heat hazard, as well as interventions such as community cool spaces – e.g. libraries or community

[6] The urban heat island effect is caused by the release (and reflection) of heat from industrial and domestic buildings; the daytime absorption and night-time release of heat by hard surfaces, such as concrete, tarmac; transport related hygroscopic pollutants, relative absence of water and green space for evapotranspiration related cooling and wind blocking (Smith, 2010).

centres opened and cooled for people to seek refuge from the heat (Joynt & Golbiewski, 2019). Neighbourhood scale actions include protection and increase of green infrastructure to offset urban heat island effects and provide shade and shelter in public spaces (Bentley, 2015; de Oliveira & Ward Thompson, 2015). Potential built environment adaptations at the neighbourhood scale include integrating community district cooling infrastructure into developments (Joynt & Golbiewski, 2019; Williams et al., 2012). For residential housing, the best building adaptations utilise passive ventilation, and the prevention of heat build up, through building orientation, window shading, all weather canopies, thermal insulation and light building colour use (Williams, et al., 2012).

As with all elements of creating a WFUE, locally negotiated resolutions are the most effective, particularly where significant support and understanding of the potential risks need to be communicated (Rouse et al., 2017, Williams, et al., 2012). Furthermore, interventions that do not require occupant behaviour change or additional cost are preferable (Klinenberg, 2018).

3.2.9 Critical infrastructure

Due to the complex inter-relational characteristics of transport infrastructure, extreme weather events pose significant risks for city functionality (Forero-Ortiz, Martínez-Gomariz, Cañas Porcuna, Locatelli, & Russo, 2020, Ministry for the Environment (MfE), 2017, New Zealand Lifelines Council, 2020). New infrastructure development requires resilient design integration to anticipate very different climatic conditions than that of present. Particularly as transport infrastructure has a substantial lifespan, and once implemented, rarely gets changed significantly (Blashki, et al., 2011)

To design resilient transport, long-range RCP projections which closely align with current policy and global emissions projections should be adopted. For existing transport infrastructure, adaptations can include expanding alternative access or modal options, thus reducing the impact of disruption should discreet parts of the network be compromised by flooding, excess heat or other extreme weather impacts (Blashki et al., 2011).

Secure electric vehicle charging infrastructure and shared vehicle options should be planned into new developments to pre-empt a shift away from internal combustion vehicles. The move to electric and hybrid vehicles is anticipated to grow exponentially, with many countries and car manufacturers signalling the phasing out of new non-electric vehicles by 2040 (The Climate Centre, 2021). An increase in demand for charging infrastructure will occur in tandem with increasing density, potentially limiting the practical installation of accessible charging facilities.

The same resilience principles of providing excess backup capacity through localised distribution networks and alternative generation sources apply for utilities (electric, telecommunications). In Auckland, the effects of flooding and extreme winds currently impact power outages, primarily at the local distribution level and this is anticipated to intensify due to climate change (New Zealand Lifelines Council, 2020). The creation of new district-scale developments allows for building in climate resilience measures, such as underground power networks. Notably, retrofitting resilience in existing neighbourhoods is much more challenging and would require significant investment to achieve (Keall, 2018).

3.2.9.1 Three waters infrastructure

Water is the final piece of critical lifeline infrastructure for a city. Collectively referred to as ‘three waters’, a city's water system is made up of the potable water supply, wastewater management, and stormwater management system. Which concurrently provide both source and receiving environment for a range of users and uses (Johannessen & Wamsler, 2017). Although intrinsically connected, three waters are often managed under separate regimes, which at times can result in negative outcomes for health, well-being, and the environment (Johannessen & Wamsler, 2017).

All three parts of the water system will be under stress and require adopting resilience measures because of both urban growth and climate change. Increasing drought will pressure the quantity of water going into the supply system, whilst population growth will increase demand for potable and wastewater management. As urban areas grow, so too will the demand on the stormwater system. The removal of greenspace for urban development will impact the speed of water transmission through the city network following rainfall. This disruption of water transmissions through the urban environment will be compounded by the projected increase in frequency and intensity of rain because of climate change.

Adaptive resilience strategies for water at the home, neighbourhood, and community level, include retrofit of existing potable water supplies to reduce leakage. Improving capacity, capture and retention of water through smaller scale tank systems which offer the opportunity to reduce dependency on reservoir supplies. Protection of water supply may also be enhanced through the integration of designs that induce behavioural change, such as low flow showerheads, water meters and costing water to greater reflect its value (Levin & Muehleisen, 2016). Finally, capture and retention of water using tanks at the neighbourhood and building scale can create a water source for non-potable uses such as watering gardens.

Adaptive resilience options for stormwater include retaining and expanding green infrastructure, including green roofs, to slow water transmission through the system water-sensitive designs (WSD). WSD promote land-use planning practices that conserve water use and protect receiving environments from environmental degradation. WSD is an inter-disciplinary design approach, which considers stormwater management in parallel with the ecology of a site, best practice urban design, and community values (Grafakos et al. 2019; Green, 2016; Haaland & Konijnendijk van den Bosch, 2015; Jones & Somper, 2014; Kabisch, 2015; Newman, 2013; Lewis et al., 2015; Raskin, 2015).

As well as the prevention of pluvial flood risk, the use of green infrastructure and WSD also protect receiving water bodies from pollutant runoff (Williams et al., 2012; Everett, Lawson & Lamond, 2015). Reducing the impact on receiving environments is also crucial to the cultural value of water to Māori (The New Zealand Conservation Authority, 2011).

Despite the clear need for resilience planning, there is no nationally consistent standard for the resilience of critical infrastructure. This is compounded by the multisectoral nature of infrastructure provision administered under a range of different Ministries (New Zealand Lifelines Council, 2020). Addressing these inconsistencies may enable the preparation of infrastructure to withstand climate change without compromising the functionality of the urban environment

3.2.10 Waste management

Waste management is an integral part of creating a WFUE. As populations grow, so too does the waste burden on a developing city. Many regions worldwide are setting zero waste targets, and Auckland has also set out this objective in the Auckland Waste Minimisation Plan (Auckland Council, 2018b). The waste generated in Auckland is equivalent to one tonne per Aucklander per year (Auckland Council, 2018b). Consideration of how additional capacity can be achieved requires consideration for the whole waste management system. Particularly due to the limitations on space for urban landfill and the vulnerability of landfill sites to climate change impacts (Simonson & Hall, 2019) and, more broadly, the need to reduce resource depletion (Ministry for the Environment, (MfE) 2019).

In the built environment, waste is generated both through the occupation of buildings and the development of buildings. The construction demolition sector contributes considerable waste to the system, accounting for 40 per cent of overall waste sent to landfill in Auckland (Rohani, Huang, Hoffman, Roberts, & Ribeiro, 2019). Retrofitting suburbia towards sustainable urbanism creates a more resilient city than continued

outward growth (Williamson, 2015). In particular, the re-use and repurposing of existing buildings provide an opportunity to optimise land use and minimise waste.

Opportunities for waste minimisation are available in brownfield development and intensification. Brownfield redevelopment often requires the generation of significant demolition waste. For example, a case study undertaken on replacing 7000 homes with 22,000 new homes for Kāinga Ora (formerly Housing New Zealand) was expected to generate 212,000 tonnes of demolition waste (Rohani et al., 2019).

Circular economies and the reclamation of demolition waste are increasingly seen to minimise waste and reduce carbon emissions, particularly for the construction sector. Much of the waste from the construction sector can be recycled or, in the case of rubble and concrete, be reused for use in infrastructure projects (Auckland Council, 2018b).

Aligning the objectives of the NPS-UD with the Auckland Waste Minimisation Plan (Auckland, 2018) will contribute significantly to meeting the goal of zero waste in Auckland and aligning with the Auckland Climate Action Plan and the Carbon Zero Act whilst providing WFUEs for the population.

3.2.11 Summary

To summarise, the built environment, inclusive of the residential and commercial buildings and the public realm, needs to reflect society's varied needs. These needs are best understood by engaging a representative cross-section of society in meaningful participatory planning and placemaking. Recognition of the needs of minority groups and those socially excluded from everyday city life means considering the needs of the ‘non-average citizen’. The non-average citizen can achieve a fairer and more universally accessible built environment through informed design approaches focussing on existing barriers and inequalities experienced by different gender, age, ethnicity, and income groups.

Provision of amenities needs to reflect the need profile of the community in a context of high density, human-scale buildings, mixed housing uses that generate vibrancy and visual interest. Improved accessibility is also required, created with a range of housing choices (typology and tenure), within proximity to education, health and employment opportunities, whilst permeable and legible, streetscapes should reflect the needs of multiple varied citizens. In summary, access to amenities should not be contingent on wealth, physical health, gender, sexuality, age or ethnicity.

The use of adaptive building designs, known as long-life loose-fit, will help easy reconfiguration of use, allowing citizens to age in place or accommodate variations in household composition and cultural and social norms. Diversity and inclusivity in both the public realm and buildings can be achieved by adopting universal design principles.

The built environment and transportation network need to reflect the context of the climate crisis, which will increase the intensity and frequency of hazardous extreme weather events. Building and the public realm more broadly, as well as infrastructure, require resilient design features. Localised power generation and dynamic multi-dimensional public transport systems can reduce systemic hazard vulnerability. Whilst adoption of climate-sensitive building designs and avoidance of development in hazardous locations will minimise the impacts of climate hazards.

Finally, as New Zealand is one of the most urbanised countries in the world, with 86.7 per cent of the population living in urban areas, waste management is a critical issue for the functionality of the urban system (Te Tari Taiwhenua | Department of Internal Affairs, 2019). Maximising waste minimisation efforts and integrating circular waste infrastructure into the design of cities helps recycled materials use and use of new construction materials efficiently, reducing the amount of waste diverted to landfills.

3.3 The ‘social’ urban environment

A city's social environment's success is arguably the most critical element of a WFUE (Bambrick et al., 2011). To thrive, individuals and communities need a sense of belonging and opportunities to participate in an inclusive environment with opportunities to live, work, connect, and grow. The physical built environment affects the social environment by providing formal and informal spaces within and between the urban fabric where social interactions can occur, improving the quality of life for communities (Bijl, 2011). There are two main elements to the social city, the social infrastructure (the physical, tangible buildings and spaces) and the social capital (the intangible aspects of societal cohesion, support and resilience generated when communities connect).

3.3.1 Social infrastructure

Social infrastructure (SI) is the tangible spaces and places that facilitate social interaction. SI can take the form of permanent purpose-built single occupant settings, such as churches, marae, schools, and early childhood centres to multiple purpose spaces such as libraries, community and sports centres through to more informal areas such as streets, parks, pocket parks, playgrounds, squares, plazas, swimming pools, skate parks, playing fields and community gardens. Even some commercial spaces that create an opportunity to linger and have informal conversations are SI, such as cafes, pubs, markets and laundrettes (Latham & Layton, 2019). Therefore, SI often has a primary function, such as schools educating children, but it creates a secondary role of being a unifying hub from which communities can grow, offering opportunities for hard to quantify outcomes such as fun, joy, hope and sense of place (Derr & Lance, 2012; Latham & Layton, 2020; Howden-Chapman et al., 2017).

Unlike the economic measure of asset value, the value of SI is measured in improved well-being and health outcomes, reduced social isolation, greater tolerance of diversity and the creation of connections across age, race, gender, sexuality and income (Latham & Layton, 2019). Conversely, a decreased sense of community is linked to stress, anxiety and social withdrawal (Waters, 2016). SI improves collectivism, community cohesion and a sense of belonging and increases community resilience through informal support networks, critical in crisis times (Klinenberg, 2018).

Internal and external civic spaces must reflect the local community's needs and desires to be a well-functioning 'social' environment. To meet the requirements of a specific community, creators of these spaces must have a well-grounded understanding of the community they are designing for, their needs and aspirations, and the social landscape within which the community functions (Boyce, 2010).

3.3.1.1 Accessibility and activity

The quality, location and layout of SI influence its use and success (Basso, 2018; Blomkamp & Lewis, 2020, Davoudi & Brooks, 2016). Public spaces that fail to reflect diverse needs can decline, diminishing the social benefit they serve. For example, accessible open spaces, with good pedestrian thermal comfort and shelter and designated play areas which are well maintained and surrounded by actively used buildings provide passive surveillance. Good quality open space can attract children, adolescents, and their caregivers to socialise and participate in sports, recreation, and play (Derr, & Lance, 2012; Whitzman, 2010). Whilst careful placement of street furniture such as seating and rest spaces and easy access to public toilets can open the same area for older, less mobile or disabled groups (Davoudi & Brooks, 2016). Should the same civic space be poorly maintained or contain areas concealed from public view, they are less likely to feel safe for use and may attract anti-social behaviour (Cardia, 2013; Lopston, Muhajarine & Ridalls, 2012; Whitzman, 2010).

As well as a purpose-built area for recreation, consideration should be given to the use of less formal areas to encourage play and entertainment. For example, the pedestrianisation of streets and parking space removal can create safe play areas for children in proximity to their homes (Lopston, et al., 2012, Whitzman, 2010). A site considered safe for children to play may also attract the elderly, provided consideration is given to adequate seating and shade provision. The use of semi-private spaces outside properties, such as reserves between houses and shared courtyards, can create social interaction opportunities and a place where community activities occur, such as communal BBQs and street parties (Whitzman, 2010). Care is required when pedestrians are prioritised in street layouts to retain access for those with limited mobility through the provision of disability parking spaces.

Play and socialising opportunities can also be lost when residents park on reserves and block laneways with private vehicles due to parking provision removal. In some instances, consideration of alternative 'secure' parking may be required rather than reduction.

3.3.1.2 Public transport access

Access to public transport options close to developments can result in a modal shift; this, however, is contingent on the target community having a viable transport alternative to access work and education facilities (Barton & Grant, 2013). For example, in households with children where a school is located far from residential housing without a safe active or public transport option, the removal of parking is unlikely to result in a modal shift away from private vehicle use (Reid, Jennings &

Butler, 2019; Boyce, 2010). Likewise, where residents do not have viable public transportation options to get to work, either due to the location of their employment or due to the times they work (i.e., shift work or multiple part-time jobs in various places). The removal of parking spaces will not result in a modal shift. Instead, removing parking spaces may create a greater risk of accidents and reduce safe places to socialise (Reid, et al., 2019; Boyce, 2010).

Equitable access to transport is constrained by the prevalence of lower cost housing in areas with poor public transportation access (Mattingly & Morrisey, 2014). Research undertaken by Mattingly & Morrisey (2014), demonstrated socio-spatial patterns of transportation equity in Auckland. Their research evaluated mean annual commuter variable costs across the region indicating that areas of greatest social deprivation had relatively high transportation costs, when compared to more economically affluent suburbs in closer proximity to the central business district. In larger families where there may be the need for multiple vehicles, the fixed costs of owning a vehicle are increased. Therefore, for households with multiple occupants, the need to locate at the city fringes to find appropriately sized housing may exacerbate overall housing affordability due to higher transportation costs.

3.3.1.3 Urban agriculture as social infrastructure; food security, social justice and resilience

Despite Jane Jacobs' (1961) assertion that 'communities cannot be created, only destroyed', social cohesion and networks can be nurtured with the right conditions of good social infrastructure. One area that is increasingly identified as an opportunity to unite and empower communities and increase resilience and address social equity issues is around food access. Indeed, access to nutritional food is arguably as important as access to any other form of critical infrastructure.

Prompted by food security issues and environmental sustainability 'eat local' movements, and urban food production has seen a growing trend (Pfeiffer, Harrington, Rhodes, & Silverman, 2017). Urban food production is undertaken either in ad-hoc use of potted gardens in small urban back yards and balconies, hydroponics or through more organised community gardens, school garden to table projects and city farms (Cvejić, et al., 2015; Monroe, Wals, Kobori, & Ekne; 2017; Pfeiffer, et al., 2017; Pevec, Shava, Nzira. & Barnett, 2010). There is also a 'guerrilla gardening' movement that denounces the waste of civic space that can be used to grow food, with these movements often taking over latent spaces alongside infrastructures such as roads and railways or in the unutilised spaces between civic and private buildings (Barthel, Parker & Ernstson, 2015).

Urban agriculture serves several purposes. The growth of food in the latent spaces within the urban landscape create ecosystems to support biodiversity (Andersson, et al., 2014; Barthel, Parker & Ernstson, 2015; Cvejić, et al., 2015). Although the central goal of edible urban landscapes usually has broader societal objectives (Robinson & Farmer, 2017). These include reducing vulnerability to food shortages in times of crisis (Bambrick, et al., 2011; Barthel, Parker & Ernstson, 2015; Pfeiffer, et al., 2017), providing access to nutritious, affordable food supplies and presenting an opportunity to connect communities and build social capital (Pevec, et al., 2010; Pfeiffer, et al., 2017).

Despite New Zealand being considered well placed to withstand decreasing global food security demise (Fyfe, 2020), there is evidence that economic deprivation in specific sectors of society leads to food insecurity at the household level. One in five children in New Zealand is reported not to have enough to eat or a sufficiently healthy or varied diet (Ministry of Health, 2019).

Urban agriculture projects increase access to fresh fruit and vegetables, which is generally deficient in food-insecure households. Education is also a benefit of urban agriculture by teaching cooking skills, improving economic access, youth engagement and empowering people and communities (Barthel, Parker & Ernstson, 2015; Pfiefer, et al., 2017). Food security is a matter of social justice; disparities in society can be addressed by enabling food production in urban green areas to bridge the gaps in food security caused by social deprivation and provide education and skill acquisition opportunities (Barthel, Parker & Ernstson, 2015; Barton & Grant, 2013; Basso, 2018).

The inclusion of urban agriculture as an incremental element of WFUE policies and plans is not mandated. However, recognising and enabling urban agriculture through urban food planning creates a new perspective on social sustainability and an opportunity to rediscover the value of public spaces in cities for reactivation and regeneration (Basso, 2018).

As well as addressing health inequalities, local urban agriculture projects create and strengthen active, rather than passive, welfare networks in marginalised communities, creating welfare infrastructure and mutual support networks and improving overall well-being (Barton & Grant, 2013; Basso, 2018).

Interest in integrated food systems in urban design is increasing globally. Carrot City, based in Canada, is a web-based resource that collates a database of hundreds of practical examples of urban agriculture projects integrated into the urban form. From small planter boxes within urban squares to much grander scale innovations. One such

example is a new residential building in Toronto, '60 Richmond Street'[7], that integrates a productive garden into a residential apartment block. The design uses vertical and horizontal voids on the sixth floor to create a space for the garden, with setbacks capturing daylight for the garden and natural lighting and ventilation for the apartments. Water for irrigation is captured in a rooftop stormwater runoff, and the green roof also reduces the heat island effect (Carrot City, 2014). The design serves the function of providing food to the restaurant business on the ground floor and creates a space for social interaction for the apartment occupants. This type of innovative design is rarely led by generic profit-driven developers.

Prioritising the integration of food production systems within the urban landscape requires raising the expectation on developers to produce designs that meet aspirational social and environmental objectives instead of a plan that meets the minimum necessary to offset negative externalities.

This shift will only come from a directive push from local authorities to establish food as a planning issue (Borelli, 2018), or more explicitly a critical infrastructure issue. Experiences in Portland, Oregon, illustrate a successful approach to creating food as a planning issue. In the Portland example it is achieved through the careful control of the urban growth boundary implemented to contain sprawl and retain access to food systems. Additionally, the development of the Portland plan food system aids access and education to urban agriculture. The food plan includes an interactive heat map detailing the locations of community gardens, restaurants, grocery stores to illustrate both the existence and dearth of food systems across the city. Urban food zoning codes are developed from these two planning tools that dictate information on the production, consumption, and distribution of food. The urban food zones help shape future interventions and prevent the development of housing areas in 'food desserts' [8] (Borelli, 2018).

At the rural-urban boundary, continued food security is contingent on the availability of the crucial resources: a viable urban ecosystem with sufficient land for cultivation and practical knowledge of how to grow food (Barthel, Parker, & Ernstson 2015). All of which need continued protection to provide meaningful food security (Borrelli, 2018). Land competition from accelerating property prices and the loss of agricultural areas near cities for other purposes may jeopardise food security in the coming decades (Barthel, Parker, & Ernstson, 2015).

[7] https://www.ryerson.ca/carrotcity/board_pages/housing/60_richmond.html

[8] Food desserts are areas without access to healthy, diverse food options, either due to cost or accessibility constraints such as transport access.

Creating or allowing public spaces to host farmers markets is another means of creating food-based social infrastructure. Hobsonville Point in Auckland demonstrated this with great success as the farmers market was established in a centrally located civic space prior to the final completion of the development. The market created a sense of vibrancy and a social hub and point of attraction for the immediate and surrounding communities. By integrating food as a tool for community cohesion from the outset of the development, Hobsonville created a sense of place and social connectivity, which has seen the area thrive (Howden-Chapman, et al., 2017).

Opportunities for agriculture in the urban landscape can be promoted using local regulatory policies which overtly support urban agriculture. Identifying community growing spaces in neighbourhood designs helps enable the establishment of community cooperatives that serve multiple health, environment and social goals (Barthel, Parker, & Ernstson, 2015). Basso (2018) noted that the establishment of food spaces in design constructs a complex urban welfare infrastructure.

Less popular in New Zealand, allotments have been used in Europe for generations of gardeners to grow food near home in small patches of rented land (Johnston, 2017; Marot, Golobič & Müller, 2015). As gardens have become smaller or non-existent for apartment dwellers in urban areas in the United Kingdom, allotment popularity has soared (The National Allotment Society, 2021). With city councils reporting long waiting lists of people keen to secure a slot (Smithers, 2020). Integration of allotments into urban design and regeneration can offer a solution to access to food growing opportunities in the compact city (Williams, Joynt & Hopkins, 2010).

More simple policy examples for food in the urban landscape include those that encourage the use of roadside berms for alternative flora than grass. There is some contention around the use of roadside berms for food production based on international literature (Mok, et al. 2013; Säumel, et al., 2012). However, in light of the nutritional deficit in some communities in New Zealand, the opportunity to explore this food growing potential should be explored and potentially allowed with careful controls to limit risks. Creating a blanket ban on roadside food production based on international literature is potentially overly cautious. Particularly in the suburban local neighbourhood contexts, where traffic flows are lighter. Furthermore, the level of risk posed by growing informal edibles adjacent to local roads, relative to industrial agriculture adjacent to main state highways, common in the food growing areas of South Auckland, also needs to be evaluated to determine relative risk.

In civic spaces such as parks, encouragement of edible planting schemes over ornamental can utilise latent food growing capacity. However, this approach is not without challenge, as urban green space is a valuable public commodity subject to

competing interests from powerful interest groups. Urban agriculture can be highly politicised, which can mean new governance measures may need to be developed to enhance its capacity (Barthel, Parker, & Ernstson 2015).

The final element of including urban agriculture as an element of WFUEs is its role in resilience to climate change. Both urban agriculture and the associated urban social movements build local ecological and social response capacity against climate change-induced disruption of food supplies (Barthel, Parker, & Ernstson, 2015). As noted, the impacts of climate change on New Zealand are projected to include increasing drought, more prolonged, hotter summers, more severe and intense winter rainfall with associated flooding and storm surges and the introduction of invasive species (Pearce, et al., 2018). Each of these risks will have a role in the food security and availability of staple food products in New Zealand. As well as being a large producer of food, New Zealand also imports significant amounts of food from overseas, the supply of which could be disrupted due to changing climatic conditions around the world. Therefore, increasing local resilience to climate change through the inclusion of alternative food sources can enhance community resilience (Basso, 2018). Urban agriculture can also be an economic tool. It is linked to the social and economic innovation pathways of ‘zero km’ food production and provides the opportunity for sale networks that involve citizens, non-profit organisations, social cooperatives and public and private subjects (Basso, 2018).

3.3.1.4 Funding and planning of social infrastructure

Funding and phasing of SI are essential for the improvement of quality of life. Despite this, the provision of SI is outside of the scope of New Zealand’s foundational planning document, the Resource Management Act 1991 (RMA) which confines provision requirements to utilities and transport infrastructure. SI is addressed explicitly in the NPS-UD under additional infrastructure; however, this does not detail a specific definition or requirements for the sequencing of SI in a development project.

Early implementation of SI in development is important as communities start to establish connections and habits when they first move into an area. Both Hobsonville and Waimahia (new housing developments in Auckland) had social infrastructures, such as primary schools and community centres, alongside housing and hard infrastructure development from the outset of the development’s establishment. Consequently, both areas have demonstrably connected communities with residents engaged in community projects, active in residents’ associations and reporting high satisfaction with their neighbourhood (Howden-Chapman, et al., 2017).

Kāinga Ora (formerly Housing New Zealand) are undertaking significant regeneration and development work across Aotearoa. The importance of the social infrastructure for residents is acknowledged in a series of design guidance. The guidance topics include Living with Children at Density (Kāinga Ora, 2018), which details how the needs of various age groups from 0-18 years old can be accommodated within the development to enhance play, social interaction and well-being, both within the home and in the surrounding community. Whilst, The Built Environment guidance (Kāinga Ora, 2021), details measures to reach targetted outcomes such as uptake of active transport and public transport use.

Requiring developers to implement SI early can be difficult for several reasons; new urban areas are often designed in a more piecemeal rather than a master-planned way, such as Waimahia and Hobsonville. Or barriers can be created by a lack of coordination between, for example, the Ministry of Education, healthcare providers and private developers. Consequently, SI can either be implemented much later in a community's establishment or may not reflect the needs of the community it serves (Bowie, 2017).

Effective implementation requires incorporating local knowledge through using community groups, locally elected councillors, and local boards to ensure SI is appropriate to the community it will serve. (Howden-Chapman, et al., 2017). This enables neighbourhoods that reflect the society in both social and aesthetic components, which symbiotically play an essential role in well-functioning design (García-Doménech, 2015).

Funding of SI is a contentious issue. Although access to good SI is widely acknowledged as beneficial to citizens and developers alike, funding responsibilities is less clearly defined (Bowie, 2017; Howden-Chapman, et al., 2017).

Challenges in implementing adequate SI are not confined to New Zealand; In the United Kingdom, infrastructure levies were introduced as a planning obligation under section 106 of the Town and Country Planning Act 1990. The purpose of the levy was to require developers to provide a proportion of affordable housing products within developments and close to social infrastructure. The fund, however, has been increasingly used to replace public funding for social infrastructure. Consequently, new developments are not resulting in a net gain of SI to support growth, but a replacement of funding source which keeps SI at an existing level (Bowie, 2017). Furthermore, where developers are required to fund affordable housing under their S106 obligations, they can make the case for development of affordable housing in a separate location. These alternative sites are often away from the primary development site used to

optimise access to existing SI and transport infrastructure, meaning affordable housing residents do not have the same access to the essential SI required (Basso, 2018).

Development contributions in New Zealand are like that of S106 contributions, with the purpose of use determined by the local authority. Under the Local Government Act 2002, funding covers ‘reserves, network infrastructure and community infrastructure’ (Auckland Council, 2019). However, there is no requirement under the RMA to provide social infrastructure, but there is to provide network infrastructure. As demand for network infrastructure is widely acknowledged to exceed capacity, network infrastructure tends to be prioritised for funding allocation, much of which is used to catch up with existing demand rather than meeting future requirements (Chitale, 2017).

Ensuring adequate SI may require a new approach to funding. A potential underutilised funding mechanism in New Zealand is private equity investment. There is an untapped opportunity to use the high demand for social infrastructure as an opportunity to expand private institutional investment using consumer price index (CPI) linked concession arrangements as an alternative investment fund option for public-private partnerships. The benefit to investors is long term stable returns, whilst society benefits from social infrastructure funding that does not result in local government rate rises (Inderst, 2020).

3.3.2 Linking social infrastructure and social capital

Good social infrastructure can increase social capital, which is a verifiable outcome of a WFUE. Social capital relies on a rise in collectivism and leads to improved community resilience. Collectivism is a construct in which members of society prioritise the good of a group over personal interest. Collectivism, therefore, reflects greater community cohesion (Hari, 2018). Brewer & Chen (2007:134) define collectivism as prioritising collective identity, emotional dependence, group solidarity, sharing duties and obligations, and needing stable and predetermined friendships, group decisions, and particularism. Based on this description, collectivism as a measure of social capital is a central component of a well-functioning 'social' environment.

In contrast to collectivism, a widely accepted belief in western post-neoliberal society is that individualism is increasing, which manifests in the breakage of social bonds in families and communities (Dodson, 2014). A causal factor in this shift is the destruction and erosion of spaces that make social encounters in urban life possible (Coward, 2017) – compounded by increased mobility and community displacement through gentrification (Joynt & Hoffman, 2021). At a societal level, retention and enhancement of social bonds can reduce social vulnerability and improve resilience against existential issues such as climate change (Klinenberg, 2018; Latham and Layton, 2019).

At an individual level, reduced community cohesion (collectivism) can induce loneliness, stress, and anxiety, commonly associated with deleterious health outcomes (Hari, 2018; Klinenberg, 2016; 2018). A practical action to protect community cohesion caused by gentrification and counter community dispersion is to provide affordable housing with affordable access to employment opportunities (Etzoni, 1968, cited in Brewer & Chen, 2007). The ‘affordable’ element of access to employment is a critical determinant of household financial security and consequent tenure stability. As detailed in research undertaken by Mattingley & Morrisey (2014), when housing affordability calculations consider transportation costs, many of Auckland’s seemingly more affordable areas have significant transportation cost burdens associated with living in them.

3.3.2.1 Defining and measuring social capital

Social capital is the intangible strength, cohesiveness and well-being of a community. Te Tai ōhanga/The Treasury (2020:1) stated that there are no universally agreed definitions of well-being and social capital but that this did not necessarily create a problem. The definition accepted by Te Tai ōhanga/ The Treasury is that 'social capital refers to the social connections, attitudes and norms that contribute to societal well-being by promoting coordination and collaboration between people and groups in society' (Te Tai ōhanga/ The Treasury 2018:2).

Social capital, although mentioned or implied sporadically over the 19th and 20th century (Jacobs, 1961; Manning, 2015), only began to emerge as a research area from the 1980s onwards Manning (2015), Bourdieu (1980), Coleman (1987), Putnam (1993), Fukuyama (2001) and Lin (2001) are widely accepted as seminal thinkers in the field of social capital. Still, they do not share a single definition for the term. Neither did they share a belief in whether social capital has a negative or beneficial impact. For example; Bourdieu held a negative perception of social capital, seeing it as a tool for social stratification, and describing social capital as an asset used by the rich to further their own networks whilst excluding those of other socio-demographic profiles (Bourdieu 1985: 243 in Castiglione, Van Deth & Wolleb, (2008).

Bourdieu's definition aligns with a view of an 'old boys’ network where the nepotistic actions of those in positions of power benefit only a small, privileged section of society. Coleman, on the other hand, describes social capital as reflecting social norms throughout society. Noting that social capital is not static and can be lost as communities become less 'mutually dependant', as affluence grows through government aid or some other factor that removes the dependency on the soft infrastructure of social capital (Manning, 2015).

Coleman introduced a broader understanding of social capital that benefitted more than just the privileged and could be accessed by all actors, including 'individuals, collectives, privileged and disadvantaged' (Manning, 2015).

Putnam introduced the more widely known explanation of social capital as: 'Networks and the associated norms of reciprocity which have value (Putnam, 1993; Putnam, 2001). Putnam's definition was further built upon by Fukuyama, who saw the validity of norms, values and morality across a network: 'Social capital is an instantiated informal norm that promotes co-operation between individuals' (Fukuyama, 2001).

Lin's contribution to the discourse was more critical of the conceptualisations noting that 'social capital is defined by its functions' (Lin, 2001:26). According to Lin the fact that social capital is both a means and an end introduces a 'tautology', whereby the 'potential causal explanation of social capital can only be captured by its effects' (Lin, (2001:28) in Manning (2015).

Social capital is therefore developed in formal and informal networks based on trust, common interest, expectations and obligations (Coleman (1990) cited in Manning 2015). Formal networks are characterised by organised groups e.g., political parties, religious groups and colleagues, parent teacher associations. Whereas informal networks are demonstrated in neighbourhood groups, new parent coffee groups and sports teams. The existence of these networks depends on social infrastructure, which can be a physical space, such as a community centre, church or marae, gym or school, and virtual places such as online support groups connected through locality (i.e., neighbourly) or common interest. Putnam (2001) further distinguished between social capital within and across social groups, the so-called bonding versus bridging social capital. Wherein bonding (exclusive) capital is generated from groups of similar backgrounds with shared norms, for example, family groups, cultural or religious groups. Whereas bridging (inclusive) is developed across more diverse networks from different socioeconomic, age, or cultural backgrounds that connect through a common interest such as work or affiliation with a union, political party, sports club, or charity volunteers. Putnam helped clarify this distinction using the metaphor that bonding capital is sociological superglue and bridging capital is a sociological lubricant (Manning, 2015).

The varied definitions and interpretations of what constitutes social capital underline the complexity of measuring it. However, the following definition summarises the most common descriptions: social capital is the social networks existing within and across communities, which allow for reciprocal dependency and support.

Despite the challenges in measuring social capital, its impacts are less disputed but can vary by context (Aldrich 2011; Bambrick et al., 2011, Bannister, 2012; Barton &

Grant, 2013; Bijl, 2011 Klinenberg, 2019; Klinenberg 2018). Putnam (2001:2) noted that some forms of social capital impact are 'good for some things and not for others'. For example, a formal social capital entity, such as a labour union, may be good at supporting employees day-to-day but may be less helpful during a civil emergency. In contrast, social capital provided in communities of neighbours is less formal but is often demonstrably effective at reducing vulnerability in crises such as floods, heatwaves, and earthquakes (Aldrich, 2011; Klinenberg, 2016; 2018).

Social capital, or more broadly civil society, is the space in society where largely informal civilian actions occur, often with the outcome of decreasing social inequality, harm and increasing well-being. Therefore, social capital is essential to the liveability of a society (Bijl, 2011).

3.3.2.2 Social capital and community resilience

The climate crisis has brought the importance of nurturing social capital into a sharp perspective. Social capital's vital role in reducing community vulnerability will be relied upon more heavily as society is exposed to more frequent and intense hazards.

The observation that social capital can be grown or depleted through external influences is significant. Where communities have substantial social capital, this may result from limited access to other capitals such as economic, physical, human or political capital. This illustrates the weakness in reliance on social capital to address community problems. Putnam (2000:355 in Manning (2015)) warned that 'social capital often reinforces social stratification, resulting in inequalities being imbedded into society'.

In the United Kingdom, following the global financial crash, the government offset its austerity measures by introducing the 'Big Society' under the Localism Act 2011, on the premise that the state was 'crowding out initiatives by communities' (Patel, 2016). The de-centralised approach to governance sought to use social capital to address issues from planning, libraries, policing, health and education, youth services and poverty using grassroots community resources. Proponents of this approach saw it as empowering for communities, allowing them to take control over many factors of their lives. Critics saw the approach as a relinquishing of government responsibility to protect the most vulnerable in society, leaving the less well off in society to fend for themselves. The critics view reflects that of Fukuyama (1995:349-354 in Manning (2015)), who advised against artificially engineer social capital as it can lead to 'punitive unintended consequences'. It is important that this 'dark side' to social capital is acknowledged and that strong social capital is not used as an excuse to deplete resources on already compromised communities.

Rather than artificially engineering social capital, Putnam (1993), noted that social capital can be 'replenished', under the right conditions and that it increases with use. Arguably under this rationale, as communities are increasingly exposed to stress caused by climate change, any existing social capital reserves will be replenished. But as with all capital, it fluctuates and therefore providing the conditions to foster social capital, i.e., social infrastructure, is essential to WFUEs.

The last consideration of social capital is that it does not necessarily reflect socio-demographic categorisation. Often areas of economic deprivation are couched as ‘vulnerable’, which fails to reflect the inherent resilience usually found in communities not captured by purely economic parameters. Although communities of deprivation often have increased sensitivity to hazards and reduced adaptive capacity due to restricted financial capital and underlying health inequalities, social capital's role in protecting them should not be overlooked. There is a risk of victimisation of economically deprived communities, which devalues their strength and resilience in times of crisis (Klinenberg, 2018). This is not to imply that communities with low means should be left to their own devices, but it does mean that their strengths and inner knowledge of their situation should be respected, heard, and enabled.

3.3.3 Health, well-being and urban form

Health outcomes are a good proxy for a socially thriving community, with health and well-being inherently connected to urban form (Bijl, 2011). As defined by the World Health Organization, health is not just the absence of disease and infirmity but captures complete physical, mental, and social well-being (World Health Organization, 1946).

Placing human well-being at the centre of design proposals helps to refocus the purpose of the city as a place for people to thrive. Putting private vehicles or economic profit as the central driving force of a design rarely results in preferable well-being outcomes (Blomkamp & Lewis, 2020).

The characteristics of WFUEs that impact physical health include outdoor spaces and buildings that allow physical exercise opportunities and mitigate risk from physical injury and harm (and fear of harm). These environments should also enable easy access to healthy, affordable, nutritious food, access to good quality natural environments and not result in extended periods sitting in traffic, instead of allowing for active transport through a natural and safe setting (Olsson, Garling, Ettema, Friman, & Fujii, 2013). Whilst indoor spaces require buildings that capture daylight and ventilation and a careful balance of living space to provide active frontages without exposing residents to noise and poor air quality. (Andersson, et al., 2014, Barton & Grant, 2013; Basso, 2018, Cook, Bose, Marshall, & Mai, 2013).

Mental health outcomes are also closely related to the quality of the urban environment. Good mental health is defined as the ability to cope with normal life stresses, work productively, and contribute to the community (Cinderby, 2018). Good mental health is enhanced by access to nature, opportunities for social interaction and reduced social isolation and a sense of security without threat, either from crime, injury or environmental hazards (Boyce, 2010; Barton & Grant 2013; Barton & Rogerson, 2017: Davoudi & Brooks, 2016; Hari, 2018).

Cinderby (2018) noted that focusing on discreet links between specific environmental factors and health is not sufficient to realise widespread health and well-being outcomes. Instead, broader dynamic contexts need to be considered to understand the interactions of the environment on residents' quality of life (Barton & Grant, 2013). In practise, this means that urban projects and plans should adopt as a minimum a health impact assessment that uses the broad definition of health, but more importantly, one that evaluates cumulative impacts of proposals in the broader environmental, economic and social context (Johnson Thornton et al., 2013). So, health impact assessment should focus not only on quantifiable elements, such as cumulative noise, but also on more intangible health effects caused by exacerbating deprivation or exclusion or worthwhile causes such as the therapeutic value of nature on health.

Improving health outcomes for all of society requires targeted policy intervention. To assume that an average health indicator reflects health outcomes for the whole population is wrong. The ill-effects of socioeconomic inequality can be hidden within urban areas when measured at a regional scale. Even within the same city, those from rich and poor communities can live in vastly different epidemiological worlds (Rydin, et al., 2012) and vastly different urban environments. As noted by Friel (2020) 'it is no use, getting the physical built environment right if the underlying social inequities prevail.'

Thus, addressing the underlying causes of poverty is fundamental to improving well-being and health issues in society. However, disparities in the urban environment's quality between rich and poor areas also need to be addressed (Anthony, 2017). Making morphological changes at the local scale and then measuring the impacts at a regional level does not give a representative comparison of impacts. Work undertaken as part of developing the heat vulnerability index in Auckland (Joynt, 2019) and findings from the urban forest canopy cover report (Golubiewski, Lawrence, Zhao & Bishop, 2020) demonstrate the localised disparity in natural environment quality. Consequently, areas of social disadvantage should be viewed from a perspective that the built environment, natural environment, and social infrastructure may be inferior in

quality and require heightened investment to improve a community's well-being (Clarke, 2012).

The well-functioning ‘social’ urban environment enables citizens from diverse backgrounds with diverse needs to engage in meaningful and rewarding activities.

High quality and inclusive public and semi-private built and natural spaces facilitate common interests and reciprocal relationships, which indicate high social capital. Social capital is built on relationships bridging across contrasting communities, building tolerance and understanding or through bonding similar communities. Outcomes of high-quality social environments are heightened resilience to the negative externalities of urban life, such as climate change, pollution and isolation, and improved mental and physical well-being.

3.4 The ‘natural’ urban environment

The human-nature separation is stark in the urban environment (Bartel, McFarland, & Hearfield, 2014). The city, suburbs and surrounding peri-urban boundary are more dramatically altered than any other environment to serve human needs. Human settlements are designed for human rather than ecological well-being (Cohen, 2018), and the measurement of environmental and human well-being predominantly occurs through a lens of economic production and consumption (Bartel, et al., 2014). However, it is increasingly evident as we face a growing health and environmental crisis that we need to prioritise the protection of nature in the city. Protection is not just for eco-centric reasons, but to protect all species, including humans, recognising the symbiotic and intricately dependent relationship we have with the environment.

Aligned to indigenous world views, including Maori, we are, in effect, ‘nature’ and cannot detach ourselves from its exploitation outcomes (Andersson, et al., 2014; Barnaud et al., 2018; Lennon & Scott, 2014; Marques, Grabasch & McIntosh, 2018). The indigenous relationship with nature is an intricate, holistic, and interconnected relationship between people and the natural environment. Value of resources is primarily formed in spiritual terms instead of as material assets (Marques, Grabasch & McIntosh, 2018). The term mātauranga Māori describes an understanding of the holistic natural system developed and passed between generations in oral narratives, songs and customs, which detail observance of nature over time.

In contrast, the western science perspective seeks technological solutions to contain and control nature for our advantage. It ultimately leads to a system where competing demands on land in urban centres create situations that marginalise nature at the expense of the communities' well-being (human and non-human) (Andersson, et al., 2014). Despite the clear benefits to humans of protecting nature, the capitalist imperative is to develop and measure success through gross domestic product outputs, which rarely captures the intrinsic benefit of valuing nature even if that requires a non-development approach. An alternative and much more palatable narrative is preserving ecosystems services to enhance the cities liveability and create a place that attracts people, culture, and commerce (Cohen, 2018; Lennon & Scott, 2014; Newman, 2013).

The following section describes the ecosystem services available in urban environments and methods to enhance and expand these as we develop into the future. However, there is a cautionary note to the pursuit of environmental protection based solely on ecosystem services. The benefits people derive from the functioning of nature or ecosystem processes (Cvejić et al., 2015) still reduce the natural environment to a commodity to exploit, and this has constraints. The limitation of

adopting sustainable urbanism and incorporating green infrastructure to increase resilience to specific threats does not guarantee improvement to social-ecological systems' overall adaptive capacity (Turner, 2017). Despite this caveat, good ecosystem functioning requires the provision of products and services that all species depend upon for their existence. Thus, broader environmental benefits can be created by enhancing ecosystem services (Bishop, 2017).

3.4.1 Ecosystem services (ESS)

The most commonly classified ecosystem services (ESS) fall into the following categories: provisioning services, regulating services, habitat or supporting services and cultural services (Cvejić et al., 2015; Doick & Wilson, 2015).

Provisioning services include the raw materials captured from the environment, for example, materials for fuel and construction, water, and food (Cvejić et al., 2015; McPhearson, Hamstead, & Kremer, 2014). Regulating services create balance in the ecosystem, examples include reducing heat island effects, controlling water transmissivity through the environment, and controlling flooding and water supply, water filtration, and carbon sequestration. Regulating services also increase resilience against natural hazards, such as storms and tsunamis, by reducing exposure through buffering or reducing impacts. Habitat and supporting services underpin the biodiversity of species, which provide regulatory, provisioning and cultural services. Finally, cultural services are non-material socio-ecological benefits of improved physical and mental well-being that connection to nature provides with opportunities for recreation and traditional cultural practices (Barton & Rogerson, 2017; Cvejić et al., 2015; Marques, Grabasch & McIntosh, 2018).

3.4.1.1 Green infrastructure

Ecosystem services are dependent on the availability of green infrastructure (GI), which is a relatively new but increasingly more prominent concept in planning and policy spheres (Mell, 2015). Although the collective term GI is new, de Oliveria & Ward Thompson (2015), stated the concept of green interventions to offset the negative externalities of urban living can be traced to the 19th century, with examples in Britain including Victoria Park in the East End of London and Birkenhead Park, outside Liverpool, designed to create a healthy environment in the context of the polluted inner city in the midst of the industrial revolution. Cvejić et al., (2015:8) Define GI as “an interconnected network of green space that conserves natural ecosystem values and functions, and that provides associated benefits to human populations”. Despite its rising profile, as with social infrastructure, and unlike utility infrastructure, urban development is not contingent on the presence of GI, but it is fundamental to a well-

functioning and liveable urban environment (de Oliveria & Ward Thompson, 2015). GI encompasses green spaces in varying settings, including large parks, pocket parks, urban woodland, sport and playing fields, private gardens, street berms, street trees, infrastructure sidings, green roofs, bioswales, city farms and community gardens (Andersson, et al., 2014; Marot, Golobič & Müller, 2015; Wamsler, et al., 2015). It is essentially the green cover in all its forms that intersect and establish in (planned and unplanned) spaces between and on top of the built form. Despite the name, according to some scholars, GI can also be expanded to encompass blue infrastructure, such as canals, rivers and wetlands (Grafakos et al., 2019; Jones & Somper, 2014; Kabisch, et al., 2016; Newman, 2013; Wamsler et al., 2015).

GI can therefore be protected or planned in development (Lennon & Scott, 2014). When brownfield development occurs in urban centres, green infrastructure can be lacking and may require careful planning to incorporate it into the compact form's design (Andersson et al., 2014; Cvejić et al., 2015; Kristl, Senior & Temeljotov Salaj, 2020).

Trees are a critical element of GI, but under the RMA in New Zealand, there is no blanket protection for trees, with tree protection status limited to the protection of native species, but not necessarily the ESS a tree offers regardless of species. Covenants and notable tree protections can be implemented locally, but these are piecemeal in their application across a city region. Maximising ESS potential in new development is achievable using GI varieties that create provisioning services, regulating services, habitat or supporting services and cultural services. For example, encouraging the planting of diverse species rather than monocultural species, with food for humans, or other species and varieties that capture carbon efficiently, filter air quality, and offer resilience to heat and flooding (Barthel, Parker & Ernstson, 2015; Faehnle, Söderman, Schulman, & Lehvävirta, 2015; Marques, et al., 2018; Pfieifer et al., 2018; Raskin, 2015, Vallance et al., 2012).

Existing GI should be protected where greenfield development and intensification occur, particularly prioritising the safeguarding of mature trees to protect established ecosystem services. Protection should move beyond specific species protection to also include an evaluation of the ESS provided. For example, the value of existing green cover can be judged by its contribution to soil erosion protection, habitat creation or food sources, flood risk reduction and shading and shelter benefits before removal for development. To demonstrate value, developers of GI often need to create an economic valuation of the benefits in monetary terms (Sunderland, Rolls & Butterworth, 2015). This is challenging, as GI offers benefits of an attractive landscape and reduced air pollution to everyone, regardless of contribution.

Consequently, when evaluated from a pure economic impact assessment framework, GI fails, as it creates the conditions for a public good market failure. In other words, the market will not deliver GI alone and requires non-market intervention, for example, from a local or central government level. An alternative approach is cost-benefit analysis, including both goods and services provided by GI, as well as non-market costs and benefits, through the creation of a hypothetical market based on willingness to pay, and willingness to accept compensation for a loss of service (Sunderland, Rolls & Butterworth, 2015). Although the cost benefits may be reasonable to calculate at a community or regional level, this may not be as clear in smaller infill development. Therefore, mandating a requirement on developers for GI provision or active contribution from local and central government for targeted GI investment may offer the best solution for GI adoption.

It is preferable to interconnect GI to maximise ESS from greenspaces (Lennon & Scott, 2014). Contiguous GI creates biodiversity corridors, supporting habitat as well as regulating services. Reflecting a mātauranga Māori approach (Walker, et al., 2019), the importance of spatial connectivity, as well as the cultural and well-being effects of GI, should underpin the basis for planning frameworks. Using the principles of kaitiakitanga such as whakapapa, intergenerational knowledge, resource engagement and spirituality in the establishment of urban development, creates a symbiotic relationship with ecological networks. A mātauranga Māori approach safeguards against the severance of ecosystems and protects existing biodiversity as well as the spiritual integrity of an environment (Walker et al., 2017). This approach is far preferable to starting with the urban form and trying to retrofit the ecological spaces (Faehnle, et al., 2015; Lennon & Scott, 2014).

3.4.1.2 Urban forest

Collectively termed ‘urban forest’, tree canopy cover can be evaluated in the urban context using LIDAR[9] technology. LIDAR studies reveal the extent and distribution of urban forest across a city region. Through these types of assessment, trends common to urban forests emerge, including trends indicating an inverse relationship between canopy cover and deprivation, with deficits of green cover in lower socio-economic areas common throughout the world (Bentley, 2015; Cvejić et al., 2015; Davoudi & Brooks, 2016; Joynt & Golubiewski, 2019). This trend is also reflected in Auckland (Joynt & Golubiewski, 2019; Golubiewski, et al., 2020) and illustrates how the distribution of GI can mirror social and health inequities in cities. For example, air and

[9] LIDAR – Light Detection and Ranging. Aerial technology for mapping topographical cover as a 3D image

noise pollution levels are higher in economically deprived areas (Raskin, 2015; Talbot, 2019), as are underlying health conditions such as asthma, obesity and cardio-respiratory diseases (Joynt & Golubiewski, 2019). Therefore, low-income citizens have a greater sensitivity to the impacts of poor air quality and heat exposure, making urban forest critical to community well-being in areas of deprivation (Bentley, 2015; Davoudi & Brooks, 2016; Joynt & Golubiewski, 2019; Talbot, 2019). The protection and enhancement of GI and in a particular urban forest can be a tool to address social inequity in cities (Bentley, 2015, Ernstson et al., 2010).

3.4.1.3 Health, well-being and green infrastructure

One of the most articulated links between GI and human well-being is GI's cultural and societal services (Andersson et al., 2014; Bentley. 2015; Kristl, Senior & Teeljotv Salaj 2020; Tyrväinen et al., 2005; Niemelä et al., 2010). In addition to reducing the urban externalities of pollution, flooding and excess heat, GI also enhances more subjective attributes that impact well-being, such as aesthetic qualities and improved soundscapes (Andersson et al., 2014; Fahelnle, 2015).

Physical health improvements occur through cleaner air, better water quality and fewer diseases, whilst mental health benefits, come from the opportunity for enhanced social contacts, a strengthened sense of community and social capital creation in areas of GI (Andersson et al., 2014 Davoudi & Brooks, 2016 Kristl, et al., 2020; Pfeiffer et al., 2017).

Pressure on GI comes from the demand for compact urban living, which can reduce access to privately owned green space. To avoid the negative impacts of dislocation from nature, planning of the compact city must incorporate accessible and high quality open green space (Coolen & Meesters, 2010). Universal access to the cultural services parks and public open land offer is contingent on GI being well maintained as unmaintained overgrown areas can induce fear of crime and dissuade use (Cardia, 2013; Davoudi & Brooks, 2016; Golan, Henderson, Wilkinson, Weverka, 2019).

3.4.1.4 Freshwater and marine ecosystem services

Other natural environments also present opportunities to harness productive, regulating, habitat and cultural services in and around the urban environment. Auckland has a wealth of natural marine, estuarine and freshwater environments, natural and artificial wetlands, surrounding and transecting the urban environment.

The presence of wetlands and estuarine ecosystem help regulate storm impacts, filter water, provide natural habitats for a wealth of species, and provide areas for recreation. Research undertaken by Fernandez (2020) and Nunns, Hitchins, & Balderston (2015)

indicated that the cultural services afforded by proximity to natural wetlands and water views in Auckland are highly prized. It is, however, well understood that our aquatic systems are already highly compromised from existing urban development (Ministry for the Environment, 2020). Future developments need to go further than merely maintaining the status quo, to restore and enhance rivers, streams and marine environments and help to regulate flooding, provide potable water sources and food. Limiting encroachment into aquatic environments and preventing pollutant accumulation is imperative to the designing of WFUEs.

3.4.1.5 Soil protection and urban development

Urban sprawl is widely detailed in the literature as being counter to well-functioning urban development (Green 2016; Haaland & Konijnendijk van den Bosch, 2015, Kabisch & Kuhlicke, 2014, Koon Hean, 2010). To prevent urban sprawl, land value needs considering more broadly than just monetary exchange value to include its non-monetary provision. The hedonic modelling of ESS is a tool for the non-monetary valuation of provisioning, habitat, regulatory, cultural services. Hedonic price models assign an equivalent fiscal value to a resource (Grafakos, et al., 2019) and can create the conditions to value green space and resist urban sprawl.

Greenfield development poses a particular issue for protecting the ongoing resilience of cities as the climate changes. Greenfield development changes land use from one of carbon sequestration, flood resilience, species habitat and food production, which benefits citizens at a regional scale, to unproductive land with a net negative impact on climate resilience, food access and species protection (Curran-Cournane, Golubiewski & Buckthought. 2018). Currently, there is no national policy guidance in New Zealand on the protection of soil resources, which in the face of growing pressure to grow out and up leaves regional councils with limited tools to push back on developer demands for land-use changes. The forthcoming NPS on indigenous biodiversity and highly productive land may go some way to address this issue yet understanding of how this NPS will interact with the NPS-UD is yet to be resolved.

Protecting prime soils at the city-fringes also increases resilience to food shortages in a changing climate. Counterarguments contest the imperative of protecting prime soils at the city fringe, stating that due to the relatively low population levels in New Zealand, there are alternative opportunities beyond the city limits (Partridge, 2016). This approach does not account for a growing need to localise supply chains and maintain ESS.

3.4.1.6 Ecosystem services basis for urban development

The current legislative reforms in New Zealand, including, but not limited to the NPS-UD, reflect a continuation of a broader global shift from land-use planning characterised by regulatory approaches towards a more holistic view of spatial planning. This shift recasts the role of planning and planners to be one of integrator and mediator of wider policy streams and multi-scalar actions (Lennon & Scott, 2014; Tewdwr-Jones, 2012). In practice, as defined by Lennon & Scott (2014) the evolving planning context shifts from planning for public interest through to planning for sustainable development and on to planning resilient places (Cocks, 2011). This shift reflects a supportive context for the protection of GI and the adoption of ESS as a central framework for planning and development.

As with all elements of the WFUE, collaboration beyond expert institutions is important. Broad coalition not only informs the subjective human needs and preferences (Lennon & Scott, 2014) but establishes stewardship roles in the community, helping with the ongoing preservation, maintenance and protection of GI (Salmond et al., 2016, Barnaud et al., 2018).

To integrate and protect both GI and other natural environments into a practical planning approach requires a move from preserving islands of greenspace around urban developments, to a policy of enhancing, restoring, creating and designing new ecological networks characterised by multifunctionality and connectivity (Ernstson, et al., 2010; Lennon & Scott, 2014). This approach applies to the conception, design, implementation and maintenance of spatially connected GI planning initiatives (Lennon & Scott, 2014) to ensure that GI is not only planned but can thrive (Haaland & Konijnendijk van den Bosch 2015).

As well as making GI spatially connected to create biodiverse contiguous corridors, Lennon & Scott (2014) also recommend integrating GI and, more broadly, ESS should reflect scalar connectivity, which views the GI in a regional, national context across time and spatial settings. Expanding the view of GI connectivity reflects the argument for protecting the rural-urban boundary for agricultural use, which will serve benefits beyond the immediate vicinity and users.

Urban ecosystem, ranging from agricultural land at the rural-urban boundary to larger woodland and nature areas to private gardens, green roofs to sustainable urban drainage systems, play a significant role in city resilience (Cvejić et al., 2015). Central to the integration and protection of these ecosystems and the services they provide is protection and education on the intrinsic value of ESS. The natural environment helps regulate the urban landscape's externalities, providing solutions for clean potable water, flood resilience, air quality, noise reduction, soundscape improvements, heat

island reduction, sewerage and waste management, energy and fuel provision and habitats for biodiversity to thrive. In addition, GI provides cultural services that improve citizen well-being through the experiences of connectivity and social capital as well as urban resilience (Schaffer, 2015; Waters, 2016; Salmond et al., 2016).

Urban resilience is defined by Pichler-Milanovich & Foski, (2015) as the degree to which cities can tolerate alteration before reorganising around a new set of structures and processes. Cilk (2020) notes that the term ‘urban resilience’, which is generally used in connection with the threat of climate change, can be broadened to capture the nature of an urban system's response to uncertainty. As described in this section, the role of ESS goes beyond simple biophysical interactions to influence socio-ecological and socio-technical networks across temporal and spatial scales. Protecting ESS in the context of a growing city is not without challenges as urban areas grow, so are the demands on ESS, particularly for regulating services. The multifunctionality of greenspaces may result in competing needs and conflicting interests, which may compromise the integrity of the planned system over time (Andersson et al., 2014). In summary, the ongoing protection and enhancement of the natural city is a powerful tool to offset inequality and negative externalities and create functional urban environments now and into the future.

3.5 The ‘cultural’ urban environment

The final domain of the WFUE is the cultural aspect. Implicit and explicit to all parts is recognition, integration and enhancement of culture and cultural perspectives. Culture has multiple meanings and manifestations in the context of a WFUE. The most cited definition of culture is the UNESCO definition: ‘the set of distinctive spiritual, material, intellectual and emotional features of society or a social group that encompasses not only art and literature but lifestyles, ways of living together, value systems, traditions and beliefs’ (UNESCO, 2001). As such, the enhancement of cultural elements is both a product and a process to integrate into urban development; it is simultaneously equated to art, ethnicity and lifestyle (Blomkamp, 2014; Cohen, 2012).

Local governments in New Zealand have a long and involved contribution to communities' cultural life, mainly through the provision of services and infrastructure for creative activities. The Local Government Act 2002 (LGA) specifies a requirement for enhancing community well-being from economic, social, environmental and cultural dimensions. Although not exclusively focused on Māori, the intent of cultural well-being in the LGA is a desire for politics to recognise indigenous rights and Māori cultural values in planning legislation (Blomkamp, 2014).

In practice, cultural investment is usually focused on delivering ‘cultural infrastructure’, such as art galleries, museums, community centres, and civic art installations. Cultural investment also cover grants to artists and community groups and specific investments in indigenous and multicultural policies (Blomkamp, 2014).

Cultural infrastructure in the urban environment creates opportunities for pleasure, creativity, advancement and education. Cultural infrastructure can also reflect a community’s history or shared beliefs and present opportunities for communities to thrive and connect through the sharing of leisure time, knowledge, language, stories, shared preferences, resources and food. Social benefits of a rich cultural environment include reduced isolation and more cohesive cross-cultural bridging, inclusion and tolerance (Basso, 2018; Blomkamp, 2014).

As with the natural city, measuring the cultural city in economic terms is difficult. Cultural vitality is often equated to well-being indicators, although these are contentious due to the subjective nature and the contextual differences that impact definitions and well-being experiences (Blomkamp, 2014). Understanding a community’s quality of life can also help to unveil its cultural health to some degree. Alternatively, descriptions of WFUEs commonly include elements of art, creativity and the preservation of traditions as proxies for an advanced cultural climate that improves societal well-being (Blomkamp, 2014).

3.5.1 Culture in planning and policy

The very diverse population of New Zealand, particularly Auckland, means that multiple cultures share and co-exist in the built environment. Allowing space for diverse cultures and cultural activities to thrive helps meet the varying needs of a community. Enhancing cultural wealth can be enabled through urban planning.

In New Zealand, cultural responsiveness is increased through recognition that planning stems from a perspective of colonial traditions and views of land rights (Livesey, 2017, Njoh, 2010). To redress this issue requires critical evaluation and reconfiguration of the way we design and develop our urban landscapes from a culturally sensitive perspective (Marques, et al., 2018).

The Auckland Plan defines cultural heritage as follows:

- tangible culture – such as buildings, monuments, landscapes, books, works of art, and artefacts
- intangible cultures – such as folklore, traditions, language and knowledge
- natural heritage – including culturally significant landscapes and biodiversity (Auckland Council, 2018a).

These distinctions can be usefully applied in planning and development and help frame elements that require consideration in urban development.

A good practice baseline in New Zealand takes a bi-cultural approach to development. Mandated within the principles of the Treaty of Waitangi, biculturalism is embedded in several critical pieces of legislation (Livesey, 2017). In addition, there are multiple cultures and subcultures in any urban area, which also require consideration. They can be linked by demography, religion, or shared beliefs, values or common pastimes.

Recognising multiculturalism as a design element requires an understanding of a community from the bottom up. Culture is more than just ethnicity and should not be conflated. However, understanding the ethnic mix of a community can help inform the type of cultural infrastructure required to support cultural wealth (Blomkamp, 2014). Local community place-based engagement is necessary for urban development to reflect the cultural diversity and need of communities. Engagement helps communities inform and have ownership of both the design and the ongoing use and monitoring of the impact of space on cultural wealth (Cohen, 2012; Dayaratne, 2016). An informed multi-cultural approach to development provides an inclusive and responsive environment for all cultures.

3.5.1.1 Embedding Indigenous cultural perspectives into planning and design

As noted above, biculturalism and the recognition and embedding of Māori cultural values are mandated in New Zealand law (Livesey, 2017). Despite the legal imperative, Livesey (2017) and Walker et al. (2019) report challenges in retaining Māori cultural values in a fast-developing urban environment.

Grounding development in kaitiakitanga principles of stewardship and guardianship, respecting and protecting the natural environment's inherent mauri (life force), results in conservation beyond an approach that merely offsets ecological impacts. Moving instead to a state of improvement as measured by the environments ability to thrive and provide. For example, kaitiakitanga principles might reduce pollutant concentrations in waterways beyond an arbitrary stream health indicator to a level that allows the collection of food (Walker, et al., 2019).

Forthcoming planning reforms will see the repeal and replacement of the RMA (1991), with three different replacement laws; Natural and Built Environments Act (NBA), Strategic Planning Act (SPA) and the Climate Change Adaptation Act (CAA) (Parker, 2021). These law changes anticipate an emphasis on whakatā Kaupapa (spatial planning as applied by Māori) (WaateaNews.Com, 2021). The implementation principles outlined in the most recent exposure draft of the Natural and Built Environments Bill (MfE, 2021), include: *a requirement to recognise and provide for the application, in relation to [te taiao], of [kawa, tikanga (including kaitiakitanga), and mātauranga Māori*], which will create a significant elevation of māturanga Māori in planning relative to the existing legislative framework. The legislative reforms make it prudent to take a precautionary approach. To pre-empt adopting these principles in implementing the NPS-UD, defining WFUEs through a mātauranga Māori lens and moving away from the central tenet of planning that land is a private possession for exploitation (Livesey, 2017). Prioritising instead the principles of kaitiakitanga: (managing and conserving the environment as part of a reciprocal relationship, based on the Māori world view that humans are part of the natural world); manaakitanga (generosity, kindness, and showing care for others), kotahitanga (unity, cohesion and collaboration) and mana (authoritative, prestigious, of status; power deserving of reverence) (Auckland Council, 2021; Livesey, 2017; Porter et al., 2017; Marques, et al., 2018; Walker et al., 2019)).

Centring urban planning on the principles of urban resilience and protection of ESS aligns with kaitiakitanga principles. It meets the obligations set out under the articles of te tiriti o Waitangi (Livesey, 2017). Respecting the mana of Māori and creating the conditions for Māori to practise rangatiratanga, the power to control and decide how

resources, including land, are used is the most effective means by which urban planning authorities can meet the conditions of Article II of Te Tiriti o Waitangi (Livesey, 2017; Walker et al., 2019).

In practice, this will require giving greater mandatory weight to the inclusion of recommendations from initiatives such as Te Pokapū Whakatairanga Tikanga Māori in development and spatial planning (Auckland Council, 2021). Other requirements include timely and meaningful opportunities to influence developments and decisions on land use more broadly, including engagement long before shovels hit the ground.

Although symbolism is a meaningful way to include Māori culture in design, caution needs to be taken to avoid cultural appropriation. For example, the arbitrary use of Māori names for places, buildings, street names or even institutions can be offensive if misused. The use of a te reo Māori name is a gift, a taonga, which usually reflects the relevance of the place or activity to Māori. It is culturally insensitive to include Māori names or symbolism without careful consideration of its appropriate use.

In summary, the cultural city in New Zealand is multi-faceted. Stats NZ has devised the following indicators as a cultural measure: languages spoken; people's sense of belonging; religious affiliation; participation in cultural activities; trust and participation in government and the well-being of different groups. This definition gives a very generic overview of cultural wealth and not the more nuanced reflections required to understand how culturally rich an area is. Equitable provision of cultural infrastructure is a starting point for the cultural WFUE. Allowing the opportunity for cultural expression regardless of ethnicity or socio-cultural background will also provide the space for cultures to flourish. Cultural infrastructure is only one element of cultural enhancement. Working directly with communities and engaging them in a meaningful and proactive design of their environment and ongoing use and monitoring would give a more accurate measure of the efficacy of cultural interventions aiming to enhance socio-cultural wealth.

3.6 Discussion

Despite the separation of the sections for this review, all elements are intrinsically connected. As noted above, a WFUE is the sum of its parts built, social, natural, or cultural. The intrinsic connections between each of these elements mean that no one should be elevated above another. The literature has demonstrated that sustainable development, liveable communities and good governance require designers to address the binarized false view of the human-nature dichotomy. WFUEs are achieved through the balanced valuation of the built, social, cultural and environmental domains holistic value rather than an economic rationalist perspective (Bartel, McFarland, &

Hearfield 2014). Building without connection to the people who will or already live in the community, social infrastructure and the objective of maximising social capital or reflection of the ecosystem services, climate context, or cultural acknowledgement, will not result in a WFUE. Instead, a socio-ecological approach to development should be the founding basis for growth, which will require a shift in priorities and governance of our urban areas (Frantzeskaki & Tilie, 2014; Haase, Frantzeskaki & Elmqvist, 2014).

Returning to Policy 1 of the NPS-UD, the literature review informs an expansion of the definition of a WFUE. Policy 1 states:

(i) meet the needs, in terms of type, price, and location, of different households; and
(ii) enable Māori to express their cultural traditions and norms.
(iii) have or enable a variety of sites that are suitable for different business sectors in terms of location and site size.
(iv) have good accessibility for all people between housing, jobs, community services, natural spaces, and open spaces, including by way of public or active transport.
(v) support, and limit as much as possible adverse impacts on, the competitive operation of land and development markets; and support reductions in greenhouse gas emissions.
(vi) are resilient to the likely current and future effects of climate change.

Following the collation of the literature through a comprehensive and rigorous analysis, a series of key elements relevant to a well-functioning urban environment emerged. In summary, a WFUE reflects the context and purpose of its development, meeting the practical, economic, physical, social and cultural needs of all the citizens it serves today and into future generations. WFUEs reflect the diversity and disparity in society and aims to address social justice and inequity through engagement, accessibility, transferral of power, ownership and informed transformation or protection of land and services.

Informed engagement with citizens is paramount, using tools that provide ownership of decision-making through interactive and meaningful platforms relevant and usable by the target group.

The inclusion of circular waste strategies, localised energy production, secure electric vehicle charging infrastructure, water conservation and green buildings standards will reduce resource use associated with the escalating climate crisis. Whilst long-life loose-fit designs will enable flexibility of use, reflecting the changing nature of population needs over time.

Varied housing typologies and tenures close to employment, amenities and accessible transport will increase social justice and human rights, provided the services and opportunities reflect the needs of more than an ‘average user’. Whilst infrastructure and civic spaces built to meet the needs of diverse communities of varying ethnicities,

genders, income levels, age groups, and abilities will help improve health, environmental, social and cultural outcomes for all whilst reducing negative ecological externalities.

Social and green infrastructure critical to urban environments will enhance community health and well-being, create social interaction, reduce negative externalities, and increase resilience. Valuation of ecosystem services accounts for non-asset or land-based contributions to a well-functioning urban environment. ESS contributions include provisioning services, regulating services, habitat or supporting services and cultural services.

Māori design principles embedded as the platform from which all development stems will create spaces that value the distinctive cultural identity, principles and aspirations of Māori. Whilst multiculturalism will be recognised and enhanced through the provision of cultural infrastructure representative of the wider community.

The systematic literature review builds upon the NPS-UD definition with the following additional priorities:

1. Maximise inclusion and belonging of citizens, through actionsactions to address thethe barriers for citizens of all ages, genders, ethnicities, incomes and abilities to engage in both planning and use of the urban environment.
2. Use creative placemaking and appropriate innovative technology to gain insights and inform development opportunities for all citizens to acquire ‘full right' to use, appropriate and shape their cities.
3. Meet the human rights of the incumbent and future city residents in terms of economic, social and cultural rights, including the right to affordable safe housing.
4. Create residential and commercial buildings designed to minimise resource consumption and negative externalities. Using long-life loose-fit designs, universal design standards, low carbon construction and entire lifecycle and end of life material use considerations during construction and occupancy.
5. Promote vitality and safety through informal surveillance and connectivity opportunities, created with active frontages of mixed-use residential and location appropriate commercial premises.
6. Enable high density, compact, human-scale buildings for mixed uses to generate vibrancy and visual interest.
7. Maximise equitable access with a range of housing choices (typology and tenure), near active or public transport links connecting education, recreation, health and employment opportunities. With access available for all citizens regardless of wealth, physical health, gender, age or ethnicity.

8. Access to a range of employment options, both within the central business district (CBD) and inter-local centre or out to main employment hubs, such as airports, hospitals, and industrial centres using affordable efficient public transport. Recognition of the requirements for trip chaining, off-peak transit demands, and non-linear routes to access work and amenities. Particularly relevant for women and low-income groups.
9. Public transport design inclusive of accessibility features from multiple user perspectives including varying gender, mobility, age and income levels.
10. Enable resilient and renewable community energy production, water use and secure electric vehicle charging infrastructure. Minimise waste through reduction and re-use. Promote net zero energy buildings and communities.
11. Prioritise pedestrianisation of city blocks using highly connected permeable routes and legible streetscapes to encourage walking, social interaction and visual complexity, e.g., laneways, human-scale buildings, pocket parks and plazas. Ensure pedestrian access routes reflect the needs of multiple users, including those with physical and mental impairments.
12. Enhance social capital with inclusive neighbourhood designs which are safe, comfortable, and convenient for people of all ages and abilities to play, thrive, and have social and cultural interaction in the public realm.
13. Incorporate health impact assessments (HIA) in development plans, to identify and mitigate immediate and cumulative health impacts, reflecting that health is complete physical and mental well-being and not just the absence of disease and injury.
14. Classify social, green and cultural infrastructure as critical infrastructure and ensure the timely implementation and phasing of its development to maximise community use.
15. Integrate high quality accessible green infrastructure within, upon and adjacent to the built environment, with a focus on high-quality amenities, social interaction and biodiversity, using contiguous green infrastructure corridors, retention and enhancement of tree canopies particularly in areas of current deficit.
16. Create opportunities to enable regenerative food production using urban agriculture at a range of scales including within and between building envelopes, alongside transport corridors (where safe to do so) and within open space to address social inequities and enhance social capital.
17. Integrate water sensitive design, which minimises use and enhances water receiving environments. Minimise potable water use for non-potable services and integrate greywater systems into new build and retrofit designs.

18. Value ecosystem service (ESS) reflecting the contribution of green infrastructure (in all its forms) to health, climate resilience, amenity value and cultural value.
19. Prioritise the principles of kaitiakitanga to restore and enhance marine and freshwater aquatic environments using a high threshold for quality, e.g., the collection of kai moana / seafood.
20. Protect prime soils at the city fringe to meet the food supply needs of future generations whilst shortening supply chain length and minimising climate emissions.
21. Design buildings and neighbourhoods that are resilient to the likely current and future effects of climate change whilst addressing and not exacerbating social inequities.
22. Enhance opportunities for people of all cultures to enjoy pleasure, creativity, advancement and education through the equitable provision of cultural infrastructure.
23. Respect the mana of Māori and create the conditions for Māori to practise rangatiratanga, with the power to control and influence the use of resources in line with Article II of Te Tiriti o Waitangi.
24. Use smart technology data in concert with more nuanced citizen participation to improve systems.
25. Preservation of significant natural and built cultural heritage (both colonial and Māori).

4.0 Conclusion

The work presented in this systematic literature review explores the definition of a WFUE as documented in international governmental and academic literature. The use of systematic review enabled a broad lens to be cast across the sources, drawing evidence from 322 articles, as well as additional supplementary articles in the fields of architecture planning, sociology, urban design, urban economics, politics, governance, agriculture, forestry, construction, landscape architecture, ecology, hazard management, climate change, transport, health, psychology, and cultural studies.

The evidence gathered concludes that a WFUE is the sum of its parts. No one element creates a WFUE, nor is there a measurable standard to demonstrate such an environment's achievement. Instead, there are common elements across the built, social, environmental and cultural domains that contribute to experience and outcomes for all urban citizens.

Understanding the needs of communities and enabling participation and belonging of communities is contingent on active participation in planning and design (Palich & Edmonds, 2013). Utilising technological advancement in engagement processes and innovative technology to optimise designs offers an opportunity to engage those who may ordinarily face barriers to inclusion in placemaking.

Invariably, assessments of use, such as walkability assessments, are undertaken for a nominal average person. This approach disregards the heterogeneity of society in terms of income, ethnicity, gender, cultural norms, health and well-being status, mobility and household composition. This review helps to detail both the importance of delegation and citizen control in the creation of plans and designs for both a sense of belonging and to optimise design solutions to meet the needs of a diverse ‘non-average’ population.

The review also highlights that creating a WFUE requires integrating high-quality urban design principles and low impact architecture, which enable frugal use of resources for the entire lifecycle of a building or neighbourhood. The acknowledgement that urban spaces, infrastructure and buildings created today will, by and large, remain significantly unchanged for the foreseeable future is also essential in the design of a WFUE. A WFUE will need to meet the needs of today’s generations without compromising the ability of future generations to meet their needs. Buildings should be designed with flexibility in mind, using a long-life loose-fit model incorporating universal design features that reflect the needs of a changing demographic, with an ageing population and growing ethnic diversity of our communities. More broadly, urban spaces and infrastructure need to be designed to mitigate against changes in climatic

conditions using low carbon technology and renewable energy sources. Whilst simultaneously and without creating perverse outcomes, increase resilience through both engineering solutions and the enhancement of social capital. Accessibility, legibility and connectivity of space by active and public transport options are needed at the neighbourhood level, across city regions and intra-city suburbs, to reflect the varying needs of society and to address the existing social inequalities created by lack of affordable housing within easy access to transport hubs.

The well-being of citizens is mainly attributable to their environment meeting their basic needs for health, housing, access to purposeful work, and inclusion in a community. Communities suffering social inequality can have limited capacity to meet their basic needs and should therefore be prioritised for improvement investment. Investment in WFUE should focus on the provision of a range of housing types and tenures within access to education, health, employment and opportunities to connect with nature. Whilst housing quality standards need to enhance health outcomes rather than compromise them, now and for the life of the building.

The functionality of urban environments should be quantified through a broader lens than economic measure of asset value. As an alternative to asset financial value, active enhancement and equal prioritisation of social, cultural and green infrastructure, can be measured in improved well-being and health outcomes, decreased negative environmental externalities, reduced social isolation, greater tolerance of diversity and the creation of connections across age, race, gender, sexuality and income profiles.

Under the provisions of the NPS-UD, development feasibility is currently assessed through the lens of land price and the cost of development, including utility infrastructure. To incorporate the principles of a WFUE into the development capacity assessment, green and social and cultural infrastructure should be included. The inclusion of ecosystem services (ESS) assessments classified into the following categories: provisioning services, regulating services, habitat or supporting services and cultural services also needs to be evaluated, in addition to health and cultural impact assessments. This broader approach would create a more representative evaluation of the development feasibility of WFUEs.

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