

**Analysing the Impacts of Metropolitan
Adelaide's Open Space Policies on Engaging
Young People (18-30)**

By

Emily Glew

Master of Environmental Management and Sustainability

Thesis

Submitted to Flinders University

for the degree of Master of Environmental Management and Sustainability

**Master of Environmental Management and
Sustainability**

Faculty of Humanities, Arts, and Social Sciences

Flinders University

30.05.2025

TABLE OF CONTENTS

TABLE OF CONTENTS	I
ABSTRACT	IV
DECLARATION	VI
ACKNOWLEDGEMENTS	VII
LIST OF FIGURES	VIII
LIST OF TABLES	VIII
LIST OF EQUATIONS	IX
GLOSSARY	X
1. INTRODUCTION	1
1.1 Overview.....	1
1.2 Justification of Thesis.....	2
1.3 Research Question	3
1.4 Aims and Objectives	4
2. LITERATURE REVIEW	5
2.1 Environmental Significance of Greenspace.....	5
2.2 Greenspace Provision and Development	7
2.3 Wellbeing of Young People.....	9
2.4 The Significance of Young People’s Engagement with Greenspace.....	12
2.5 Global Context of Open Space Policy	15
3. METHODOLOGY	19
3.1 Overview.....	19
3.2 Open Space Policy Content Analysis	19

3.3 Greenspace and Recreation Survey.....	20
3.4 Vegetation Analysis.....	21
3.5 Comparative Analysis	23
4. RESULTS	25
4.1 Open Space Policy Analysis	25
4.2 Greenspace and Recreation Survey.....	27
4.2.1 Descriptive Statistics	27
4.2.2 Greenspace Perception.....	32
4.2.3 Recreational Behaviours	39
4.3 Survey Analysis.....	45
4.4 Vegetation Analysis.....	50
4.5 Comparative Analysis	55
5. DISCUSSION.....	57
5.1 Recreational Behaviours.....	57
5.1.1 Commuting Activity.....	57
5.1.2 Outdoor Recreational Physical Activity	57
5.1.3 Indoor Recreational Physical Activity.....	58
5.1.4 Sedentary Recreational Activity	59
5.2 Greenspace Engagement.....	59
5.3 Vegetation Quality.....	62
5.4 Recommendations for Future Open Space Policy	64
6. CONCLUSION.....	69
6.1 Summary.....	69
6.2 Recommendations for Future Research.....	72

6.3 Research Limitations.....	72
REFERENCES.....	74
APPENDICES.....	95
Appendix 1: Greenspace and Recreation Survey	96
Appendix 2: Open Space Policy Themes and Focus Areas	112
Appendix 3: Visualisation of NDVI of Inner-Metropolitan Adelaide	116

ABSTRACT

Urban greenspace (UGS) is an instrumental resource amongst metropolitan neighbourhoods as they are designed and distributed to mitigate urban heat indices, improve air quality metrics, reduce carbon emissions, and foster natural disaster resilience. UGS, when perceived to be of adequate quality and accessibility, also contributes to societal prosperity through the passive promotion of physical activity, encouragement of healthy diet, social cohesion, stress reduction, and increased cognitive recovery. However, increasing urbanisation of metropolitan regions have jeopardised equitable provision of UGSs throughout Adelaide, South Australia. Thus, open space policy is the tool through which such resources can be manipulated to manage civil, environmental, and economic welfare of a local council area (LGA).

This thesis synthesises an original perspective of existing knowledge of the provision of informal mental and physical health intervention for young people (18-30 years) through UGSs. COVID-19 lockdowns spanning 2020-2021 prompted a trend away from regular engagement with physical activity amongst young people, alongside an increased reliance on online and sedentary behaviours for socialisation and outlets for wellbeing. This has been trailed by an increased burden from mental health-related disease and symptoms amongst young people, albeit at an age of highly malleable cognitive development.

This research quantified young people's engagement with inner-metropolitan Adelaide UGS alongside council vegetation vitality and inclusions of open space policies. Young people's perceptions of their local UGS were also compared to broader expectations to formulate recommendations for future policy to encourage young people's use and consequential relief from the demographic mental health epidemic.

Open space policy had a considerable correlation with frequency of engagement with outdoor recreational physical activity, yet little correlation with local vegetation vitality. Barriers to engagement were correlated to perceptions of biodiversity, social connection, and safety. Perception of biodiversity encourages engagement through the strengthening of residential place-based relationships. Reception to experience nature in its diversity is linked to strengthened social

cohesion, perceived liveability, and ultimately improved quality of life. Blockages on these fronts directly impede on resident receptivity to known mental and physical benefits of engaging with greenspace.

The perception of safety to partake in recreational activities was not aligned with the demographic's expectations, serving as an additional barrier to willing engagement. Arrangements of UGS that contribute to such accessibility include a connected urban design, with easy and structurally safe access to greenspaces. Infrastructure encouraging safe use such as footpaths, lighting, and adjacency to significant landmarks must also be considered, particularly amongst women. Aesthetic perception of UGS also influences use, particularly acknowledgement to pre-colonial selection and arrangement of flora.

Whilst indoor physical activity still delivers on physiological benefits, psychological benefits are limited. It is important for councils to create safe, biodiverse, and social greenspaces to engage with to foster the health of younger residents and liveability of their localities. To do so, future policy should be directed at healthy lifestyle promotion, greenspace accessibility, thriving natural environments, community engagement, and upholding heritage and culture, which can be actualised through dedicated land use with infrastructural and program standards. Pledged ongoing government management of spaces and related policies should also be done so transparently.

DECLARATION

I certify that this thesis:

1. does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university
2. and the research within will not be submitted for any other future degree or diploma without the permission of Flinders University; and
3. to the best of my knowledge and belief, does not contain any material previously published or written by another person except where due reference is made in the text.

Signed *Emily Ines Glew*

Date *30.05.2025*

ACKNOWLEDGEMENTS

I would like to express my gratitude to my supervisor, Assoc. Prof. Gareth Butler, for his continued guidance and feedback throughout the journey of this thesis. His generous provision of knowledge and expertise has been paramount in the shaping of this research.

I would also like to extend thanks to supporting academics, Dr Gerti Szili – for invaluable insight onto urban planning and local policy resources, and Assoc. Prof. David Bruce – for sharing knowledges from his vast experience with remote sensing tools and methodologies.

I also acknowledge the participants in my primary research modalities. Without you, I would have no data.

Finally, I would like to thank the friends and family, particularly Mum, Auntie Kara, Nusrat, Caitlin, and Lauren, who all contributed ongoing moral support throughout the evolution of this project, help in the distribution of survey materials, and sincere excitement for updates on my work.

LIST OF FIGURES

Figure 4.1: Frequency of theme inclusion in inner-Adelaide metropolitan LGA OSP	26
Figure 4.2: Theme inclusion in inner-Adelaide metropolitan LGA OSP	27
Figure 4.3. LGA Distribution by Ward	32
Figure 4.4. Average use of local greenspace by survey respondents over 12 months	33
Figure 4.5. Distance of closest UGS from survey respondents' homes in minutes to walk .	33
Figure 4.6. Reports of commute behaviour against residence by ward	46
Figure 4.7. Reports of commute behaviour against residence by LGA	47
Figure 4.8. Reported outdoor recreational physical activity against residence by ward	48
Figure 4.9. Reported outdoor recreational physical activity against residence by LGA	48
Figure 4.10. Reported indoor recreational physical activity against residence by ward	49
Figure 4.11. Reported indoor recreational physical activity against residence by LGA	50
Figure 4.12. Reported outdoor sedentary recreational activity against residence by ward .	50
Figure 4.13. Reported outdoor sedentary activity against residence by LGA	51
Figure 4.14. NDVI classification through inner-metropolitan Adelaide area 18/01/2025	53
Figure 4.15.a-e Distribution of NDVI scores across LGA	54-55
Figure 5.1. Tree canopy cover horizontal extents	64

LIST OF TABLES

Table 3.1: NDVI score classifications	23
Table 4.1 OSP scores for inner-Adelaide metropolitan LGAs	28
Table 4.2. Descriptive statistics of survey respondents	30
Table 4.3. Survey respondents residence in inner-Adelaide LGAs	31
Table 4.4. Survey participant views about general UGS	34
Table 4.5. Survey participant views on local UGS	35
Table 4.6. Survey participant views on local UGS by ward	37-39
Table 4.7. Survey respondent commuting activity behaviours	41
Table 4.8. Survey respondent outdoor recreational physical activity behaviours	42

Table 4.9. Survey respondent indoor recreational physical activity behaviours	43-44
Table 4.10. Survey respondent outdoor recreational sedentary behaviours	45
Table 4.11: NDVI scores by LGA	52
Table 4.12. Regression analysis of LGA OSP, NDVI, and surveyed behaviours	56
Table 4.13. Regression analysis of LGA OSP, NDVI, and surveyed behaviours	57

LIST OF EQUATIONS

Equation 3.1: NDVI using hyperspectral imagery	24
Equation 3.2: Simple linear regression formula	24

GLOSSARY

A series of abbreviations will be used in this document. Please refer to the following summary.

CS – City of Charles Sturt

HB – City of Holdfast Bay

LGA – local government area

MH, MHD – mental health, mental health disorder

NPSP – City of Norwood, Payneham and St Peters

OSP – open space policy, also refers to plans and strategies.

PA, IPA – physical activity, insufficient physical activity

PAE – City of Port Adelaide Enfield

TTG – City of Tea Tree Gully

UGS – urban greenspace

WT – City of West Torrens

1. INTRODUCTION

1.1 Overview

Urban greenspace (UGS) is a focal point for a neighbourhood's ecological and community vitality. UGS typically refers to open spaces within urban settings either partially or entirely covered by vegetation (Atiqul Haq et al., 2021). More recent definitions have come to include street-lining vegetation, parks, blue-green infrastructure, and natural areas as recognition of opportunities to increase greenness in urban settings (Venter et al., 2021). Quality UGS has been recognised in delivering an array of environmental benefits historically (Vaughn, 1964; Warren, 1973) gaining particular recognition amidst mitigation of climate change including easing urban heat island (UHI) effects, improving air quality metrics, carbon sequestration, biodiversity support, as well as natural disaster protection (EPA, 2025; Fei et al., 2023; Semeraro et al., 2021; Xu et al., 2023).

Recreational activities refer to those completed external to work duties (Berdejo-Espinola et al., 2022). In Australia, recreational activity is largely represented by forms of physical activity (PA). Regular engagement with preferred recreational activity modality exhibits proven improvements in both acute poor mental health (MH) symptoms as well as chronic mental health disorders (MHD) (Kemel et al., 2022). PA, in particular, is an accessible, highly proven MHD self-management strategy and preventative tool (Australian Bureau of Statistics, 2023; Kemel et al., 2022). Regular PA, in conjunction with a healthy lifestyle, also aids in the prevention of non-communicable diseases including diabetes and hypertension (Geneshka et al., 2021).

The presence, quality, and accessibility of greenspace in urban settings not only helps to motivate PA participation but enhances associated benefits in comparison to PA completed indoors or in low biodiversity settings (Chen et al., 2021; Geneshka et al., 2021; Houlden et al., 2021). Recreational interaction with natural spaces outside of PA also enhances wellbeing. Particular improvements in physiological and psychological stress reduction and sense of self have been observed amongst young people (Barron & Rugel, 2023).

1.2 Justification of Thesis

Growing global populations, prompting rapid infrastructural development, have seen a decline in the prioritisation of public and private greenspaces (Boulton et al., 2021; Fluhrer et al., 2021). Whilst efforts have been made in the global north for incidental UGS creation such as streetscapes, Australia's population growth is surpassing a rate at which such UGS implementation can ensure equitable provision (Boulton et al., 2021; Green Adelaide, 2023).

In metropolitan areas of Australia, the leading cause of burden from disease amongst young adults is poor MH, with a noticeable increase observed following COVID-19 related confinement (Australian Bureau of Statistics, 2023). Factors including affordability and accessibility of MH services prevent this demographic from accessing structured treatment (Huang et al., 2024). Research around the development and use of UGSs does not commonly identify young adults as an isolated demographic affected. The relationship of this age group with poor MH alongside reduced desire to engage in community-based programs for PA such as team sport highlights them as a pertinent stakeholder in greenspace provision (Karageorghis et al., 2021).

The Greater Adelaide region reveals the lowest public open space coverage of the nation's capital cities, with an observed increase in ground impermeability and decrease in tree canopy cover in the lead-up to the inception of Green Adelaide's Urban Greening Strategy for Metropolitan Adelaide (Green Adelaide, 2023). Identified inadequacies of council demonstrations of approaches to climate change, biodiversity loss, social injustice, and healthy living simultaneously serve as major challenges for sustainable development of cities and novel causes of stress or hopelessness amongst young people (Bray et al., 2022; Hansen et al., 2023). The Department for Environment and Water recognised these barriers and have imparted a roadmap to tackle them as such, boosting Adelaide's liveability (Green Adelaide, 2023).

The physical and mental benefits of both PA and engagement with greenspace are continuously being solidified in research (Australian Bureau of Statistics, 2023; Lyons et al., 2022), yet there is little thought as to their application as an intervention for young people in local policy. Young people are often overlooked in policy yet amongst those most in need of conversation

around community-based environmental opportunities of wellbeing intervention. Open space policy (OSP) has the opportunity to provide this societal and community welfare within a neighbourhood structure through considered planning, implementation, utilisation, and maintenance (Aminah et al., 2024; Andriansyah et al., 2021).

1.3 Research Question

This thesis contributes an original perspective of existing knowledges surrounding theoretical understandings of government-based contributions to environmental and societal wellbeing. The research synthesises cost effective and easily accessible implementation strategies for local government intervention of vulnerabilities to the poor mental and physical health of young people. Through this consideration, the research question was formed:

How do inner-metropolitan Adelaide LGA open space policies influence young people's recreational engagement with urban greenspaces?

1.4 Aims and Objective

This project serves as a pilot study to thoroughly understand the influence metropolitan Adelaide local councils have on improving greenspace quality within their regions and supporting the engagement of residents aged 18-30 with such spaces. This research ultimately intends to identify opportunities to shape future local policies to promote young people's utilisation of UGS through the following objectives:

- Quantify vegetation vitality and young people's engagement behaviours and associated opinions with their local UGSs.
- Review and identify inclusions in existing local council open space policy, plans, and strategies that contribute to positive perception and vitality of UGSs.
- Conduct quantitative analysis of the views and experiences of young people on UGS in relation to their respective LGAs.
- Provide recommendations of inclusions in future policy, plans, and strategies to promote the engagement of young people with their local UGSs and hence optimise associated benefits.

In order to address these aims, this thesis will first provide a detailed overview of the significance of UGS and its use as a PA and MH intervention for young people, as well as the role OSP has on promoting UGS vitality and engagement. The project will then explore correlations between vegetation vitality, young people's use and opinions on greenspace, and analysed themes of OSP to suggest associations between factors. This analysis alongside the reviewed literature will be used to formulate recommendations for future OSP and research in this space.

2. LITERATURE REVIEW

2.1 Environmental Significance of Greenspace

As major contributors to national CO₂ emissions, urban settings require intentional and adequate planning of greenspaces to contribute to net-zero status (Liu et al., 2022; Strohbach et al., 2012; Xu et al., 2023). Design is increasingly vital to mitigate resulting ramifications of climate changes and improve the liveability of increasingly dense residential spaces (Sharifi et al., 2020; Strohbach et al., 2012).

It is stated that UGS acts to mitigate localised air and surface temperatures contributing to UHI effects (EPA, 2025). Present emission magnitude renders tree and shade cover alone inefficient in reducing ground temperature. However, green infrastructure design factors have been shown to reduce energy consumption of buildings, with some plant-based insulation installations saving 140 000 tonnes of CO₂ in Adelaide annually (Liu et al., 2022; Sharifi et al., 2020). Factors such as tree species (Shekanino et al., 2023), greenspace configuration (Hu et al., 2021), and seasonal variation in greenspace (Lin et al., 2024) act as intricate variables in optimising UHI relief across unique climates and topographies (Wang et al., 2022; Q. Wang et al., 2023). Strategic tree and vegetation cover has been found to lower local land temperatures up to 6°C in Adelaide (Green Adelaide, 2023).

UGS presence has demonstrated a positive relationship with numerous air quality metrics. Greenspace in such studies has been measured in both quantitative metrics such as percentage of cover (Lei et al., 2021) and street-level view (O'Regan, 2024) and qualitative metrics including tree species (Bao et al., 2024; Belaire et al., 2022; Kwak et al., 2020) and configuration (Nguyen & Liou, 2024). Tree species richness and native species success has a two-way positive correlation with carbon sequestration effectiveness (Belaire et al., 2022; EPA, 2025). Adelaide's air quality performs well against international standards, likely due to weather patterns alongside urban design preventing build-up of particulate matter seen in other Australian cities following major

weather events (EPA, 2018). The continued integrity of UGS could play a vital role in the ongoing management of local air quality as urbanisation and population density rises (EPA, 2025).

Adequate biodiversity plays a major role in optimising environmental and human benefits of greenspace. Threatened by common greenspace arrangements including turf grass lawns and foliage pruning, UGSs have on average 21% lower biodiversity than rural greenspaces (Rega-Brodsky et al., 2022). Despite evidence that biodiverse spaces can further urban emissions reduction by 34% relative to non-diverse spaces, biodiversity cannot reduce urban emissions alone (Fisher et al., 2021; Rega-Brodsky et al., 2022; Stanford et al., 2022). Plant arrangement and continuity supports the self-sufficiency of greenspace ecology, with extension to informal arrangements of urban greenery (EPA, 2025; Z. Gao et al., 2021; Semeraro et al., 2021; Stanford et al., 2022). The presence and sufficient arrangement of native flora furthers this (Belaire et al., 2022; EPA, 2025; Semeraro et al., 2021), with instances of biodiversity worsening local air quality due to incorrect plant species selection (Hu & Lima, 2024). The connectivity of biodiverse pockets also helps support species conservation and natural habitat restoration as everchanging human influences continue to shape greenspaces (Semeraro et al., 2021; Zhou et al., 2023).

Recent research has also highlighted the role of UGS in natural disaster prevention and protection (Chen, 2021; Fei et al., 2023; Z. Wang et al., 2023; Wen et al., 2024), which is of particular pertinence to high fire-risk areas of Adelaide within Cities of Mitcham, Burnside, Campbelltown, Tea Tree Gully (TTG), Salisbury, and Adelaide Hills Council as climate change is rendering such events increasingly unpredictable (Government of South Australia, 2024). Ultimately, greenspace stress amplifies ecological, economic, and social pressures of increasing populations (Boulton et al., 2021). Future changes in UGS allocation must not only consider quantity, but sufficiency in serving populations and ecosystems.

2.2 Greenspace Provision and Development

International studies of new greenspace development show that while net quantitative cover of greenspace has increased, provision is still not deemed equitably distributed (Boulton et al., 2021; Chen et al., 2021; Wang et al., 2019). Chen et al. (2021) observed a decrease of greenspace quantity and quality in densely populated areas of Berlin with an increase of people traveling from these areas to engage with larger greenspaces. Furthermore, Wang et al. (2019) noted while greening strategies result in general increase of UGS, newly created spaces are not of the same standard as those they are joining or replacing (Wang et al., 2019; Wu et al., 2022).

Australia's population is growing at a rate faster than UGS development, decreasing equitable provision and access to such spaces (Wu et al., 2023). Required rapid infrastructural development commonly surpasses a pace permitting thorough environmental management. As a result, residential comfort, suburban economic productivity, and general sustainability is lacking in many major cities and has consequently limited opportunity for investment in quality of UGSs and their facilities (Boulton et al., 2021; Fluhrer et al., 2021; Indrajat et al., 2022; Sarofah & Herliana, 2023). In circumstances where targets of greenspace allocation are met, they are shortly outdated by changing population conditions (Boulton et al., 2021; Zong et al., 2024). Whilst greenspace area in the global north significantly increased from 2000-2018, trends in Australia fall short to that of European nations. Australia's nationwide open space to population ratio is sufficient, though isolating urban spaces highlights the disproportionate nature of these changes (Wu et al., 2023).

The Green Adelaide and Environmental Protection Authority's Urban Greening Strategy is a functional plan for the conservation, restoration, and introduction of green infrastructure within metropolitan Adelaide. The initiative has many goals within broader target areas, including surface temperature reduction, boosting neighbourhood biodiversity, and increasing tree canopy coverage to 30% by 2045 (Green Adelaide, 2023). Presently, 73.2% of Adelaide residents have access to public greenspaces within 400 metres of their home (EPA, 2025). Between 2013-2016, total paved surface area increased 2.57% within greater Adelaide, with 36% of LGAs experiencing significant gain over 10% (Green Adelaide, 2023). On average, 25.4% of the study area ground is classed as

impermeable with areas of denser population sitting over 44% (Green Adelaide, 2023). Namely, Cities of Holdfast Bay (HB) and Norwood, Payneham and St Peters (NPSP) report over 60% hard surface ground coverage (Green Adelaide, 2023). Within the greater Adelaide region, just under half of suburbs have less than 20% tree canopy cover of 3 or more metres (EPA, 2025). Metropolitan Adelaide tree canopy cover decreased 1.8% between 2011 and 2021, with 47% of suburbs experiencing loss of 10% or more, where a 3% decrease in tree cover can reduce carbon sequestration effectiveness by over 70% (Chen et al., 2022; EPA, 2025).

The index scoring vulnerability to heat, poor health, hot spots, economic disadvantage, and access to greenspace (VHHEDA) ranks LGAs on population susceptibility to urban heat consequences out of five, 0 being most vulnerable and 5 being least vulnerable. Rankings consider health factors such as percentage of population over 65 living alone, and economic factors such as socio-economic disadvantage index, in surplus to environmental contributions such as change rate of green cover of each locality (Besser et al., 2023; McNeilly Smith et al., 2024). 79% of Adelaide LGAs were ranked as “vulnerable” according to the VHHEDA index. Furthermore, of the nine council areas nationally to receive a ranking of 0.5 out of 5, five are located in Greater Adelaide (Charles Sturt (CS), Gawler, Playford, Port Adelaide Enfield (PAE), and West Torrens (WT)) (Green Adelaide, 2023). With Greater Metropolitan Adelaide already exhibiting the lowest public open space coverage and least “stringent” tree protection laws of the nation’s capital cities, UHI effects are growing in intensity, with some LGAs experiencing heat intensities at +6.0°C (EPA, 2025; Green Adelaide, 2023). For proposed changes to be implemented effectively, the Green Adelaide strategy will require defined policy outcomes and regulations unique to each council to ensure increase and experience of such benefits is equitable (EPA, 2025; Green Adelaide, 2023).

The main challenges UGS design face include climate change, biodiversity loss, social inequities, financial availability, and encouragement of healthy living (Boulton et al., 2021; Hansen et al., 2023). Biodiversity and locational accessibility act as strong indicators of benefit reception (Fisher et al., 2021; Wu et al., 2022), though the strongest supporter of greenspace associated benefits is perception of one’s space. Perception is shaped differently amongst individuals, from aesthetics to wildness, though regardless of motivation, use is most consistent and effective when

such personal criteria is met (Atiqul Haq et al., 2021; Fisher et al., 2021; Zakharova et al., 2025). In the recent introduction of new greenspaces, design has been influenced by international planning approaches to factors including layout and biodiversity (Hansen et al., 2023). Undoubtedly, Australia's residents' needs differ, and hence have not been met. Australian residents typically engage with local greenspaces with active recreational intentions, the extent and form of which differ amongst age, socioeconomic status, and race (Boulton et al., 2021). If greenspaces are not perceived as capable of meeting needs in accordance with aforementioned environmental elements of design, greenspace will not be used to its fullest capacity. As a result, institutional constraints to greenspace improvement emerge alongside social and environmental inequities (Atiqul Haq et al., 2021; Boulton et al., 2021; Hansen et al., 2023).

2.3 Wellbeing of Young People

The WHO defines MH as “a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community” (World Health Organisation, 2022). Good MH is an intrinsic state of balance of one's physical and emotional values and their capacity to contribute to intimate and wider social climates (Fusar-Poli et al., 2020). Young adults are amongst those most affected by poor MH, as both diagnosed disorders and reported symptoms, which remains the highest cause of disease-related burden amongst people aged 20-29, particularly women (Australian Bureau of Statistics, 2023; Krokstad et al., 2022; Rodríguez-Romo et al., 2023). Prevalence of MHD in 2022 was found to be significantly greater amongst young adults aged 16-24 years (38.8%) compared to the national rate (21.5%) and the same age group rate in 2007 (26.4%) (Australian Bureau of Statistics, 2008, 2023). Moreover, this demographic saw the most acute consequences regarding MH from the COVID-19 lockdowns, with a peak in rate of mental illness lasting 12-months or longer (39.6%) in 2020 (Australian Bureau of Statistics, 2023; Karageorghis et al., 2021). MHD also contributes significantly to measures of quality of life, being responsible for 40 million Disability Adjusted Life Years (DALYs) (calculated by the loss of years lived from premature death and the loss of healthy

years from living as a result of illness or injury) and 33.8% of working years lost due to any disability globally. Of particular concern is the observation that burden due to poor MH does not ease with age once established in young adults (Krokstad et al., 2022; Rodríguez-Romo et al., 2023). This steadily increasing incidence places increased demand on MH services and additional barriers to young people accessing help (Huang et al., 2024; Krokstad et al., 2022; Ryan et al., 2024).

Despite Australia presenting amongst the highest levels of PA globally, trends in young people's engagement have declined steadily throughout the century (Krokstad et al., 2022; Strain et al., 2024; Venter et al., 2021). Insufficient physical activity (IPA), defined by WHO as failure to achieve 150 minutes of moderate intensity exercise, or 75 minutes of vigorous exercise per week, has a known relationship with increased risks of conditions including cardiovascular disease and diabetes (Haverkamp et al., 2020; Karageorghis et al., 2021; Kemel et al., 2022; Qin et al., 2020; Strain et al., 2024; World Health Organisation, 2024). Forced isolation as a result of COVID-19 lockdowns incited sudden additional changes in lifestyle surrounding diet, alcohol consumption, and time spent outdoors, all of which influence engagement with PA (Alosaimi et al., 2023; Castañeda-Babarro et al., 2020; Karageorghis et al., 2021; Qin et al., 2020). The lockdowns saw a 32% global average reduction in PA, with Australian young adults experiencing the greatest diminution, particularly women, students, shift workers, and people of colour (Australian Bureau of Statistics, 2023; Berdejo-Espinola et al., 2022; Castañeda-Babarro et al., 2020; Karageorghis et al., 2021; Qin et al., 2020). Activities reliant on community resources saw significant decreases in engagement, including organised sport, a common form of PA amongst young Australians (Castañeda-Babarro et al., 2020; Karageorghis et al., 2021). As a result, indicators of and self-reported sedentary behaviour amongst this demographic increased in a fashion that was not observed amongst older adults (Castañeda-Babarro et al., 2020; Karageorghis et al., 2021; Nagata et al., 2022; Qin et al., 2020). An increase in demand for time spent on screens for work or study obligations and unregulated access to an array of information sources alongside the highly addictive nature of electronic resources has likely influenced young people's values away from the physically active lifestyle (Haverkamp et al., 2020; Karageorghis et al., 2021; Krokstad et al., 2022; Nagata et al., 2022). Despite men seeing the greatest decrease in exercise rates, overall activity

levels remained higher than that of women. Young males also maintained better levels of emotional well-being during lockdowns (Castañeda-Babarro et al., 2020; Qin et al., 2020; Strain et al., 2024).

Lifestyle behaviours exist in clusters, and so too do their effects. Decreases in quality of life from changes in diet, PA, and time spent outdoors are exacerbated by one another, creating a strong link between degree of MHD and lifestyle (Alosaimi et al., 2023; Chang de Pinho et al., 2024; Krokstad et al., 2022). An overarching decrease in optimism for life has been observed amongst young people as uncertain systematic and economic climates, academic pressures, and social justice concerns have created a perceived inaccessibility to quality of life (Karageorghis et al., 2021; Krokstad et al., 2022). Increasing PA level is the most common self-management strategy for MH (Australian Bureau of Statistics, 2023). PA contributes to improvements in mental wellbeing physiologically and psychologically. Participation in PA has repeatedly shown improved self-esteem and wellbeing, and reduced depressive symptoms, anxiety, stress, and suicidality in comparison to inactive individuals (Huang et al., 2024; Kemel et al., 2022; Rodríguez-Romo et al., 2023). Those with diagnosed MHD have reported a change in introspective focus to one's status of wellbeing, enhanced mental resilience, and increased feelings of security in support networks following regular PA (Hovland et al., 2023). Furthermore, regular PA has a direct relationship with sleep quality, a strong predictor of symptoms of mental illness, particularly in young adults (Wickham et al., 2020).

PA throughout young adulthood is a significant indicator of behavioural regulation and exercise in later life, meaning adequate engagement can act as an early intervention for MHD development (Huang et al., 2024; Kemel et al., 2022). Though benefits can be observed regardless of PA modality, choice of engagement in preferred activity strongly influences perceptions of life satisfaction. It is suggested the additional sense of control is empowering on the back of pandemic era restrictions (Kemel et al., 2022). Those who reported passive participation in a provided PA modality as well as those who did not have the choice to commute in an active way, for example by cycling, reported worse outcomes and poorer consistency of PA than those with PA participation of a chosen modality (Kemel et al., 2022; Rodríguez-Romo et al., 2023). PA is also linked to cognitive

performance, namely attention and processing speed (Haverkamp et al., 2020; Strain et al., 2024). Bouts of exercise see temporary boosts in such aspects through increasing cerebral blood flow and serotonin levels. Repeated exercise supports neurodevelopment with the largest effects on working memory (Haverkamp et al., 2020). Young adults are at an age of great neurodevelopment and hence most receptive to such benefits, however so too are they to negative adaptations from increased technology use (Mallawaarachchi et al., 2022; Nagata et al., 2022)

Attitudes towards PA have been shaped by the pandemic, so a new understanding on influencing factors of consistent PA is required (Karageorghis et al., 2021; Kemel et al., 2022). With increased online presence to support work, study and socialisation, more Australians are reliant on a technological way of life (Krokstad et al., 2022). Australia is already seeing fewer commitments to organized activity such as team sports and gym memberships, with citizens opting for outdoor group-led training options, supporting social and emotional ideals whilst reducing financial pressures and themes of uncertainty (Alosaimi et al., 2023; Qin et al., 2020).

2.4 The Significance of Young People's Engagement with Greenspace

Greenspace presence in high-density urban areas encourages PA, with sufficient vegetation canopy cover and diversity positively correlated to exercise incidence and diversity (Geneshka et al., 2021; Wang et al., 2021). This offers residents various benefits including activities that support potential weight loss and a reduced risk of non-communicable diseases (Geneshka et al., 2021). The efficacy of such results can be manipulated through measures of greenspace quality. Factors of UGS including biodiversity, ecosystem integrity, and provision amplify existing benefits, whilst poor quality UGS can even produce negative effects on user physical health (Houlden et al., 2021; Semeraro et al., 2021). Regular interaction with natural environments also promotes the adoption of a more balanced diet (Stott et al., 2024; Uhlmann et al., 2022).

Regular PA has long been less common amongst densely urban environments (McCrorie et al., 2014). COVID-19 restrictions increased public preference for indoor environments,

particularly considering concerns of spatial crowding, resulting in a declining use of greenspaces (Berdejo-Espinola et al., 2022; Lyons et al., 2022; Venter et al., 2021). Common concern around influences of urban sprawl and infill development on public greenspaces saw young people replace regular leisure and recreational activities with technological engagement, despite history of greenspace engagement (Berdejo-Espinola et al., 2022; Eastwood et al., 2023; EPA, 2025; Paköz et al., 2022). Furthermore, the uncertainty of present-day urban development leads to rumination and depressive symptoms (Bray et al., 2022). Young people are neurologically vulnerable to changing thought processes, leaving them more receptive to both benefits and harms from the state of their environment (Barron & Rugel, 2023). With 68% of people expected to live in urban spaces by 2050, sense of connection to nature and associated benefits are likely to diminish (Eastwood et al., 2023; UN Habitat, 2024).

Elements of urban design including greenspace strongly influence their use. Individuals with a desire to partake in PA are likely to do so indoors or on footpaths if greenspace is not desirable, though exposure to greenspace for at least 20 minutes a day can increase likelihood of PA 4.72-fold (Almanza et al., 2012; McCrorie et al., 2014). Holding a positive perception of local UGS is reported to contribute to the liveability of a region (EPA, 2025). The presentation of greenspace is a commonly cited influence on use, especially amongst young people, whilst maintenance, aesthetics, greenness, and perception of quality indicate usability and safety (Lyons et al., 2022; Seaman et al., 2010; Venter et al., 2021). Greenspace proximity is also strongly linked to usage frequency, particularly amongst women (Lyons et al., 2022). Accessibility to spaces increases ease of use and perceptions of safety. Moreover, it is suggested access to quality greenspace acts as a social determinant of health (Besser et al., 2023), though if perception of quality is unsubstantial, such greenspaces are unlikely to be used, even if geographically accessible (Eastwood et al., 2023; Seaman et al., 2010; Venter et al., 2021). Presence and quality of adequate amenities extend duration of visits to greenspaces, though this is dependent on individual lifestyle and values (Berdejo-Espinola et al., 2022; Lyons et al., 2022; Seaman et al., 2010). If amenities align with users' intention of greenspace visitation, physical and mental wellbeing results are elevated in comparison to those without infrastructure to meet similar

intentions and to those who seek such resources elsewhere to greenspace (McCrorie et al., 2014; Venter et al., 2021).

The use of greenspaces amongst young people is commonly driven by social motivation (Eastwood et al., 2023; Lyons et al., 2022; Seaman et al., 2010; Venter et al., 2021; Wang et al., 2019). Such circumstances see greenspace used as a safe and convenient setting for socialisation. Young people report greenspaces would be “boring” or “tiring” to visit with no social agenda (Eastwood et al., 2023; Venter et al., 2021). However, social circles that did use greenspace to meet were found on average to be larger with greater cohesion, deeper relationships, and sense of belonging (Lyons et al., 2022). Overcrowding of spaces, however, decreased desire to visit (Paköz et al., 2022; Seaman et al., 2010). Quietness of greenspaces is also an important influence amongst young people in providing space for leisure and “time to oneself” (Eastwood et al., 2023; Lyons et al., 2022). Young people are less commonly motivated to visit greenspaces for engagement with nature and health than other age groups. Engagement with nature enhances feelings of connectedness and realisations of beauty of nature, and in-turn improves pro-environmental behaviour (Eastwood et al., 2023; Uhlmann et al., 2022). An initial engagement with local natural spaces triggered individuals’ desire for further and deeper interaction, ultimately building empathy and confidence in addressing nature-based issues such as biodiversity loss (Eastwood et al., 2023). Social norms are deterring in-person interaction. Declining greenspace engagement and PA alongside this jeopardises prospective social health of young people (Kemel et al., 2022; Krokstad et al., 2022).

Numerous studies have also outlined the enhanced psychological benefits including wellbeing and quality of life that result from intentional interaction with natural environments in urban areas, particularly during the COVID-19 pandemic (Buckley & Westaway, 2020; Pradenas et al., 2021). Not only do young people report UGS as providing a sense of escapism from common exacerbators of poor MH such as social media, regular connection with natural environments within metropolitan areas granted this demographic with a stronger sense of self and inclination for self-care (Barron & Rugel, 2023; Birch et al., 2020; Moreira-Almeida et al., 2021). Engagement with nature increasing young people’s sense of connection to self, others, and surroundings is

experienced across many cultures, often eliciting a greater sense of belonging to social connection and sustainable construction (Barron & Rugel, 2023; Davies et al., 2020; Henderson et al., 2024). It is suggested that even viewing greenspace from afar can decrease cortisol levels and increase social cohesion and general wellbeing (Fisher et al., 2021). Moreover, a sense of genuine connectedness and belonging to one's environment heightens the benefits experienced from acute interactions (Lackey et al., 2021). Natural environments have also been proven to alter biological processes of cognition, such as boosting mental recovery from cognitive fatigue upon interaction (Lai et al., 2019; Ricciardi et al., 2022). As such, urbanisation acts as a novel risk factor for poor MH.

MH intervention targeted at young people typically centres around behavioural methods, where evaluation of community structure is likely more suited to be considered in the present civil state of metropolitan Adelaide (Ryan et al., 2024). Greenspace engagement, similarly to PA, is becoming a wider accepted method, with improvements in stress, mental fatigue, and social behaviours reported (Eastwood et al., 2023; Lyons et al., 2022). Presence of native vegetation in greenspace holds a highlighted link to a reduction of depressive symptoms (Barron & Rugel, 2023), however, such changes are only observed when such aspiration behind engagement is intentional and expected (Seaman et al., 2010).

2.5 Global Context of Open Space Policy

Open space policy (OSP) is a tool for governments to achieve societal welfare through the protection of civil, environmental, and financial function, order, security, stability, and prosperity (Andriansyah et al., 2021; Sarofah & Herliana, 2023). Common shortcomings of OSPs include poor urban planning, lack of space, ineffective control for implementation, lack of awareness of importance, and inconsistent financial priority (Afeosemobo et al., 2024).

Inequitable allocation of land for greenspaces directly heightens implications of natural resource management associated with insufficient greenspace, for example wastewater

management (Sarofah & Herliana, 2023). Although a policy may be theoretically sufficient, problems may appear in the regulation of participation or implementation of procedures (Lindquist & Wellstead, 2021). A policy is only as valuable as its applicability to action, which is ultimately a wider responsibility than that of the document authors (Sarofah & Herliana, 2023). This can often be explained by the lack of understanding of importance of such regulation of external public and private organisations as well as the general public (Indrajat et al., 2022; Lindquist & Wellstead, 2021). Addressing issues that may not be prioritised in public views can be difficult to justify. For example, a lack of education on climate change translates to a misunderstanding that policy makers do not care to address public issues. It is the responsibility of governments to balance the consideration of varying priorities with environmental needs and address them as such for the implementation of all parties reliant on services UGS provides (Indrajat et al., 2022; Sarofah & Herliana, 2023). UGS has not often been considered an asset in urban planning until recently. Not only are their mitigating effects on climate change now considered, but are also praised for the aesthetic and functional value they add to suburbs (Nur et al., 2024).

A significant problem with the cohesive success of local OSP lies in the heterogeneous nature of such documents. Each party shall identify different needs and targets for local areas, each with unique methods of guiding action, and have differing availabilities of resources such as budgets, populations, and land infrastructure. OSP needs to be strategised to have meaningful, structural impact on green space availability and quality with consistency throughout Greater Adelaide (Afeosemobo et al., 2024; Sarofah & Herliana, 2023).

Such strategy can be refined into a series of steps; planning, implementation, utilisation, and maintenance (Aminah et al., 2024). An adequate policy plan must contain clear, consistent goals which endeavour to address causes and effects of influenced parties equally (Green Adelaide, 2023; Tunggul & Deddy, 2022). Initial plans must not only meet requirements but have a universally considered reasoning behind them (Aminah et al., 2024; Cainie et al., 2023). Goals should be analysed and developed in accordance with resources and relationship with broader targets and public perception (Aminah et al., 2024). Ultimately, plans for policy implementation must be neutral and in the interest of a clear shared vision of urban habitability and equity (Green

Adelaide, 2023; Nur et al., 2024). Such context guides directions and actions from project prioritisation and investments to research and behavioural aspirations (Green Adelaide, 2023).

Implementation of open space policy can be applied to a range of circumstances. In the formation of new greenspace, for example, policy implementation must consider existing environmental and community conditions in the provision of new facilities. General goals in this circumstance lie in the development of space for public use (Amanah et al., 2023). In the reallocation of greenspace, regulated spatial planning must consider the principles, vision, and goals fuelling sustainable urban development alongside existing structural influences. Goals in this circumstance encompass influencing greenspace utilisation (Amanah et al., 2023; Cainie et al., 2023). The development of existing greenspace intends to organise existing use. Goals in this circumstance are influenced by engagement with infrastructural services (Amanah et al., 2023). Intended use must also be considered in policy development, for example a cemetery will not be usable in the same manner as a sporting ground (Cainie et al., 2023).

Regardless of circumstance of policy application, there are a number of internal and external factors to be considered. Drivers of policy implementation success within an institution include communication, to ensure coordination between all parties in addressing goals from multiple perspectives, and structure, to ensure resulting adequacy of policy implementation. Such factors can be reinforced by an overseeing party, responsible for the monitoring of policy progression, adherence, and duties (Amanah et al., 2023). External drivers include engagement and commitment from all stakeholders, minimising friction rooted in misunderstanding of implementation value environmentally and socially, and adequate resources, for efficient implementation (Amanah et al., 2023; Cainie et al., 2023; Green Adelaide, 2023). Inhibiting factors may include an internal lack of education, ultimately limiting any connection to intended implementation, or infrastructure suitability, impeding on sustainable development capabilities. Externally, a lack of community engagement with policy intentions, limited cohesion between stakeholder values and significant levels of greenspace degradation may impede on implementation efficacy (Amanah et al., 2023; Green Adelaide, 2023; Tunggul & Deddy, 2022).

Monitoring and maintenance of policy occurs once implemented. This action must be ongoing and responsive to major influences such as extreme weather events (Aminah et al., 2024). The monitoring of the performance of a policy must foremost assess its effectiveness; what has influenced any variation in outcomes and where are opportunities for improvement (Howlett, 2023; Nur et al., 2024)? Secondly, evaluation of adherence to policy timelines provides regular updates of incremental goals and exposes factors which may impede implementation efficiency (Nur et al., 2024). Policy monitoring describes the coordination between prior steps of planning and implementation, determining the extent to which the policy sufficiently satisfies the needs and goals of its locality. This evaluation explains the responsiveness of the policy and identifies origins of errors, as well as realistically projects the extent a broader target may be reached (Nur et al., 2024; Sarofah & Herliana, 2023). Finally, the equitable distribution of achieved benefits must be monitored. Extending beyond quantitative population density, equity must be achieved in accessibility and translation of benefits. Particular residential or industry hubs may attract a greater need for particular types of green space, and quality should be consistent throughout (Nur et al., 2024). Ultimately, each aforementioned aspect of policy in greenspace maintenance must be considered in coordination with one another to optimise ongoing supervision requirements (Amanah et al., 2023).

The Green Adelaide strategy is directed by their stakeholder-shared identification of gaps in greenspace provision including tree protection, green infrastructure development, biodiversity and climate resilience, as well as mutual recognition of the efficiency required to address such needs metropolitan-Adelaide-wide. Strategic outcomes listed include strengthened tree protection laws, the prioritising of public infrastructure and a shift in cross-sectional incentive and education to foster vision coordination and investment. Regular research and progress publication is also considered for the longevity of the project (Green Adelaide, 2023). If such aspects of open space policy strategy are sufficiently coordinated, localities can expect socio-economic enhancement with societal and corporate support, ultimately fostering capabilities and educated willingness to ongoing compliance (Tunggul & Deddy, 2022).

3. METHODOLOGY

3.1 Overview

A mixed methods study design incorporates quantitative and qualitative interpretations of data to examine study findings. The approach allows data to be described through a numerical lens, empirically determining to which extent a data point fulfils a norm or standard, which can respond to a considered context (Taherdoost, 2022). Such methodology for the purpose of this study was utilised to quantify the subjective contributions to the existing recreational behaviours of young people in Greater Metropolitan Adelaide for determination of correlation.

The methodology for this research first utilised content analysis techniques of thematic extraction and coding in accordance with Braun and Clark's (2023) and Graddy's (1998) systems. This process allowed an index for OSP quality to be derived as well as defined themes to guide policy recommendations. A survey distributed to people aged 18-30 living in inner-metropolitan Adelaide collected data on recreational behaviours and opinions on UGSs generally and their local locations. Vegetation quality across inner-metropolitan Adelaide and within LGA was derived through normalised difference vegetation index (NDVI). Extracted quantitative information of OSP quality, UGS behaviour, and NDVI was tested for correlation through simple linear regression. Where significant trends emerged, OSP themes and UGS opinions were evaluated for deeper understanding of results. Such insight shaped recommendations for future OSP.

3.2 Open Space Policy Content Analysis

Thematic analysis is a tool used to extract themes from data or a research subject. Content analysis is the evaluation of the presence of themes within data to infer quantitative understanding (Humble & Mozellus, 2022). Themes were extracted through the Braun and Clark method of thematic analysis from the most recently publicly available electronic versions of OSP from the LGAs City of Adelaide, City of Burnside, City of Campbelltown, City of Holdfast Bay, City of Mitcham, City of Marion, City of Norwood, Payneham and St Peters, City of Port Adelaide Enfield, City of Prospect, City of Salisbury, City of Tea Tree Gully, City of Unley, City of Walkerville, City of

West Torrens, and Adelaide Hills Council. Commonly repeated topics were first identified in documents which were then grouped accordingly into major themes. This method is effective at interpreting qualitative data for use in systematic analysis by allowing interpretation of the story which analysed information provides whilst allowing incorporation into quantitative reports of data (Braun & Clarke, 2023). Despite variation in document publication date, using most recent versions reinforces the notion that perception of UGS quality is a significant metric in encouraging use and receiving known benefits (Atiqul Haq et al., 2021; Zakharova et al., 2025).

Once themes were extracted, each LGA received a calculated score based on the breadth of themes mentioned and the comprehensiveness done so in respective OSP. Methodology for derivation of index was derived from (Graddy, 1998); each extracted theme for individual LGAs was given a coefficient determined by the number of subthemes present in each theme and the number addressed within the policy. For example, a theme that described one of four subthemes would receive a coefficient of 0.25. The sums of the coefficient-modified variables were then averaged and expressed as percentages. This methodology was utilised to ensure the comprehensiveness of theme inclusion would be considered in subsequent interpretation of data, rather than equal merit for mere mention of themes as calculated analysis.

3.3 Greenspace and Recreation Survey

Collection method of primary data in research is important for subsequent analysis. Surveys are a useful instrument in gathering opinion-based and behavioural data. Surveys have the capacity to collect a larger sample size than an interview or observational methodology and hold a lower risk of influencing respondent answers compared to face-to-face collection methods due to their anonymous and independent nature (Mazhar et al., 2021). Furthermore, the structure of data extracted from surveys is typically better suited for a streamline transition into coding and content analysis (Jain, 2021).

Survey participants were defined as young adults aged 18-30 years living in inner-metropolitan Adelaide LGAs. Literature displays a variety of age ranges to classify young adults, with the most common youngest cut-offs between 18-20 years and older cut-offs 24-26 years

(National Research Council, 2015). The upper limit was extended for the purpose of this study to emphasise changed social roles and family structures in the present day, supported by the understanding that cortical development can continue up to 30 years of age (Haverkamp et al., 2020; National Research Council, 2015). The incorporation of young adults under the age of 30 has been included in previous literature (Karageorghis et al., 2021; Krokstad et al., 2022; Strain et al., 2024).

The survey was distributed through flyers around Flinders University campus and community spaces such as libraries, social media, Flinders University lectures, and word of mouth. Respondents were asked to complete an anonymous online survey covering demographic data including age, gender, LGA of residence, employment status, and Aboriginal or Torres Strait Islander heritage. Attitudes towards greenspace, both in general and those local to respondents, were investigated with questions derived and modified from Greenspace Scotland's Greenspace Use and Attitudes Survey 2017 (Why Research Ltd., 2017). This survey was used as inspiration due to the breadth of consideration of types of and reasons for engagement with greenspace included. A 5-point Likert scale quantified the strength of the questioned attitudes. Recreational behaviours including outdoor commuting, outdoor PA, indoor PA, and outdoor sedentary activity were measured through frequency, time of day, and location to allow thorough analysis of the extent to which behaviours were engaged in. The full survey is available to view in Appendix 1.

All subjects were informed of purpose of the study and their free participation in it. Participants were aware of their liberty to withdraw at any time before submission of the survey. Ethics approval was obtained by Flinders University Human Research Ethics Committee (HREC) 7737, access to which was available to survey respondents through hyperlink.

3.4 Vegetation Analysis

Vegetation quality was determined by normalised difference vegetation index (NDVI) calculations through Arc GIS Pro V3.4 (Esri, 2024). NDVI is amongst the most popular method of

mass vegetation assessment due to its simplicity and accessibility. Calculations interpret complex multi-spectral information into a single index denoting vegetation quality between -1.0 and 1.0, easily interpretable through the legend in Table 3.1 (Huang et al., 2021; NASA EarthData, 2025). Multi-spectral or hyperspectral images of varying spectral, spatial, and temporal resolutions can be used for such calculation in various geospatial analysis software available to the researcher (Huang et al., 2021).

Table 3.1: NDVI score classifications (NASA EarthData, 2025)

NDVI Score	Description
-1.0 – 0.0	Barren areas with little to no vegetation
0.01 – 0.1	Bare ground, rock, or urban area
0.11 – 0.2	Sparse vegetation; shrubs, dry grass
0.21 – 0.4	Moderate vegetation; grass, senescing crops
0.41 – 0.6	Dense vegetation; forests, growing crops
0.61 – 0.9	Healthy, dense vegetation; rainforests, high leaf area crops
0.81 – 1.0	Vigorous vegetation

Multispectral imagery was downloaded from the Copernicus Space Data Ecosystem Portal, the European Space Agency’s browser for images from the Sentinel-1, 2, 3, and 5P satellites and other contributing missions (European Space Agency, 2024). Image “S2A_MSIL2A_20250118T004701_N0511_R102_T54HTG_20250118T031503.SAFE” of metropolitan Adelaide was selected for use in this research. The image was captured through the Sentinel-2 MSI instrument on 18 January 2025 at 00:47:01 Midnight Greenwich Time, or 11:17:01 Australian Central Daylight Time. This image was selected due to the sunlight angle providing sufficient brightness for the image with minimal shadow interference and its minimal cloud cover, only 0.0098%. NDVI was calculated on this image using bands 4 (red) and 8 (near infrared) as applied to Equation 3.1.

Equation 3.1: NDVI using hyperspectral imagery (NASA EarthData, 2025)

$$NDVI = (NIR - Red) / (NIR + Red)$$

Vector LGA boundaries were downloaded from DataSA. The Extract by Mask tool confined the NDVI calculated layer to respective LGA areas. Minimum, maximum, and mean with standard deviation of NDVI values were then recorded for each LGA. The number of pixels at each NDVI classification bracket was also recorded for individual LGAs.

3.5 Comparative Analysis

A series of regression analyses were completed to determine statistically significant correlation between NDVI, open space policy index, and percentage of recreational behaviours occurring within respective LGAs. This methodology is reflected in Equation 3.2.

Equation 3.2: Simple linear regression formula (Arkes, 2023)

$$Y = \beta_0 + \beta_1 X + \varepsilon$$

where

Y = the dependent variable, recreational behaviour occurrence or NDVI

X = the explanatory variable, NDVI or open space policy index

β_1 = the estimated slope of the explanatory variable

β_0 = the intercept term, or estimated value of Y when $X=0$

ε = the distance of any point from the line of estimation

Regression analysis as used in this methodology allows robust analysis of quantitative figures translatable to qualitative interpretation. Application of the methodology allows objective and honest determination of significant predictors of outcomes related to interconnecting factors (Arkes, 2023). Additionally, as this is a pilot study, regression analysis provides a sound basis of description of predictable relationships between variables for more complex statistical modelling to be based off in future research (James et al., 2023).

The regression analysis was interpreted based on R value and R^2 . The R value lies between -1 and 1, with the R^2 simply the former value squared, resulting in a value between 0 and 1. This value explains the proportion of variation in the dependent variable as determinable by the independent variables. A value close to 1 would denote, for example, close to 100% of variation in recreational behaviour occurrence is explainable by NDVI (Arkes, 2023).

4. RESULTS

4.1 Open Space Policy Analysis

19 themes were extracted from open space policies from 16 local government areas. These themes and number of LGAs incorporating them is visualised in Figure 4.1. The distribution of such themes across LGAs can be viewed in Figure 4.2. Each theme is comprised of narrower focus areas, as explained in Appendix 2. The comprehensiveness with which each council describes each theme has derived an index allocated to their open space policy, which can be viewed in Table 4.1. The most common themes included in LGA open space policies were community, urban design, and greenspace provision. Cities of Mitcham, Burnside and Campbelltown covered the broadest number of themes, however, cities of Mitcham and West Torrens explored the topics with the most depth.

Figure 4.1: Frequency of theme inclusion in Adelaide metropolitan LGA OSP.

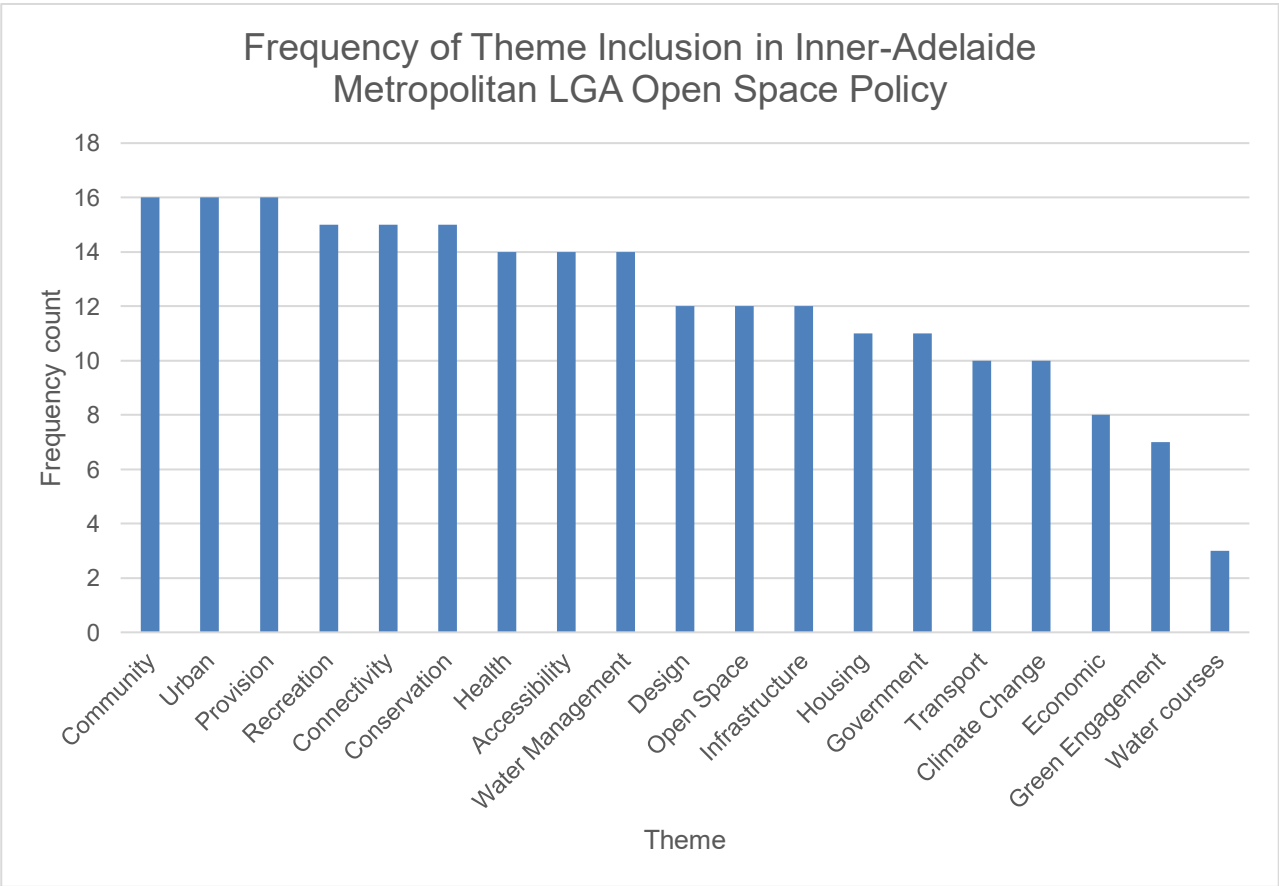


Figure 4.2: Theme inclusion in inner-Adelaide metropolitan LGA OSP.

Theme inclusion is represented by green tiles, exclusion is represented by red tiles.

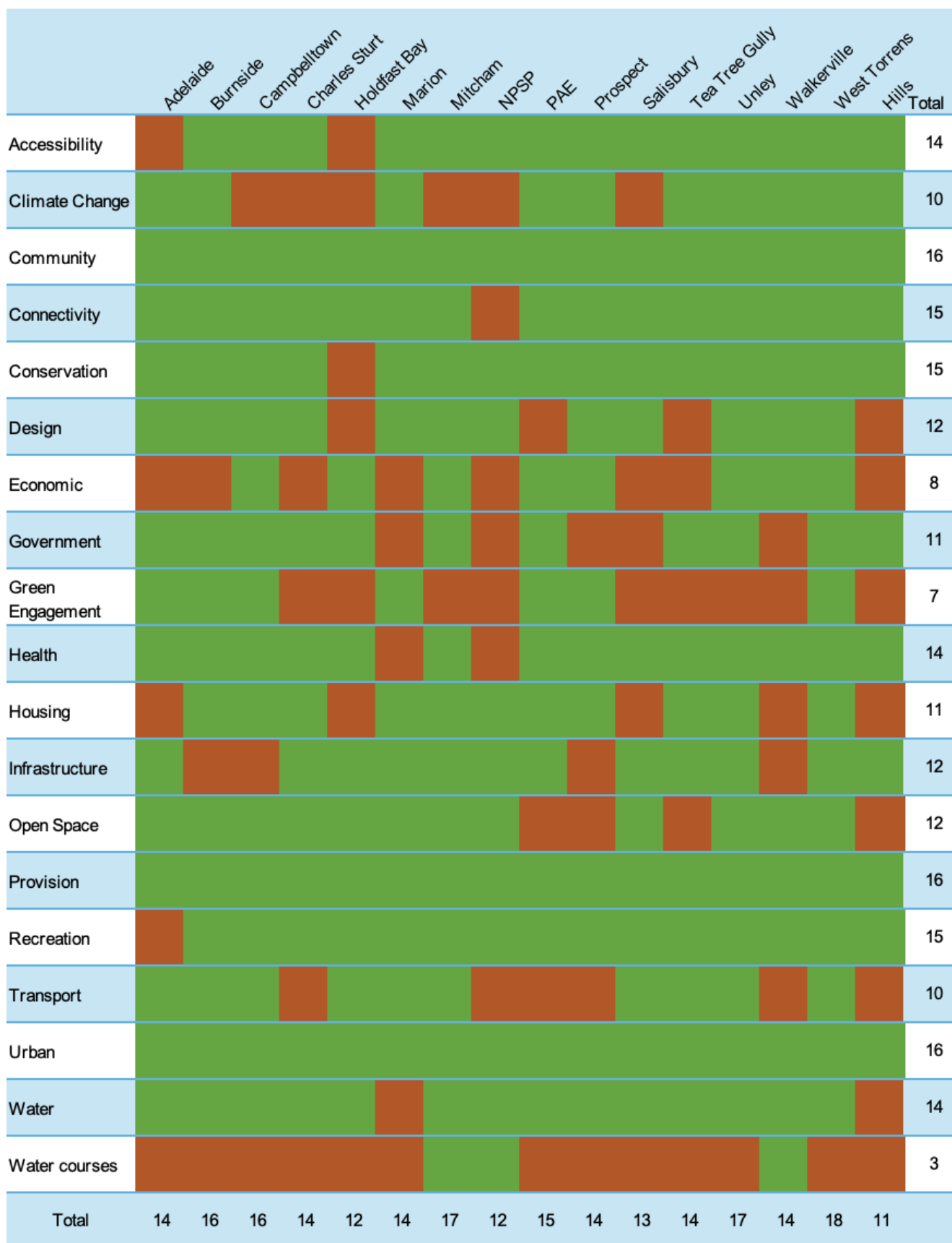


Table 4.1: OSP scores for inner-Adelaide metropolitan LGAs.

As of most recent version publicly available at August 2024.

LGA	Index
Adelaide	29.47
Burnside	49.04
Campbelltown	38.68
Charles Sturt	40.35
Holdfast Bay	30.61
Marion	39.47
Mitcham	63.68
NPSP	33.51
PAE	43.86
Prospect	42.63
Salisbury	39.3
Tea Tree Gully	34.74
Unley	48.6
Walkerville	45.35
WT	61.49
Hills	23.42

4.2 Greenspace and Recreation Survey

4.2.1 Descriptive Statistics

Of 149 survey responses, 100 were deemed usable due to demographic criteria met or completion status of the survey (67.1%). The demographic distribution of respondents is explained in Table 4.2. More respondents identified as female than any other gender (72%). The group of respondents had a median age of 28 years with the most commonly occurring age 30 years. Close to half of respondents are engaged in full-time employment. The majority of respondents were not

of Aboriginal or Torres Strait Islander descent. The distribution of LGA respondents reside in is outlined in Table 4.3. The LGAs with the highest density of response rate of the survey were City of Mitcham, CS, Unley, and WT. The City of CS is amongst the larger inner-Adelaide metropolitan LGAs, with a population of 127, 440 in 2021. Furthermore, The City of WT has a comparatively lower median age on 37.4, suggesting a great portion of the population would have fallen under the appropriate demographic for survey completion. The lowest response rates came from the Town of Walkerville and City of HB. These localities are the smallest and third smallest LGAs, spanning 353 ha. and 1,375.2 ha. respectively. The sample population mean (27.3) and median (28) ages were slightly higher than the mid-point of the age range (24). This could be attributable to a higher population of 25-29-year-olds than 20-24-year-olds residing in South Australia (Australian Bureau of Statistics, 2024). Distribution of respondents created 5 equally populated wards: Central (n=19), consisting of Cities of Adelaide and Unley; North (n=19), consisting of Cities of PAE, Prospect, Salisbury, and Walkerville; East (n=19), consisting of Cities of Burnside, Campbelltown, NPSP, TTG, and Adelaide Hills Council; South (n=22), consisting of Cities of HB, Marion, and Mitcham; and West (n=21), consisting of Cities of CS and WT. This is visualised in Figure 4.3.

Table 4.2: Descriptive statistics of survey respondents

Descriptor	Value (no.)
Gender	
Male	25
Female	72
Gender Diverse	2
Prefer not to disclose	1
Age (years)	
18-22	25
23-26	46
27-30	29
Mean (<i>std dev</i>)	27.3 (3.22)
Employment	
Full-time work	48
Part-time work	16
Full-time student	34
Unemployed	1
Prefer not to disclose	1
Aboriginal and Torres Strait Islander Representation	
Not of Aboriginal or Torres Strait Islander descent	97
Of Aboriginal descent	1
Of Torres Strait Islander descent	0
Prefer not to disclose	2
Total	n = 100

Table 4.3: Survey respondents residence in inner-Adelaide LGAs.

LGA	Value
Mitcham	13
Charles Sturt	11
Unley	10
West Torrens	10
Adelaide	9
Salisbury	9
Marion	8
PAE	6
Burnside	5
NPSP	5
Prospect	4
Campbelltown	3
Tea Tree Gully	3
Adelaide Hills Council	3
Holdfast Bay	1
Walkerville	0
Total	n = 100

Figure 4.3: LGA Distribution by Ward.

Figure removed due to copyright restriction.

4.2.2 Greenspace Perception

Survey respondents were asked about their use and opinions towards greenspaces both in general and in their local area. The results are displayed in Figures 4.4 and 4.5 and Tables 4.4 and 4.5.

Figure 4.4: Average use of local greenspace by survey respondents over 12 months.

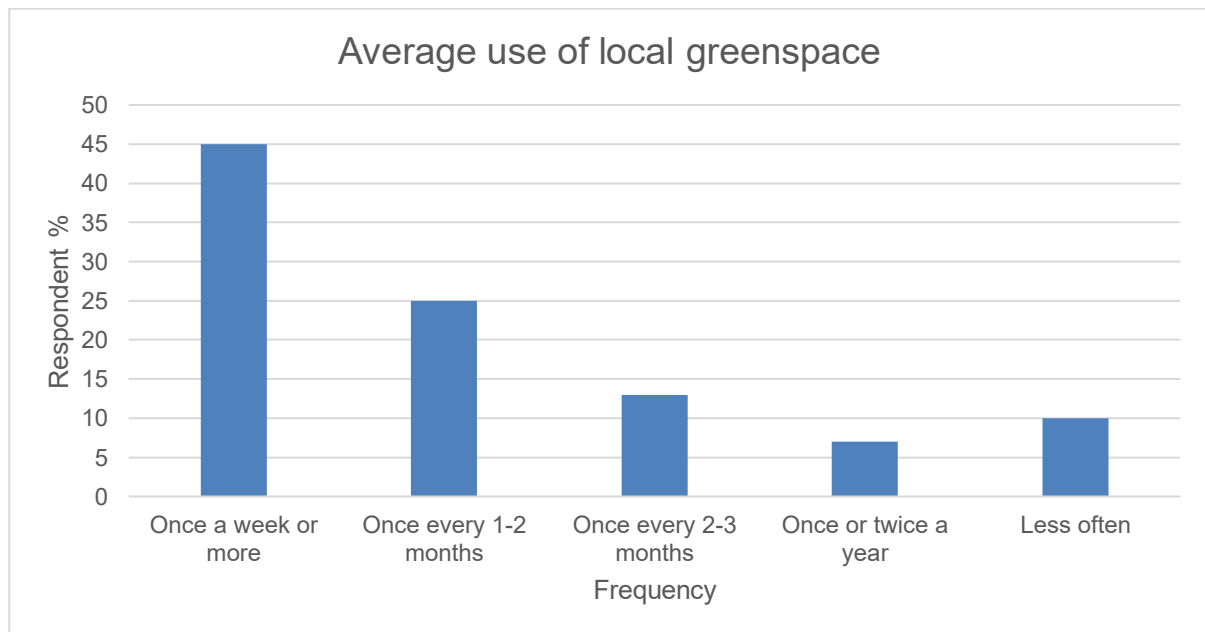


Figure 4.5: Distance of closest UGS from survey respondents' homes in minutes to walk.

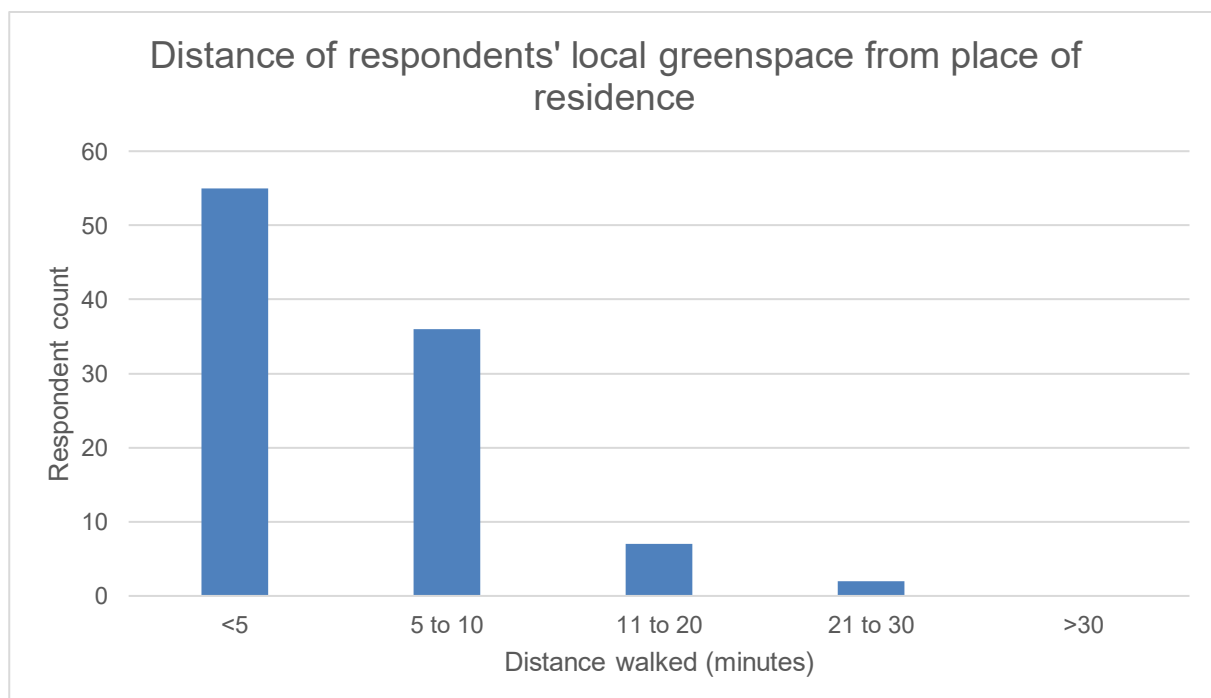


Table 4.4: Survey participant views about general UGS.

Greenspaces should...	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
be places you can relax and unwind	82	16	2	0	0
be safe places to encourage physical activity	89	9	2	0	0
provide opportunities to see the diversity of nature	72	24	3	1	0
be good places to meet others	44	34	17	3	0
make urban areas cooler	66	24	9	1	0
make an area a great place to live	85	13	2	0	0
It is important to have green space in your local area	89	8	3	0	0

Table 4.5: Survey participant views on local UGS.

My local greenspace...	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
is somewhere I can relax and unwind	34	47	10	7	2
is a safe place for physical activity – such as walking, cycling, sports and play	48	40	8	4	0
The quality of my local Greenspace has been reduced in the past 5 years	6	19	49	19	7
allows me to explore the diversity of nature on my doorstep	20	32	25	18	5
is a good place for people to meet others from the local community	15	36	30	12	7
makes my neighbourhood cooler	27	34	28	8	3
I would like to have more of a say in how my local greenspace is managed	20	36	35	8	1
makes the area a great place to live	39	38	16	7	0
I am satisfied with the quality of my local green space	17	55	15	10	3

The majority of survey respondents (40%) utilised UGS at least once a week and had identified an UGS less than 5 minutes from their place of residence (55%). 98% of respondents agreed to some extent that greenspaces should be places to relax and unwind and be a safe place to encourage PA, though only 81% and 88% respectively felt their local greenspace met these expectations. 96% of respondents agreed to some extent that greenspaces should provide them

with the opportunity to see nature in its diversity, whilst only 52% of respondents' local greenspaces did so. While 78% agreed greenspaces should serve a social function, 51% felt their local greenspace fulfilled this. 90% of respondents believed UGSs should reduce the temperature of the local urban environment, though 61% felt their local greenspace achieved this. 98% of respondents agreed that good quality greenspace makes an area a great place to live, with 77% believing their local greenspace did so. 97% of respondents felt it important to have greenspace in their local area. 72% of respondents felt satisfied with the quality of their local greenspace. 25% felt the quality of their local greenspace had declined over the past 5 years, with 56% of respondents feeling they would like to have more of a say in how their local greenspace is managed. Responses by ward are displayed in Table 4.6.

Table 4.6: Survey participant views on local UGS by ward.

	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
My local Greenspace is somewhere I can relax and unwind					
Central	7	10	1	1	0
North	8	7	3	1	0
East	6	10	1	1	1
South	7	10	3	1	1
West	6	10	2	3	0
My local Greenspace is a safe place for physical activity					
Central	12	6	0	1	0
North	9	7	2	1	0
East	9	7	3	0	0
South	8	12	1	1	0
West	10	8	2	1	0
The quality of my local Greenspace has been reduced in the past 5 years					
Central	1	3	11	3	1
North	2	4	8	5	0
East	0	3	9	4	3
South	2	5	9	5	1
West	1	4	12	2	2
My local Greenspace allows me to explore the diversity of nature on my doorstep					
Central	5	6	5	2	1
North	4	7	6	2	0
East	3	7	6	1	2
South	4	7	6	4	1
West	4	5	2	9	1

	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
My local Greenspace is a good place for people to meet others from the local community					
Central	4	3	10	2	0
North	2	12	3	1	1
East	3	6	6	3	1
South	3	9	7	2	1
West	3	6	4	4	4
My local greenspace makes my neighbourhood cooler					
Central	9	8	2	0	0
North	5	4	7	2	1
East	4	7	6	2	0
South	4	10	6	1	1
West	5	5	7	3	1
I would like to have more of a say in how my local greenspace is managed					
Central	3	8	6	2	0
North	7	10	2	0	0
East	1	6	8	4	0
South	4	4	11	2	1
West	5	8	8	0	0
My local greenspace makes the area a great place to live					
Central	12	5	2	0	0
North	5	9	4	1	0
East	10	6	2	1	0
South	5	12	2	3	0
West	7	6	6	2	0

	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
I am satisfied with the quality of my local green space					
Central	5	10	3	1	0
North	1	11	4	2	1
East	3	13	2	1	0
South	5	11	2	3	1
West	3	10	4	3	1

Residents of the Central Ward reported greater feelings of safety and cooling than other regions. These respondents were also stronger in agreeance of their local greenspace contributing to the quality of their neighbourhood, and greater strong satisfaction. The northern ward reported greater agreeance that their local greenspace provided mental wellbeing benefits and community. Northern ward residents reported a greater desire to be involved in local greenspace management than other regions. Residents of this region, however, reported significant neutrality in their agreeance that their local greenspaces provided safety and cooling benefits to their neighbourhood. Eastern ward residents were more neutral than other wards in the perception of local greenspaces being safe places and held less desire to have a say in the management of theses spaces. The southern ward reported a greater sense of safety to complete physical activities and cooling benefits and were greatly satisfied with the quality of their local greenspace. Residents of this area were more neutral in whether they would like more of say in how their local greenspaces are managed and were divided in their opinion that these spaces make their neighbourhood a great place to live. Residents of the western ward reported they did not believe their local greenspaces provided space for relaxation, natural diversity, community, or cooling benefits. Residents were neutral about whether their local greenspaces made their neighbourhoods a great place to live and were more dissatisfied with their local greenspaces.

4.2.3 Recreational Behaviours

Participant behaviours in various recreational activities are described in Tables 4.7-4.10. 84% of survey respondents reported commuting by foot or bicycle at least one day a week. This activity was observed mostly in the afternoon (42.9%), which was commonly an optional time in their day to do so (85.7%). Such commutes mainly took place in the Central Ward (42.9%), particularly within the City of Adelaide (33.3%).

71% of survey respondents reported completing some outdoor physical recreational activity. This activity mostly took place in the evening (45.1%), which was by vast majority not required (91.5%). The majority of this activity was completed within Southern (36.6%) and Central (33.8%) wards, significantly in the City of Adelaide (25.4%), and a considerable amount occurring in City of CS (18.3%) and City of Mitcham (15.5%).

72% of respondents to this survey completed indoor recreational activity at least once a week, with 40.3% of respondents reporting evening activity. 91.7% of this activity was completed at optional times for respondents. The most common location respondents would complete such activity was in the Southern ward (33.3%), namely the City of Marion (19.4%). 65.3% of respondents reported their reported activity typically always takes place indoors.

Nearly half of respondents (49%) reported they did not complete any sedentary recreational activities outdoors. Of the remaining group, 82.5% reported completion during daytime or afternoon hours, with all activity completed at an unscheduled time. Respondents reported significantly greater amount of such activity within the Central ward (35.29%), namely the City of Adelaide (22.81%).

Table 4.7: Survey respondent commuting activity behaviours.

Days Per Week	Count	%
0	16	16
1-2	36	36
3-4	16	16
5-6	12	12
Every Day	20	20
Time of Day		
Early Morning	18	21.4
Morning	29	34.5
Daytime	24	28.6
Afternoon	36	42.9
Evening	29	34.5
Night-time	3	3.6
Time Optional		
Yes, could complete any time	24	28.6
Yes, but this time was best	48	57.1
No, this time necessary	10	11.9
Council Ward		
Central	36	42.9
East	22	26.2
South	21	25
West	19	22.6
North	20	23.8

Table 4.8: Survey respondent outdoor recreational physical activity behaviours.

Days Per Week	Number	%
0	29	29
1-2	45	45
3-4	19	19
5-6	4	4
Every Day	3	3
Time of Day		
Early Morning	15	21.1
Morning	18	25.4
Daytime	17	23.9
Afternoon	21	29.6
Evening	32	45.1
Night-time	1	1.4
Time Optional		
Yes, could complete anytime	20	28.2
Yes, but this time was best	45	63.4
No, this time necessary	6	8.5
Council Ward		
Central	24	33.8
East	18	25.4
South	26	36.6
West	21	29.6
North	13	18.3

Table 4.9: Survey respondent indoor recreational physical activity behaviours.

Days Per Week	Number	%
0	28	28
1-2	24	24
3-4	29	29
5-6	14	14
Every Day	5	5
Time of Day		
Early Morning	17	23.6
Morning	20	27.8
Daytime	9	12.5
Afternoon	20	27.8
Evening	29	40.3
Night-time	3	4.2
Time Optional		
Yes, could complete any time	19	26.4
Yes, but this time was best	46	63.9
No, this time necessary	6	8.3
Activity Normally Occurring Indoors		
Always	47	65.3
Often	11	15.3
Sometimes	9	12.5
No, not normally indoors	4	5.6

Council Ward	Number	%
Central	18	25
East	16	22.2
South	24	33.3
West	11	15.3
North	17	23.6

Table 4.10: Survey respondent outdoor recreational sedentary behaviours.

Days Per Week	Number	%
0	49	49
1-2	30	30
3-4	13	13
5-6	3	3
Every Day	5	5
Time of Day		
Early Morning	4	7
Morning	9	15.8
Daytime	223	40.4
Afternoon	24	42.1
Evening	15	26.3
Night-time	5	8.8
Time Optional		
Yes, could complete any time	28	49.1
Yes, but this time was best	23	49.4
No, this time necessary	0	0
Council Ward		
Central	18	35.3
East	11	21.6
South	12	23.5
West	11	21.6
North	7	13.7

4.3 Survey Analysis

Figure 4.6 displays a significantly higher incidence of outdoor commuting activity within the central ward in comparison to residence count (89%). Greater commute activity can also be observed amongst eastern LGA's (16%). Despite a decrease in commuting behaviours in comparison to residence density amidst southern (5%) and western wards (10%), a considerable increase is seen within the Cities of Marion (25%) and CS (18%), as expressed in Figure 4.7.

Figure 4.6: Reports of commute behaviour against residence by ward.

Sorted by percent change.

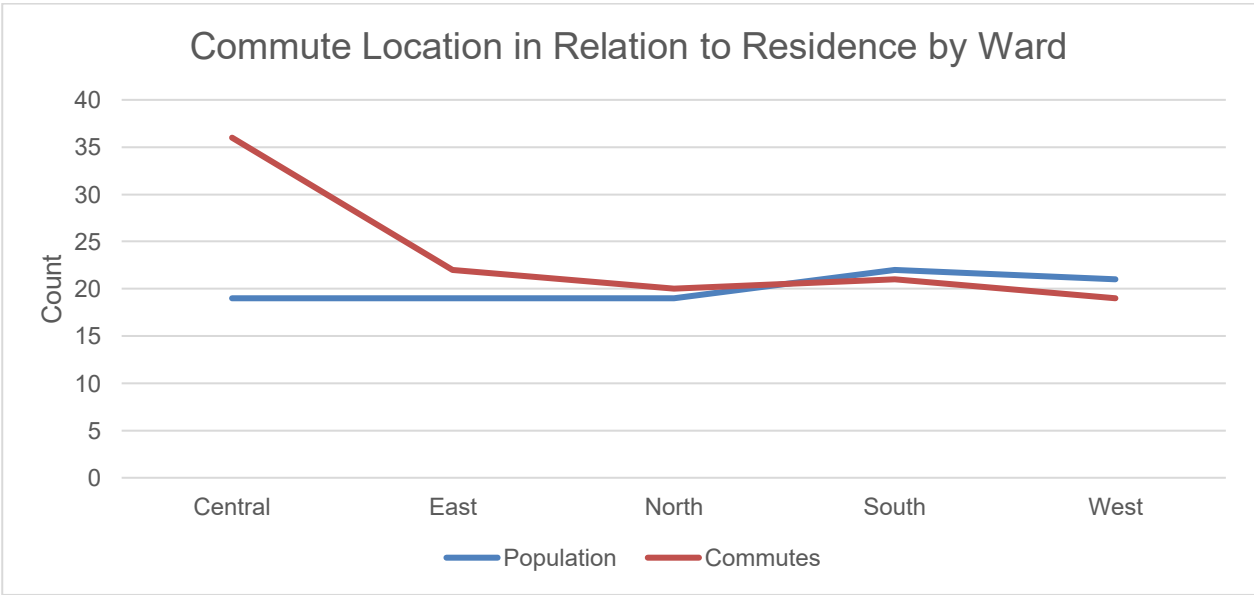


Figure 4.7: Reports of commute behaviour against respondent residence by LGA.

Sorted by percent change.

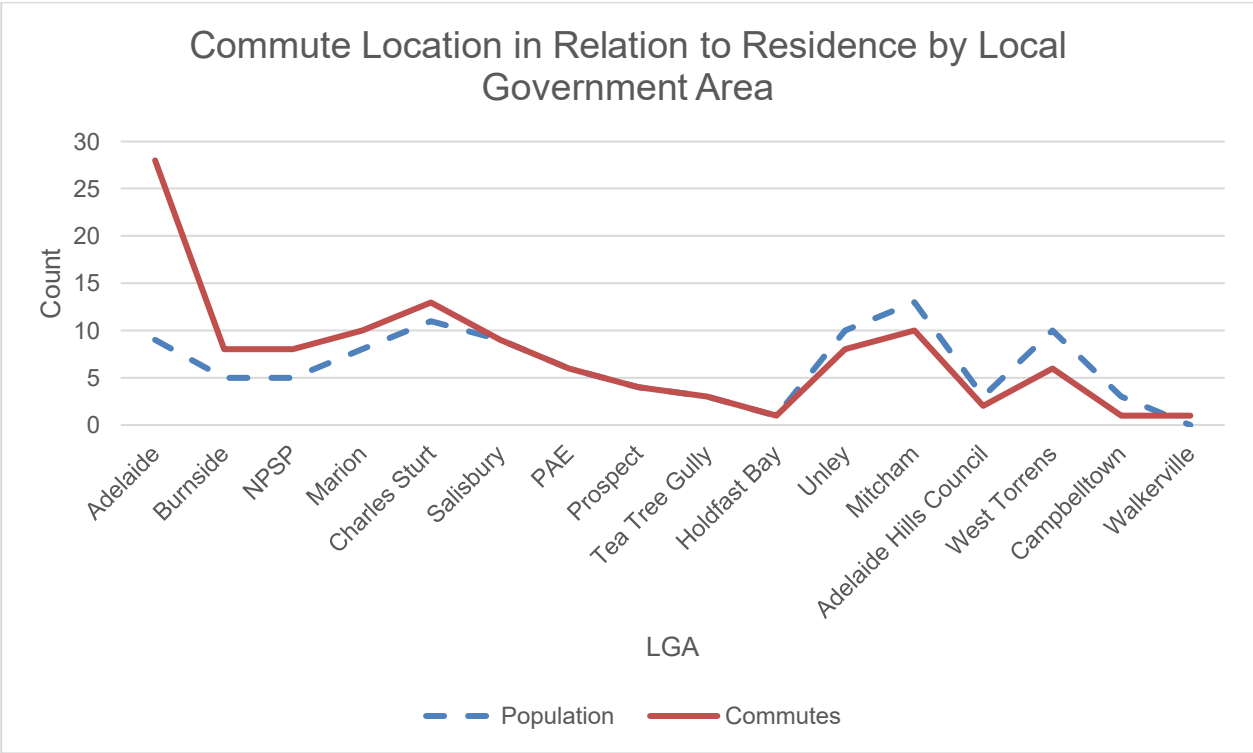


Figure 4.8 displays outdoor recreational activity higher in comparison to residence density in the central (26%) and southern (18%) wards, mostly from a significant rise in Cities of HB (500%) and Adelaide (100%). The City of Burnside also saw a considerably greater incidence of recreation (60%), as seen in Figure 4.9. Northern LGAs saw significantly reduced participation in outdoor recreation (32%).

Figure 4.8: Reported outdoor recreational physical activity against residence by ward.

Sorted by percent change.

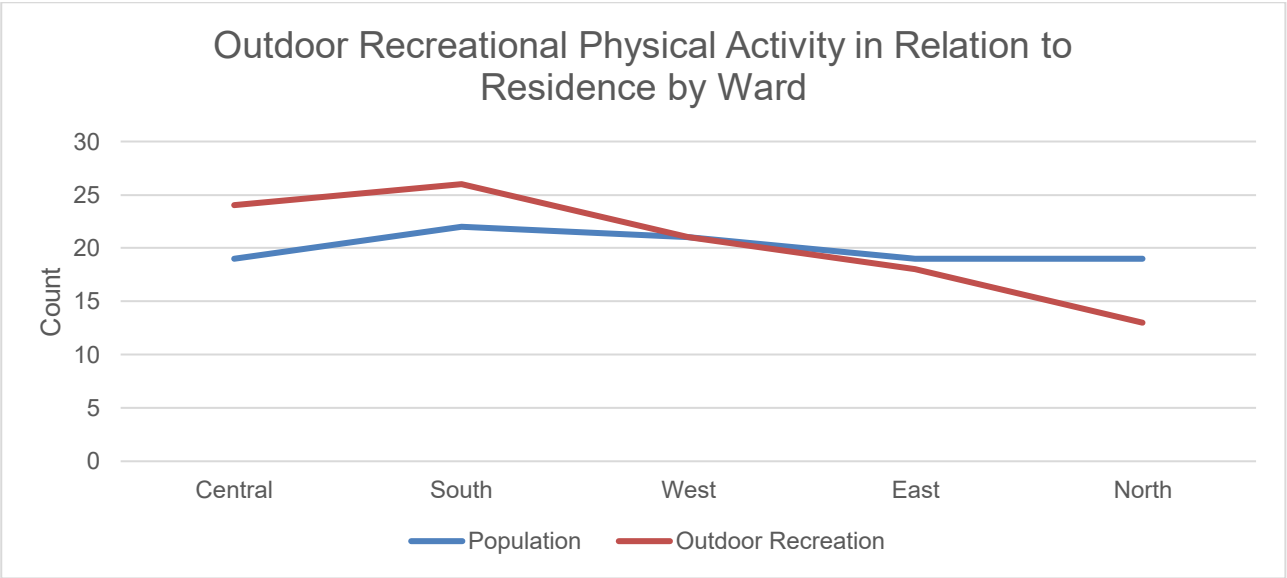
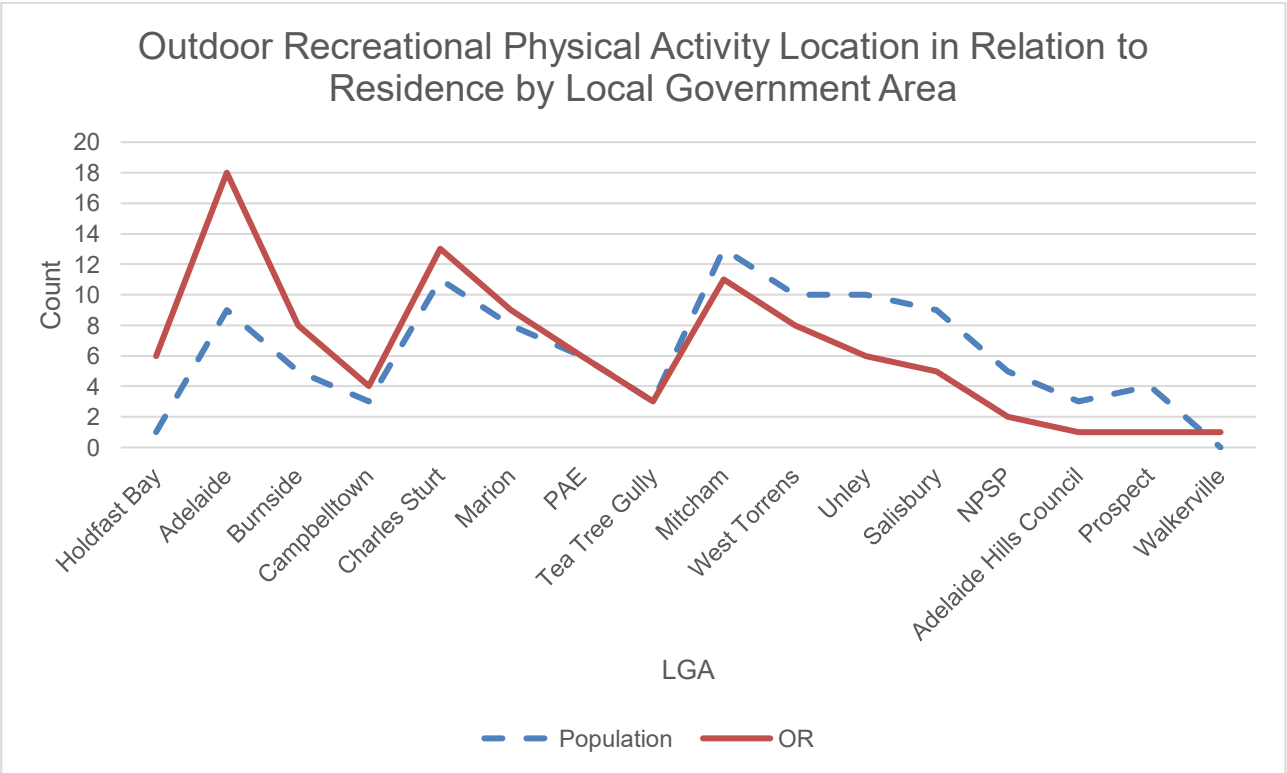


Figure 4.9: Reported outdoor recreational physical activity against residence by LGA.

Sorted by percent change.



LGA's within the western ward saw significantly lower indoor recreational activity in comparison to residence (48%) (Figure 4.10). Generally, indoor recreational activities were not significantly different from residence levels amongst the remaining LGA's, though the City of Marion sees the greatest incidence of indoor recreational activity in comparison to residence (75%), with a slight rise seen in Cities of NPSP (40%) and PAE (33%) (Figure 4.11).

Figure 4.10: Reported indoor recreational physical activity against residence by ward.

Sorted by percent change.

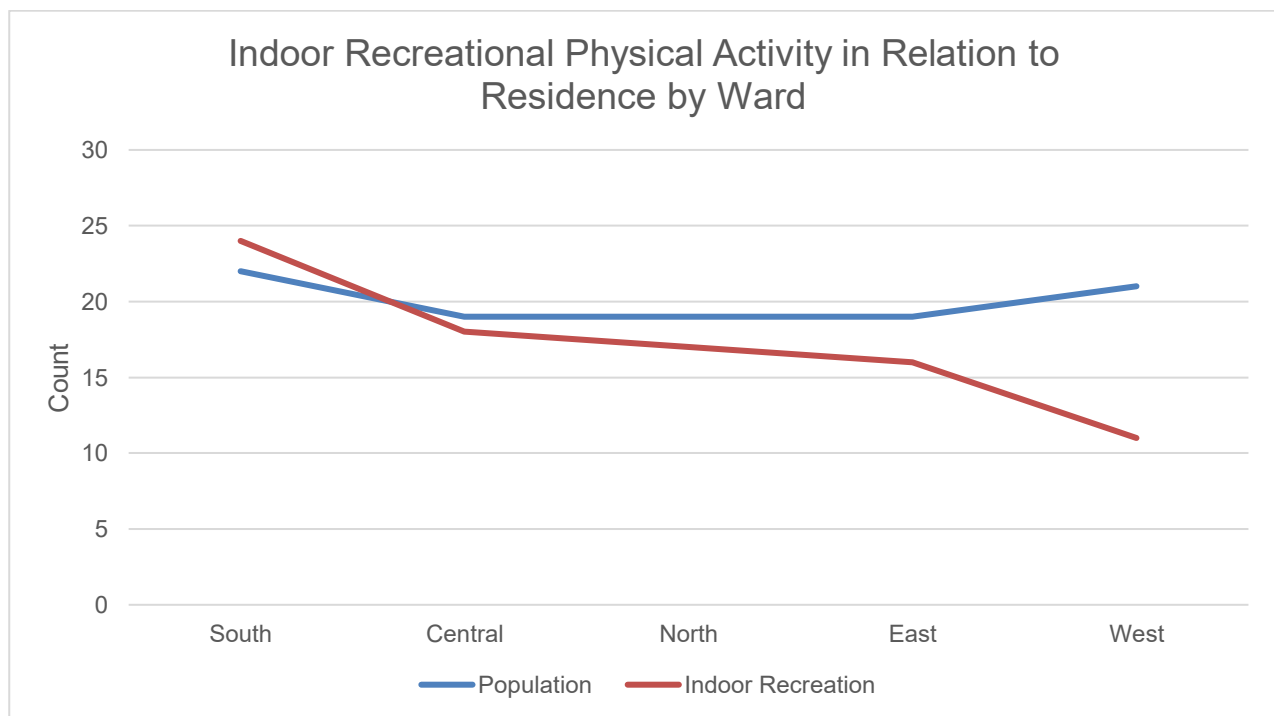
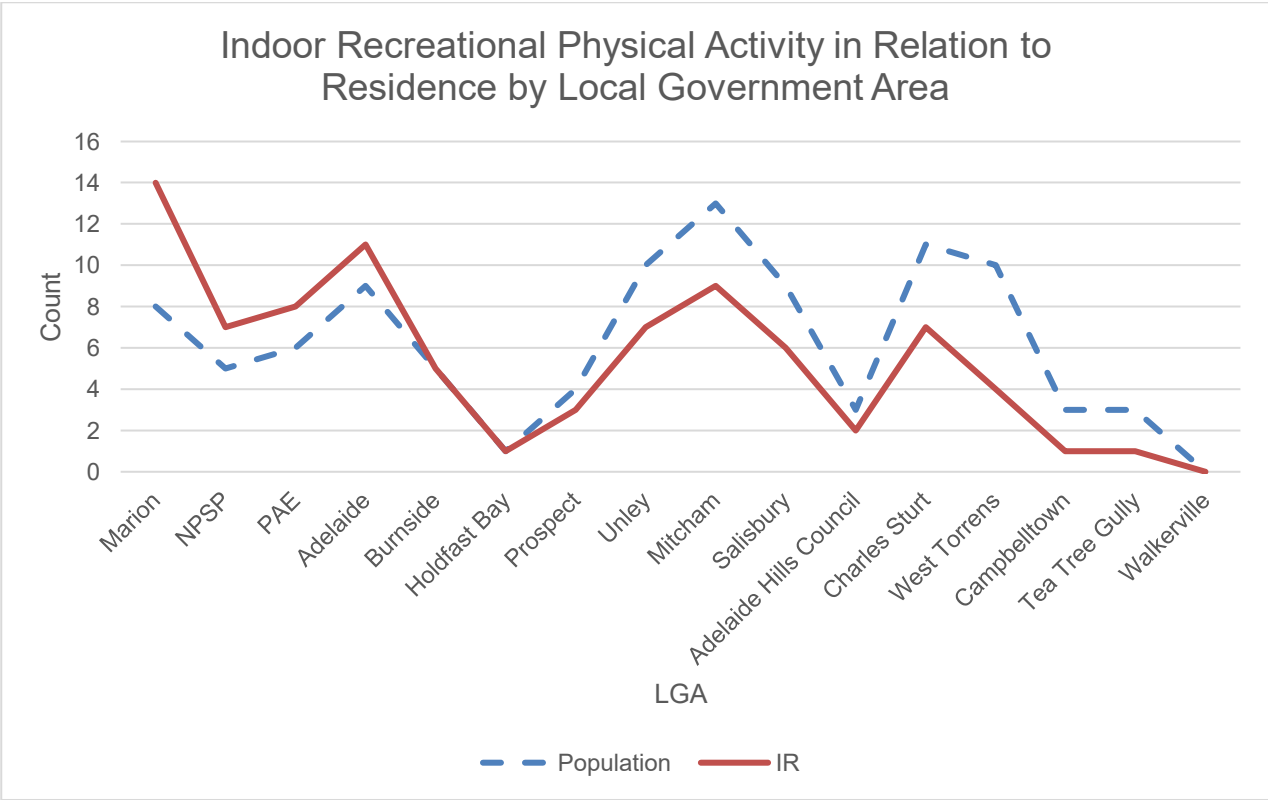


Figure 4.11: Reported indoor recreational physical activity against residence by LGA.

Sorted by percent change.



Outdoor sedentary recreational activity was generally lower in comparison to residence across all wards (Figure 4.12), however a greater incidence was seen solely in the Cities of HB (200%) and Adelaide (44%) (Figure 4.13).

Figure 4.12: Reported outdoor sedentary recreational activity against residence by ward.

Sorted by percent change.

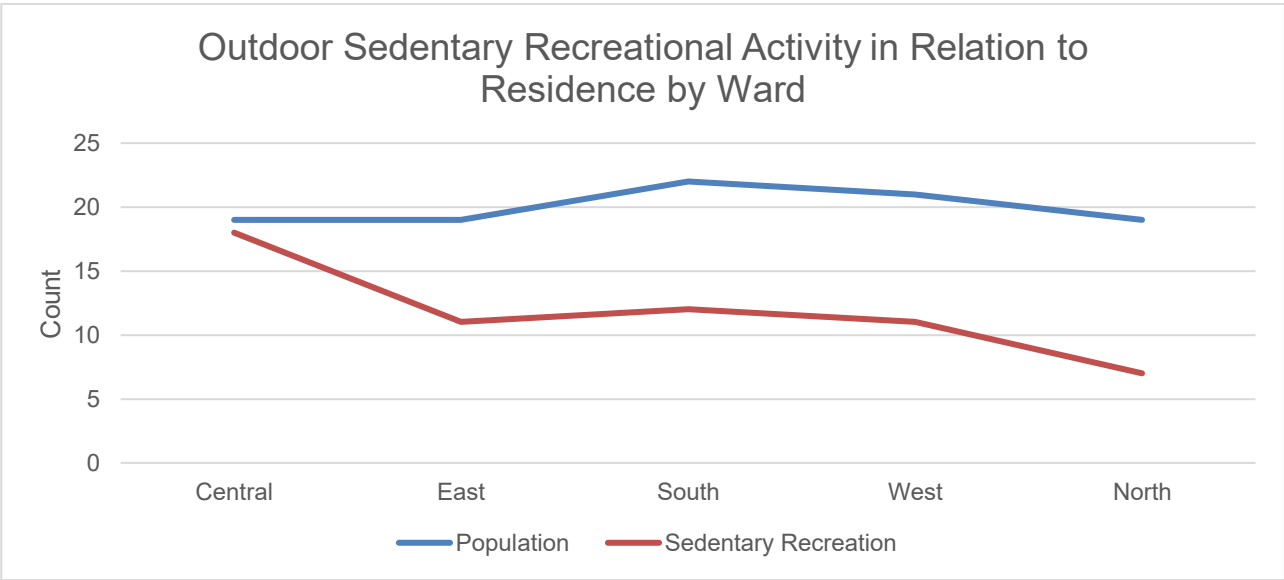
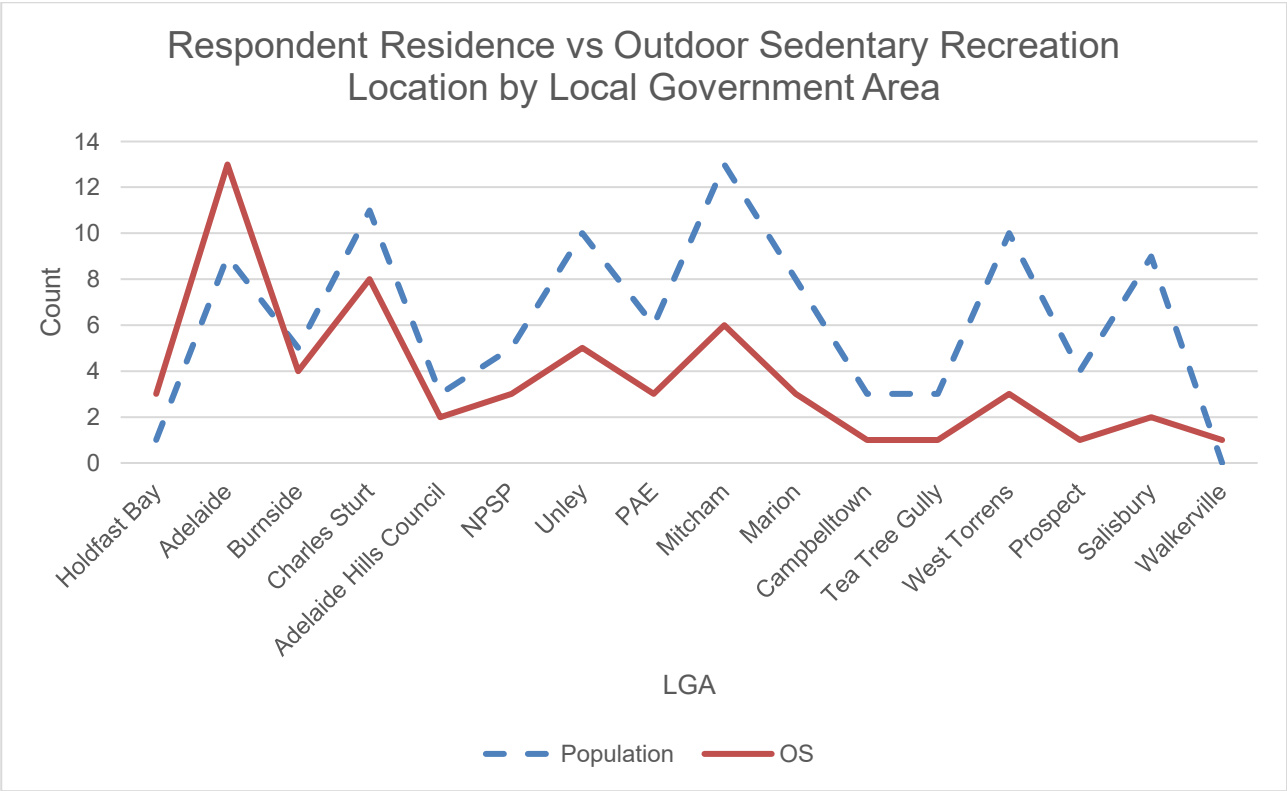


Figure 4.13: Reported outdoor sedentary activity against residence by LGA.

Sorted by percent change.



4.4 Vegetation Analysis

Images for evaluation were sourced from Copernicus Dataspace Browser from the European Space Agency. The image selected was captured from the Sentinel-2A instrument on 18/01/2025. NDVI across the studied region is numerically displayed in Table 4.11. The average NDVI score across the assessed region was 0.21 (+/- 0.045), with median value 0.214. A visualisation of NDVI across the study area can be viewed in Appendix 3. Area distribution of NDVI score classifications is displayed in Figure 4.14, with distribution by LGA ward visualised across Figures 4.15. The majority of inner-Adelaide metropolitan area is sparsely vegetated, though cities of Burnside, Campbelltown, Mitcham, Unley, and Hill City Council show moderate coverage. The high standard deviations indicate high variability amidst data. Most LGAs follow somehow normally distributed classifications of space, except for the Cities of Adelaide and TTG, exhibiting bimodal distributions.

Table 4.11: NDVI scores by LGA.

LGA	Min	Max	Mean (Std Dev.)
Adelaide	-0.11	0.71	0.24
Burnside	-0.096	0.68	0.27
Campbelltown	-0.14	0.7	0.22
Charles Sturt	-1	0.7	0.16
Holdfast Bay	-0.25	0.72	0.18
Marion	-0.22	0.7	0.18
Mitcham	-0.1	0.69	0.28
NPSP	-0.076	0.68	0.21
PAE	-1	1	0.14
Prospect	-0.082	0.68	0.2
Salisbury	-1	0.73	0.16
Tea Tree Gully	-1	0.72	0.21
Unley	-0.091	0.69	0.22
Walkerville	-0.3	0.68	0.24
West Torrens	-0.23	0.73	0.17
Hills	-1	0.81	0.29
Study Area	-1	1	0.21 (+/- 0.045)

Figure 4.14: NDVI classification through inner-metropolitan Adelaide area 18/01/2025.

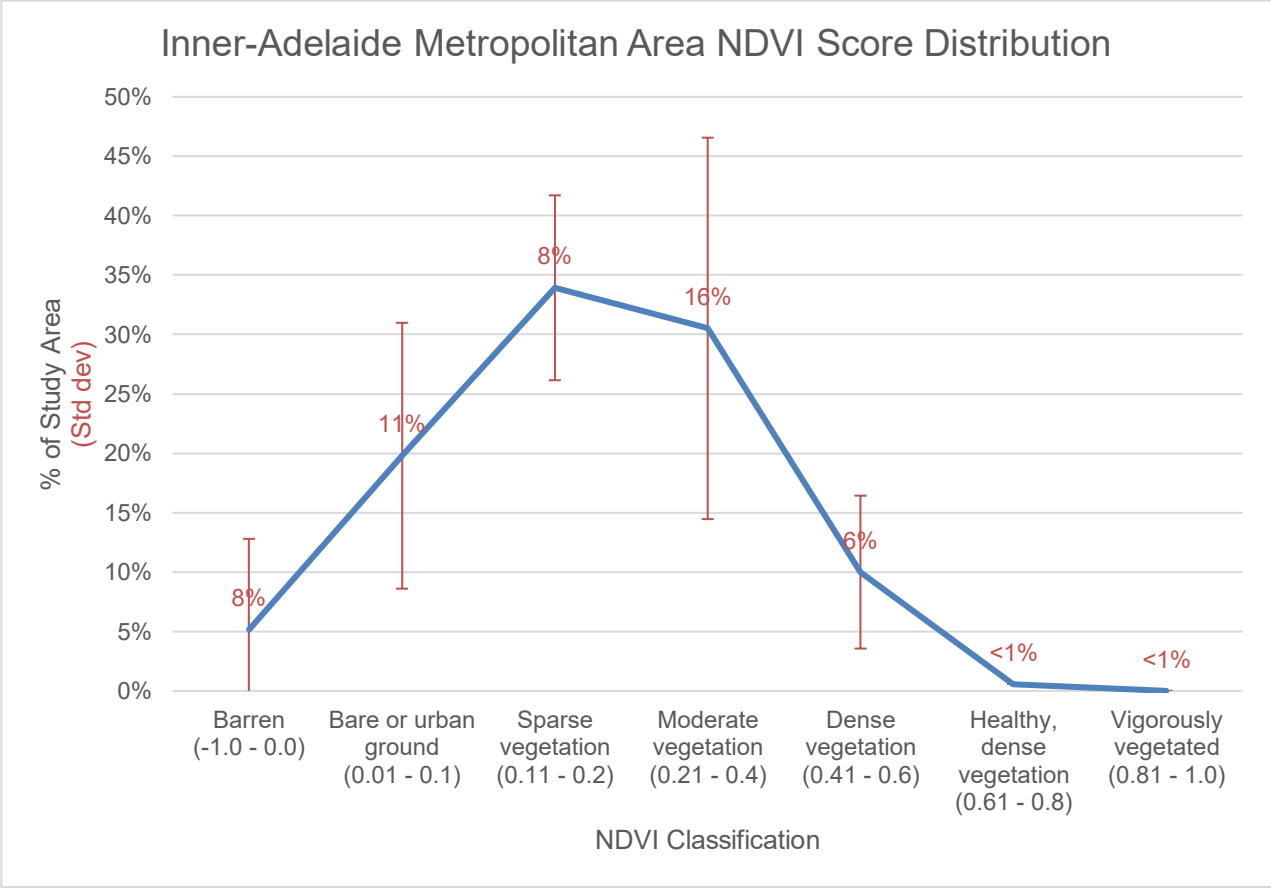
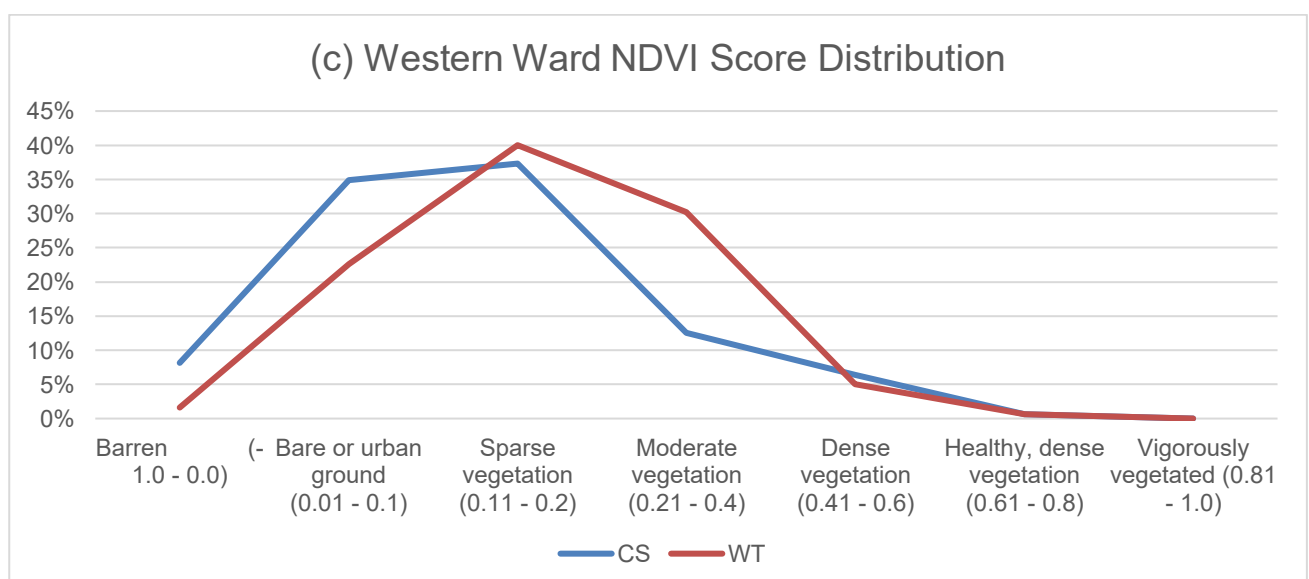
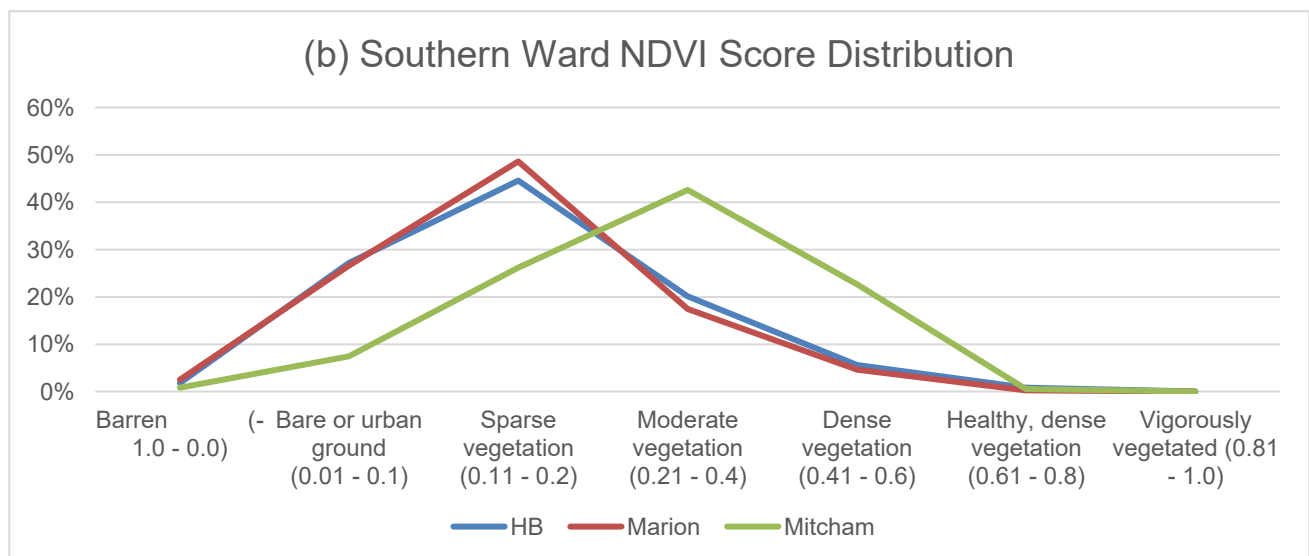
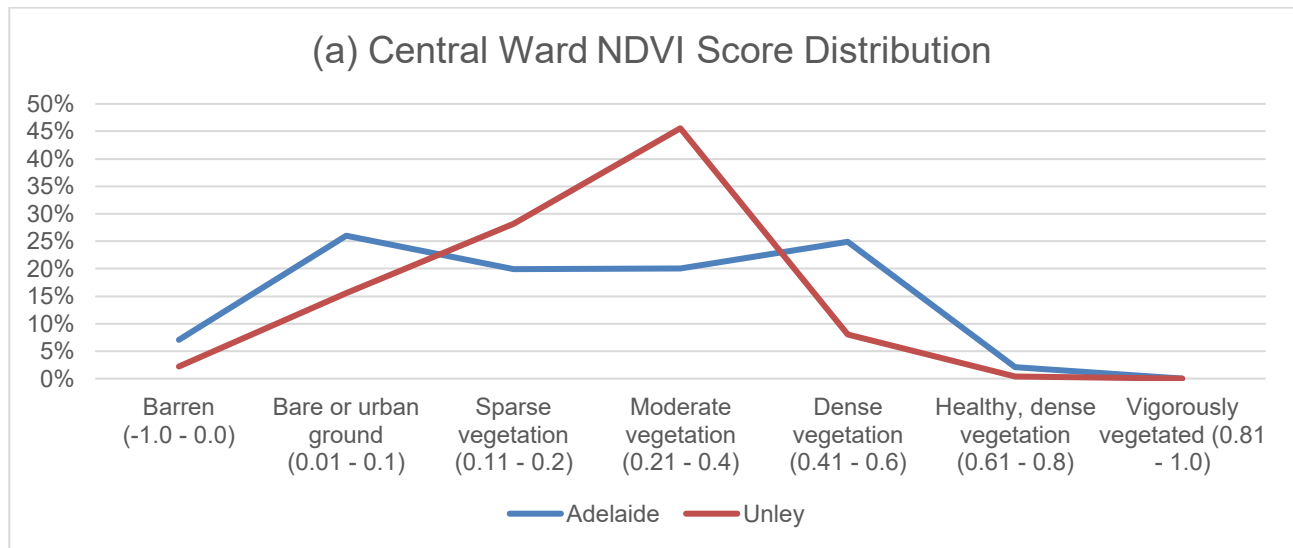
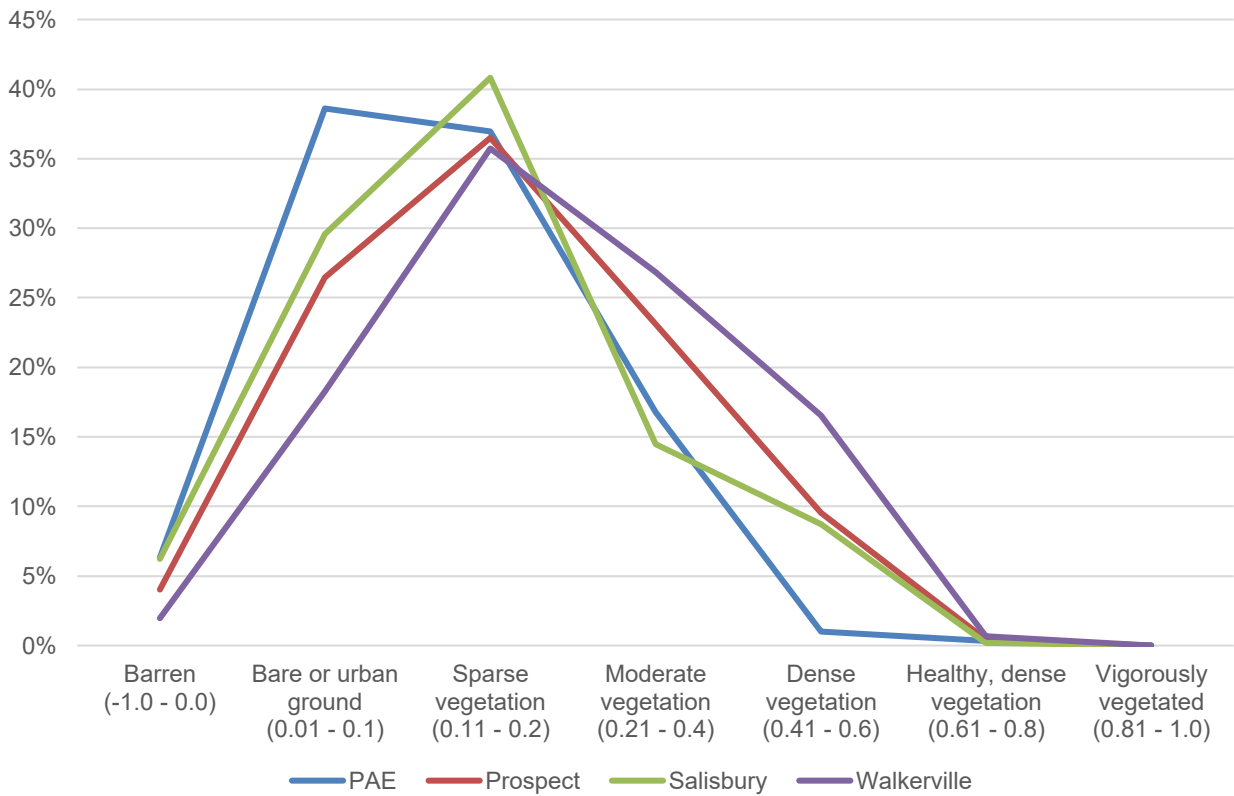


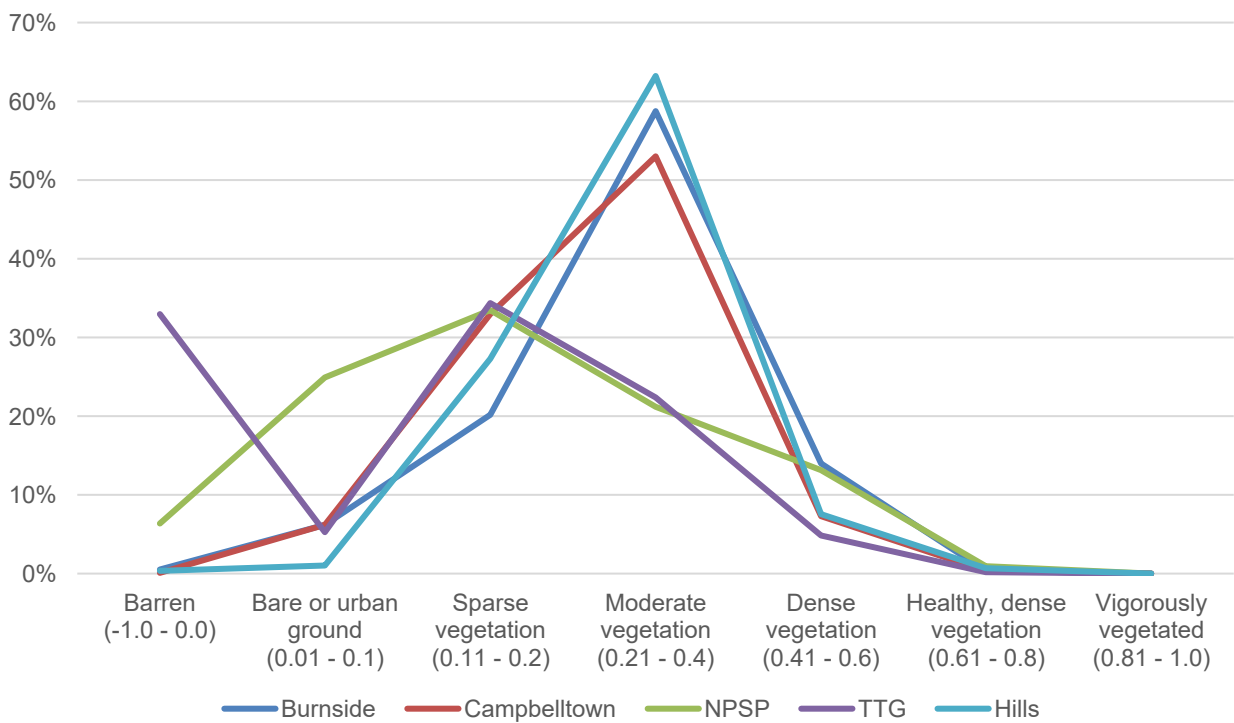
Figure 4.15.a-e: Distribution of NDVI scores across LGA.



(d) Northern Ward NDVI Score Distribution



(e) Eastern Ward NDVI Score Distribution



4.5 Comparative Analysis

A regression analysis between Open Space Policy indices, NDVI mean, and surveyed behaviours (Table 4.12) showed no correlation between residence NDVI and LGA OSP index or commute likelihood, no correlation between LGA OSP index and resident outdoor sedentary recreation. Weak correlation existed between LGA OSP index and commute location. Little correlation between residence NDVI and likelihood of outdoor active or sedentary recreation was shown. A moderate correlation between residence NDVI and likelihood of indoor recreational activity, and between LGA OSP score and both outdoor and indoor recreational activity was highlighted. Each analysis, however resulted in a low goodness of fit (R^2). As such, outliers were removed and regressions were run again (Table 4.13).

Table 4.12: Regression analysis of LGA OSP, NDVI, and surveyed behaviours.

R VALUE (R^2)					
	OSP Score	Commute	Outdoor Recreation	Indoor Recreation	Sedentary Recreation
NDVI Mean	0.009 (8.05E-05)	0.022 (0.00046)	0.051 (0.0026)	0.15 (0.022)	0.11 (0.013)
OSP Score	-	0.043 (0.0018)	0.17 (0.03)	0.15 (0.021)	0.017 (0.00027)

Table 4.13: Regression analysis of LGA OSP, NDVI, and surveyed behaviours.

Outliers removed, indicated in italics.

R VALUE (R²) [<i>Outlier</i>]					
	<i>OSP Score</i>	<i>Commute</i>	<i>Outdoor Recreation</i>	<i>Indoor Recreation</i>	<i>Sedentary Recreation</i>
NDVI Mean	0.26 (0.066)	0.22 (0.05)	0.22 (0.049)	0.056 (0.0032)	0.038 (0.0014)
	<i>[Hills]</i>	<i>[Adelaide]</i>	<i>[Adelaide]</i>	<i>[Marion]</i>	<i>[Adelaide]</i>
OSP Score	-	0.38 (0.15)	0.51 (0.26)	0.21 (0.045)	0.37 (0.14)
		<i>[Adelaide]</i>	<i>[Adelaide]</i>	<i>[Marion]</i>	<i>[Adelaide]</i>

Removal of outliers presents stronger correlation between factors and LGA OSP index. A moderate relationship remains between open space policy index and indoor recreation, though with a stronger R² value (0.045). Considerable correlation has arisen between open space policy index and commute and sedentary recreational behaviour, and good correlation between the index and outdoor recreation by removing the densely reported City of Adelaide from calculation. No more than a moderate relationship between NDVI and any surveyed factors has arisen, however R² indicates better fit of the model. This suggests local governmental influence has a greater effect on residential and visitor outdoor activity than objective greenness of a location.

5. DISCUSSION

5.1 Recreational Behaviours

5.1.1 Commuting Activity

Significantly less commuting activity to residence was observed in Cities of Campbelltown and WT, both of which are situated along the Karrawirra Parri River Torrens Linear Park Trail. The City of Campbelltown is situated further east from the City of Adelaide, the most common commute destination, than the inner-eastern City of NPSP. Various studies suggest commutes beyond 2.5-5km (general consensus threshold 3.7km) rely on additional infrastructural and lifestyle habitual factors to encourage cycling activity (Grigore et al., 2019; Lowry et al., 2016; Pritchard et al., 2019). It can also be suggested residents may not perceive benefits can be received from outdoor commuting methods (Fisher et al., 2021; Wu et al., 2022). The City of WT, however, is equidistant from the CBD as the northern neighbouring City of CS. The path on the southern side of Karrawirra Parri, however, requires each intersecting road to be crossed at street level, whereas the northern City of CS incorporates a series of underpasses to avoid this (Government of South Australia, 2025). Complexity of route and frequency of intersections are a discouraging factor to commuting longer distances by foot, bike, or scooter due to factors including mental fatigue and perceived safety (Codina et al., 2022; H. Gao et al., 2021).

5.1.2 Outdoor Recreational Physical Activity

Higher incidence of outdoor recreation in the City of HB could be suggested to be promoted by Coast Park, a common location for PA such as walking and running, as well as hosting more popular water activity areas of the metropolitan beaches (City of Holdfast Bay, 2025). The City of Adelaide also hosts a series of popular locations for PA such as a section of the Karrawirra Parri trail, the Warnpangga Park 10 sport and fitness facilities, and the Pirltawardlii Park 1 golf course (City of Adelaide, 2025b). Citizens are generally willing to travel from their residential areas to engage with UGS or greater suitability to meet engagement intentions (Chen et al., 2021).

Adequately structured greenspace including dedicated infrastructure like pathways contribute to the promotion of PA and outdoor commuting amongst young people, particularly along common routes or by landmarks (Barron & Rugel, 2023; Zhong et al., 2022). The most effective greenspace in regards to human benefits are those planned with consideration of community structures (Ryan et al., 2024). Factors such as aesthetics, wildness, and space for activities cater to reception of benefits more so than quantitative provision, particularly amongst denser urban environments (Barron & Rugel, 2023; Nur et al., 2024). The Cities of Adelaide and HB offer notable examples of this infrastructure, demonstrating that metropolitan Adelaide residents will travel from their own residential LGA to partake in PA in these locations.

5.1.3 Indoor Recreational Physical Activity

There is limited evidence that outdoor PA provides additional physiological benefits than that completed indoors (Noseworthy et al., 2023), however psychological benefits may be boosted. PA completed by those in natural environments experienced greater associated positive emotions and had a stronger effect in reducing anxiety than those completing activity in more urbanised, industrial, or indoor settings (Wicks et al., 2022). Outdoor PA also optimises influences on anger, energy, fatigue, and attitude towards PA. The presence of accessible greenspace in one's urban setting does assist in encouraging PA and adoption a healthier diet (Wang et al., 2021).

Respondents were more likely to participate in indoor PA than outdoor PA between 9pm and 10am. Whilst outdoor activity completed during any daylight hours reaps mood, cognitive, and general health benefits (Burns et al., 2021; Klotz et al., 2023; Schamilow et al., 2023), morning outdoor activity better predicts next night sleep quality, which in turn affects MH status (Anderson et al., 2025; Wickham et al., 2020). Weather can deter outdoor PA participation (Fan et al., 2023), and delayed exercise that is of vigorous intensity can impede on regular sleep cycles, including delaying rapid eye movement onset, and recovery from exercise (Leota et al., 2025; Yue et al., 2022). Encouraging outdoor PA to be completed in the morning can optimise sleep and recovery from exercise, and reap psychological, cognitive, and physiological benefits.

5.1.4 Sedentary Recreational Activity

The survey returned lower general reports of outdoor sedentary recreation. While this activity is closer linked to older populations (Lu & Misni, 2024), studied recreational behaviours for the targeted age group often encompass physical activities. Australian residents do typically engage with greenspace with the intention of partaking in PA (Boulton et al., 2021), though the literature fails to assess benefits of valid sedentary hobbies such as reading or art as well as the benefits of greenspace engagement outside of PA (Birch et al., 2020; Davies et al., 2020; Henderson et al., 2024; Lackey et al., 2021; Moreira-Almeida et al., 2021). Literature does, however, highlight increased sedentary behaviour amongst young people, mostly indoors and relating to technology. The likelihood of adopting sedentary behaviours, largely around technology use, is linked to preference for indoor activity, lack of interest in sport or PA, and lack of physical urban space (Martins et al., 2021). Large proportions of young people have reported the magnitude of their technology usage has led to negative impacts on academic performance, social interactions, and sleep behaviours (Kolhar et al., 2021). Recent research has begun to suggest increased use of online connection platforms distorts young people's sense and definition of social connection; whilst the increased access to community can support young people's personal development through identity exploration and coping mechanisms, this is heavily reliant on non-reciprocal socio-emotional connections. This reliance can create feelings of depression, anxiety, neuroticism and low self-awareness through increased self-comparison and parasocial models of inclusion during a vulnerable time of cortical development (Fioravanti et al., 2021; Hoffner & Bond, 2022; Krokstad et al., 2022). This form of use of technology and social media only reinforces the role of greenspace interaction in supporting self-confidence and self-care behaviours (Barron & Rugel, 2023; Birch et al., 2020; Moreira-Almeida et al., 2021), not to replace social media usage, but to reinforce the self-efficacy and empathy that can be harboured through online social interactions (Kim et al., 2023).

5.2 Greenspace Engagement

Respondents generally reported that they want a greater say in how their greenspace is managed, though a significant attitude of neutrality towards the statement is observed in the southern and eastern wards. Whilst research has shown resident desire for such engagement is largely dependent on context such as socioeconomic, gender, and racial demographic (DeCaro et al., 2025; Lo & Jim, 2010; Mattijssen et al., 2017; Mohapatra & Mohamed, 2013; Slater, 2022), Mattijssen et al. (2017) recognised a series of dimensions that influenced resident desire for community-based greenspace management. These include design, management, green engagement initiative, social capability, resources, and policy. In support of this study, LGAs within the central, northern, and western wards had significantly greater indices of inclusion of urban, design, community, and economic considerations in comparison to the southern and eastern regions. Aspects of government responsibility to management and existence of standing green engagement initiatives, despite being recognised by Mattijssen et al. as important motivators of desire for green engagement, had no significant difference in indices of inclusion between the two groups of wards. Formal policy structure was recognised as the most important driver of intent to engage with local UGS, though southern and eastern LGA OSP indices were on average 41% higher than other regions. DeCaro et al. (2025) recognised platforms for community-based governance, diverse governance, and operational capacity as motivators for resident-based UGS management, aspects best fitting definitions of green engagement, accessibility, and open space in this study. The indices of accessibility and open space were significantly higher amongst wards where residents expressed wanting more capacity for greenspace management in comparison to the neutral southern and eastern respondents.

Sense of attachment is also a significant indicator of community-based greenspace management in literature (Mattijssen et al., 2017; Mohapatra & Mohamed, 2013). Demographic questions did not ask respondents how long they had lived in the area they are representing, though time lived alone does not necessarily relate to sense of belonging or level of consideration for one's space. Perceived quality of infrastructure and environment does more to foster a sense of belonging (Atiqul Haq et al., 2021; Blokland et al., 2023). LGA wards where residents expressed more desire in local UGS management typically included consideration of infrastructural aspects of

UGS, however, inclusion of environmental considerations were consistent amongst the two groups. Civic participation also has no correlation to time lived in an area, however this link is stronger amongst home owners (Shin & Yang, 2022) so one must consider the higher proportion of renters to homeowners amidst Adelaide's population under 30 (Australian Institute of Health and Welfare, 2024).

Southern and western localities have reported limited opportunities to experience nature in its diversity. Biodiversity encourages engagement with a greenspace (Aronson et al., 2017) and enhances the reception of physical health benefits from UGS interaction (Houlden et al., 2021; Semeraro et al., 2021), so a limited perception of this amongst southern residents despite the ward being of median NDVI could contribute to neutrality towards wanting a connection to how their local greenspace is managed. The western LGA reported the lowest average NDVI of the study areas. Residents of this region also feel a poorer sense of social opportunity with their local open spaces and felt less strongly about the general contribution of open spaces to the liveability of their suburbs. Biodiversity encourages social cohesion and strengthens relationships when biodiverse spaces are utilised during interaction (Cameron et al., 2020). Community structure and social security act as significant protective factors of quality of life in young people, whilst lack of attachment or appreciation for one's surroundings is a major risk factor (Ryan et al., 2024; Salaripour et al., 2023; Zhao et al., 2024). Genuine connectedness and sense of belonging to one's local greenspace also improves the efficacy of benefits obtained from its engagement (Lackey et al., 2021; Zhao et al., 2024). The lack of willing reception to the known psychological, physical, and social benefits of greenspace use resulting from limiting one's engagement only exacerbates discouragement of use and weakens social cohesion.

A considerable portion of survey respondents felt their local greenspace did not provide a safe setting to partake in PA. Perceived safety can be classed by either trust in physical soundness, which is expressed through evidence of infrastructural and environmental maintenance, or protection from harmful behaviours, which is of significant importance for women and young families (Lyons et al., 2022; Venter et al., 2021). Perceived undesirability of infrastructure within greenspaces such as uneven footpaths or overgrown vegetation strongly deters participation in PA

(Almanza et al., 2012). Indicators of the latter interpretation of safety can be infrastructural, including adequate lighting and visibility, however proximity to greenspace via well-maintained and easily accessible pathways encourages increased greenspace access and use, deterring crime (Department of Sustainability and Environment, 2025; Lyons et al., 2022). Perceived provisional access and hence personal safety within a greenspace provides not only acts as an influencing factor for use, but also for reception of the restorative benefits associated with greenspace interaction, despite no association between safety and perceived naturalness existing (Fisher et al., 2021).

5.3 Vegetation Quality

The eastern ward displayed significantly greater NDVI scores than surrounding regions. The central and southern wards also displayed considerable advances on the vegetation quality of the northern and western regions. Amongst this, individual LGA's show the emergence of several patterns of distribution in NDVI. A peak of sparse vegetation was observed within Cities of HB, Marion, NPSP, Salisbury, Prospect, WT. Whilst efforts for greenspace provision may be in place within these areas, such lacking in detectable quality aligns with reduced distribution of tree canopy above 3 metres, as displayed in Figure 5.1 (DSM Geodata, 2024). A plateaued peak between bare ground and sparse vegetation within Cities of PAE and CS reflect similar distribution. A peak at moderate vegetation amidst the Cities of Unley, Mitcham, Campbelltown, Burnside, and Hills City Council are also reflected by increased tree canopy coverage across this inner-southern and eastern band. Provision of greenspace alone cannot ensure benefits of user health upon engagement, continued efforts of improving vegetation biodiversity and ecosystem quality are required (Houlden et al., 2021; Semeraro et al., 2021).

Figure 5.1: Tree canopy cover horizontal extents.

Prepared by DSM Geodata for Green Adelaide.

Figure removed due to copyright restriction.

When understanding land use distributions of these areas, the inner-south to east band does not necessarily exhibit a significant difference in area of recreational, industrial, or residential land, however such regions are larger with less frequent dispersion, pointing to the importance of the habitat continuity and plant arrangement in the self-sufficiency and vitality of UGS (DSM Geodata, 2024; Z. Gao et al., 2021).

The bimodal peak of bare ground and dense vegetation within the City of Adelaide reflects acknowledgement of the high-density urban area with distinct effort for vegetating the region through the park lands. The City recognises the role of these park lands in physical health, MH,

and cultural inclusion resultant of the LGA's rise in NDVI (City of Adelaide, 2025a). A similar pattern is observed within the City of TTG, however across barren and sparsely vegetated ground. The inclusion of the Karrawirra Parri and Yertalla Dry Creek trails as well as community gardens and natural protection areas contribute to the vegetation mass within the council area, however the council recognises the need for continued rehabilitation of these areas for vegetation quality for stronger ecosystems and communities alike (City of Tea Tree Gully, 2024). The greening of highly industrialised areas has demonstrated more successful than suburban and regional urbanicities through initiatives such as the aforementioned which focus on increasing vegetation coverage within dedicated zones of such regions (Oikonomaki et al., 2024; Sousa-Silva et al., 2023; Zhang et al., 2023)

5.4 Recommendations for Future Open Space Policy

Some LGAs cover a large breadth of themes, however, do not explore multiple perspectives of the theme or provide much depth in their explanation, showing that even though they had a high percentage of themes covered, their index score was low. Whilst it is suggested greenness of an area has some effect on appeal for outdoor activity (Martins et al., 2021; Zhong et al., 2022), vegetation index is not solely responsible for young people's time spent outdoors in urban settings. Comprehensiveness of outdoor space policies, plans and strategies had the strongest correlation with types of outdoor activity outside of work and study commitments. Derived factors from OSPs were sorted into six themes regarding their influence on recreational activity and vegetational viability.

Health was included in fourteen OSPs, though documents discussing health from the perspective of the adoption of healthy lifestyle habits had a greater link to positive outcomes than those promoting incidental PA. Accessibility to platforms for PA such as walking trails and public sports courts also have a positive outcome on regularly influencing behaviour. Health benefits received from PA are furthered when activity is completed regularly and in conjunction with additional healthy habits, extending to improved overall wellbeing as well as management of

disease and illness across all age groups (Chang de Pinho et al., 2024; Cowan et al., 2023; Restuccia et al., 2021). Globally, policies which include open space provision requirements, public transport accessibility, pedestrian and cycling infrastructure, and housing density requirements unique to geographical and social contexts reported healthier and more active populations (Han et al., 2022; Lowe et al., 2022). Greater success in population health was also correlated with government transparency, indicating easily accessible and recent policy, strategy, and plan document result in a more educated, engaged, and healthier population (Lowe et al., 2022). More respondents identified as female than any other gender. Women saw greater displacement in recreational habits and emotional wellbeing following COVID-19 lockdowns than men (Castañeda-Babarro et al., 2020; Qin et al., 2020), so weighting a female voice in formulating policy recommendations could be beneficial.

All of the investigated LGAs explored provision of open spaces. Those with poorer links to recreation behaviours and greenness discussed measures to provide equitable access to open spaces. More successful regions were more concerned with area navigation and connectivity between open spaces, suggesting geographical provision was already established. The capacity to view greenspace from one's place of residence, indicating provisional accessibility, not only decreases baseline cortisol and improves wellbeing and social cohesion, but can raise awareness or accessibility of community services, particularly amongst vulnerable populations (Fisher et al., 2021; Moseley, 2023). Considering perceived accessibility is correlated to both safety and reception of benefits from greenspace use (Eastwood et al., 2023; Wu et al., 2022), successful policy must ensure ease of access to greenspaces to optimise use amongst residents. Aspects of UGS themselves have the greatest influence on perception of accessibility as opposed to external navigation, and hence engagement (Barber et al., 2021). Dedicated infrastructure such as paths, car and bike parking, toilets and fencing can achieve this perception (De Luca et al., 2021; Leese & Al-Zubaidi, 2024). Provisional aspects including policy-based land use standards with minimal UGS coverage and inclusion and quality standards can contribute to perceived safety through reducing overcrowding (De Luca et al., 2021).

Urban design was also considered in each LGA. The urban focus of more successful LGAs encompassed specific aspects of heritage and culture within design considerations, as opposed to a focus on visual appeal in LGAs of lower vitality. Aesthetic urban design with consideration of culture and heritage has shown to increase resident connection to space, as well as boost social connectivity (Carmona, 2021). Infrastructure for dedicated physical activity such as walking paths present at heritage sites reflects increases in both site visitation and walking activity around these sites (Maniei et al., 2024). This can also stimulate economic growth through promotion of tourism and other forms of external engagement (Buckley & Westaway, 2020; Maniei et al., 2024).

Whilst the majority of LGAs discussed environmental conservation to some degree, more successful regions explored factors pertaining to the natural environment extensively, particularly concerning the protection of flora and fauna biodiversity. Such OSPs also had substantial consideration for protection and mitigation of the effects of climate change. LGAs with poorer engagement mentioned little of natural factors, though sometimes promoting habitat corridors and water management throughout spaces. International policies that have demonstrated success in improving UGS biodiversity have also observed increased resident activity levels, including recreational and commuting activity, better mental health outcomes, and improved social interactions (Leese & Al-Zubaidi, 2024; Martens et al., 2022; Wang et al., 2021). This has been achieved by dedicated landscaping efforts considering both vegetation coverage and diversity (Wang et al., 2021). Increased perception of biodiversity also increased public willingness to engage with the management of local UGSs (Martens et al., 2022).

Community engagement with open spaces were mentioned generally by each inner-Adelaide council, though greater vitality of an area was related to specific green engagement strategies such as community gardens and educational resources. Community involvement with the natural vitality of their neighbourhood not only boosts an area's resilience to climate change and urban infrastructural longevity, but also promotes social inclusivity of vulnerable populations, healthier lifestyles amongst residents, and economic development (Carmona, 2021; Dang et al., 2022; Zhao et al., 2024). Engaged public spaces such as parks, community centres, and businesses, can also deter crime through create a sense of ownership and belonging of a

community (Department of Sustainability and Environment, 2025). Proven successful inclusions in policy in promoting community-based green engagement cover physical, including intentional urban design and open space allocation, and social initiatives, including designated greenspace volunteering programs with diverse and stable community members (DeCaro et al., 2025; Mattijssen et al., 2017).

Finally, successful LGAs discussed an ongoing responsibility of the government to monitor and maintain their open spaces. Neighbourhood and governmental trust in UGS maintenance leads to civic participation, furthering resident contribution to greenspace quality and feelings of community cohesion (Dang et al., 2022; Mattijssen et al., 2017).

Successful policies maintain active consideration of local demographics to foster a sense of belonging to one's community amongst young people. This results in social connection, care for biodiversity maintenance, and adoption of a healthy lifestyle, maximising the benefits from resident UGS use. UGS considering structure and accessibility contributes to holistic wellbeing benefits including those from PA and feelings of safety. Policy incorporating measures for the protection and continuation of natural biodiversity through equitable distribution and quality of UGSs as well as considered landscaping and heritage-focused urban design expands accessibility and boosts young people's usage of UGS for regular PA and socialisation. Provision of infrastructure such as pedestrian and bicycle-friendly paths as well as internal UGS facilities such as parking and toilets should also be considered. Such provision and access should be updated in accordance with housing density changes to avoid overcrowding UGSs and enhance perceptions of safety. Policy should also invite efforts to improve greenspace network navigability through public transport accessibility and signage. Policy for greenspace design should promote participation in community programs for green engagement such as community gardens or tree planting groups to encourage place-based connection as well as provide social opportunity over shared natural environments amongst young residents, particularly in morning hours. Local governments should continue to monitor the states of greenspaces, surrounding environments, and young people's engagement to optimise the health of residents and ecosystems alike and update policy regularly, making updates

easily available. This engagement and connection will ultimately contribute to a greater residential quality of life, stronger communities, and greater neighbourhoods.

6. CONCLUSION

6.1 Summary

UGS including parks, walking trails, and green infrastructure formulate environmental and societal identities of a neighbourhood. UGS provides cities with resilience to climate change in the form of temperature regulation, air quality improvement, and ecosystem protection. Required infrastructural development of increased popularity of urban living is jeopardising provision and resilience of urban greenery, with Adelaide facing some of the greatest associated challenges of Australia's capital cities. Consistent declines in tree canopy coverage and green ground coverage limits residential comfort and economic and environmental productivity of urbanities.

Recreational engagement with quality UGS, particularly in the form of PA, promotes relief from physical ailments and MHD. Concurrent declining trends in PA engagement and rising diagnosis of MHD amongst young people positions UGS as a potential intervention tool for continued community vitality. Such differences occurred largely off the back of COVID-19 lockdowns, forcing changes in habits through PA location accessibility and increased reliance on technology and sedentary behaviours for work and socialisation duties, particularly amongst young adults. A significant rise in MHD was also observed amongst this demographic, who were already amongst those most acutely affected by MHD. This places temporal and financial stress on associated health services. Concerns surrounding sustainable development and liveability of urbanities commonly serve as catalysing stressors for this demographic. Such worries, including those surrounding climate change, urban biodiversity loss, social injustices, and healthy living, have also been recognised as areas of need for intervention by higher governmental levels. UGS serve communities from a unique position in addressing these interdisciplinary issues, though policy surrounding such resources commonly fails to recognise young people as a demographic in need.

OSP serves as a tool to guide local councils through the valuing and addressing of problems surrounding urban space allocation and associated environmental and recreational

concerns. Successful policies should balance interdisciplinary needs whilst treating UGS as an asset to neighbourhoods. This is achieved through the planning of goals considering general targets and public perception of a neighbourhood's needs for improvement. Implementation must be regulated, with continuous oversight and monitoring of methodology successes, errors and acceptance, as well as opportunities for policy amendment.

This research aimed to investigate how inner-metropolitan Adelaide LGA OSP influence young people's recreational engagement with and opinions of with UGSs. The study recognised trends and themes within associated OSP provide recommendations in future policy versions in order to optimise the MH and physical benefits young people can receive from their UGS. 100 survey responses were distributed in a way grouping LGAs into central, eastern, southern, northern, and western wards. Observed trends were categorised as such. In general, respondents often felt their local greenspaces did not meet assumptions in regard to local biodiversity and social opportunities, particularly within western and southern councils. A sense of neutrality was expressed towards the capacity of respondents' councils in meeting assumptions in community-based and council-based responsibility in greenspace management. Recreational behaviours were generally distributed evenly amongst wards, though with a significant increase in commuting-related behaviours within the central ward, which is to be expected. An observed increase in recreational behaviours was focused to perception of accessibility through considered infrastructure such as the Karrawirra Parri path spanning the City of CS to the City of Campbelltown, as well as reputation of locations as common community hubs for PA, such as Coast Park in the City of HB. The sample population typically wanted more of a say in the management of their local UGS. This level of community investment strengthens place-based relationships of residents with their neighbourhoods. Regions with poorer perception of biodiversity within UGS, however, saw lower participation in intentional forms of engagement such as community programs. An additional barrier to use of UGS amongst metropolitan Adelaide young populations included safety of UGS. Factors that can assist in improving such perception include infrastructural design promoting accessibility. All of these mentioned factors also have a direct correlation with reception to MH benefits received from engaging in UGS.

Analysis of remotely sensed imagery of the inner-Adelaide metropolitan region found the area to be largely sparsely to moderately vegetated. Little over 10% of the study area contained dense vegetation, largely located within eastern and inner-southern LGAs. A considerable correlation was determined between OSP quality and local outdoor recreation. Moderate correlation also existed between OSP and other measured forms of recreational behaviours. NDVI was found to be moderately correlated with commuting and outdoor recreational activity, though no correlation existed between NDVI and indoor PA or outdoor recreational activity. Analysis also suggests a moderate correlation between OSP and NDVI.

Local councils can address the development of UGS in line with the continued promotion of young people's outdoor PA by considered encouragement of healthy lifestyle through UGS infrastructure accessibility and provision. Thorough protection of biodiversity, opportunities for community green engagement, heritage and culture, and continued monitoring of policy can reinforce the encouragement of UGS engagement. Use of these findings are of particular pertinence amidst denser urban environments.

The correct application of these findings has the power to address poor MH incidence amongst young people in a multifaceted manner. Implementation can provide both direct MH relief, including promotion of PA, in-person socialisation, and wellbeing relief, as well as indirect relief, through the easing of stressors around environmental and societal issues.

6.2 Recommendations for Future Research

This study served as a pilot study investigating the impact considerations of LGA OSP have on young people's recreational engagement with USG. Not only could this methodology be replicated across other Australian metropolitan regions, but further investigation could consider:

- Causal reasoning behind found correlations of policy and dependent recreational behaviours. In situ research could assess aspects of UGS aspects such as connectivity or infrastructure to identify specific aspects within LGAs that may be contributing to found opinions and behaviour patterns of residents. This will provide the opportunity for council-specific OSP recommendations to be made in line with the themes extracted in this research.
- How infrastructure and programs should be implemented in greenspace to encourage opportunity for social connection outside of PA programs. A retrospective or prospective study design could assess changes in perception of opportunity for and engagement with social behaviours amongst UGSs before and after infrastructural changes or program commencement.
- The inclusion of place-based relationships as an influencing factor of opinion and behaviour. A similar design structure could include survey questions asking residents of the length of time they have lived in their place of residence, whether they own or rent their home, if their neighbourhood or local UGS has any emotional significance to them, and other questions indicating place-based relationship to assess as additional influence on recreational behaviours.

6.3 Research Limitations

The study was limited in sample size. Whilst 100 responses is sufficient in completing simple statistical analysis, a greater sample population increased validity and interpretability of results (Arkes, 2023). Future research could reduce the study area for greater validity within

regions. The smaller sample size also required the reduction of the survey area. Future replications of this study with the capacity for a broader outreach for respondent recruitment could also include Cities of Playford and Onkaparinga, Town of Gawler, and Mount Barker District Council. Furthermore, the structure of a survey-based methodology limits the researcher's capacity to ask follow-up questions or request elaborations (Jain, 2021). Future research should utilise more open-ended questions or incorporate interviews for data collection. Furthermore, survey self-selection bias was possible due to largely distributing the survey through known groups to the researcher and to students of similar disciplines.

The satellite images used for NDVI calculations had some minor flaws. Despite being chosen for minimal risk or interference, a patch of 15 pixels identified as vigorously vegetated within PAE, indicating an oversaturated section of image. This could be due to the influence of the intensity of the late-morning summer sun. The strength and the angle of the sun can influence the optical properties of surfaces, impacting spectral signatures used in multispectral analysis (Fröhlich & Pap, 1989). Future investigation could compare winter and summer NDVIs as well to observe annually relevant scores of vegetation vitality. This study was limited due to insufficient cloud coverage of images across winter months and funding for sourcing higher quality images.

Finally, linear regression only assesses correlation between variables. Whilst useful for identifying patterns in relationships between factors of interest, additive and linear responses can only be assumed. With more appropriate sample sizes, a multiple linear regression model can be fit to determine the interaction of all factors, or a polynomial regression can determine a relationship between variables beyond linear prediction and response (James et al., 2023).

REFERENCES

- Afeosemobo, D. S., Mohamad, S., & Jasmani, Z. (2024). An Analytical Evaluation of Urban Open Space Policies in Nigeria. *International Journal of Academic Research in Progressive Education and Development*, 13(1). <https://doi.org/10.6007/IJARPED/v13-i1/20791>
- Almanza, E., Jerrett, M., Dunton, G., Seto, E., & Pentz, M. A. (2012). A study of community design, greenness, and physical activity in children using satellite, GPS and accelerometer data. *Health & Place*, 18(1), 46-54. <https://doi.org/10.1016/j.healthplace.2011.09.003>
- Alosaimi, N., Sherar, L. B., Griffiths, P., & Pearson, N. (2023). Clustering of diet, physical activity and sedentary behaviour and related physical and mental health outcomes: a systematic review. *BMC Public Health*, 23(1), 1572. <https://doi.org/10.1186/s12889-023-16372-6>
- Amanah, H., Ngarawula, B., & Sadhana, K. (2023). Study of Implementation Effectiveness of Urban Green Open Space Management. *International Journal of Research in Social Science and Humanities (IJRSS)*, 4(8), 38-47. <https://doi.org/10.47505/IJRSS>
- Aminah, S., Alam, A. S., & Wulandari, T. W. D. (2024). Implementation of the Green Open Space Policy Regarding the Provision and Arrangement of Kaombona City Forest Areas, Manikulore Ko'a Palu City. *Jurnal Penelitian Pendidikan IPA*, 10(SpecialIssue), 396-403. <https://doi.org/10.29303/jppipa.v10iSpecialIssue.8304>
- Anderson, A. R., Ostermiller, L., Lastrapes, M., & Hales, L. (2025). Does sunlight exposure predict next-night sleep? A daily diary study among U.S. adults. *Journal of Health Psychology*, 30(5), 962-975. <https://doi.org/10.1177/13591053241262643>
- Andriansyah, A., Sulastri, E., & Satispi, E. (2021). The role of government policies in environmental management. *Research Horizon*, 1(3), 86-93. <https://doi.org/10.54518/rh.1.3.2021.86-93>
- Arkes, J. (2023). *Regression analysis: a practical introduction*. Routledge. <https://doi.org/10.4324/9781003285007>
- Aronson, M. F., Lepczyk, C. A., Evans, K. L., Goddard, M. A., Lerman, S. B., MacIvor, J. S., Nilon, C. H., & Vargo, T. (2017). Biodiversity in the city: key challenges for urban green

space management. *Frontiers in Ecology and the Environment*, 15(4), 189-196.

<https://doi.org/10.1002/fee.1480>

- Atiquel Haq, S. M., Islam, M. N., Siddhanta, A., Ahmed, K. J., & Chowdhury, M. T. A. (2021). Public perceptions of urban green spaces: convergences and divergences. *Frontiers in Sustainable Cities*, 3, 755313. <https://doi.org/10.3389/frsc.2021.755313>
- Australian Bureau of Statistics. (2008). *National Survey of Mental Health and Wellbeing*. Australian Government. Retrieved 16 April from <https://www.abs.gov.au/statistics/health/mental-health/national-study-mental-health-and-wellbeing/2007>
- Australian Bureau of Statistics. (2023). *National Study of Mental Health and Wellbeing*. Australian Government. Retrieved April 16 from <https://www.abs.gov.au/statistics/health/mental-health/national-study-mental-health-and-wellbeing/latest-release>
- Australian Bureau of Statistics. (2024). *Education and Work, Australia*. Retrieved 31 March from <https://www.abs.gov.au/statistics/people/education/education-and-work-australia/latest-release>
- Australian Institute of Health and Welfare. (2024). *Home ownership and housing tenure*. Australian Government. Retrieved 11 April from <https://www.aihw.gov.au/reports/australias-welfare/home-ownership-and-housing-tenure>
- Bao, X., Zhou, W., Wang, W., Yao, Y., & Xu, L. (2024). Tree species classification improves the estimation of BVOCs from urban greenspace. *Science of the Total Environment*, 914, 169762. <https://doi.org/10.1016/j.scitotenv.2023.169762>
- Barber, A., Haase, D., & Wolff, M. (2021). Permeability of the city – Physical barriers of and in urban green spaces in the city of Halle, Germany. *Ecological Indicators*, 125, 107555. <https://doi.org/10.1016/j.ecolind.2021.107555>
- Barron, S., & Rugel, E. J. (2023). Tolerant greenspaces: Designing urban nature-based solutions that foster social ties and support mental health among young adults. *Environmental Science & Policy*, 139, 1-10. <https://doi.org/10.1016/j.envsci.2022.10.005>

- Belaire, J. A., Higgins, C., Zoll, D., Lieberknecht, K., Bixler, R. P., Neff, J. L., Keitt, T. H., & Jha, S. (2022). Fine-scale monitoring and mapping of biodiversity and ecosystem services reveals multiple synergies and few tradeoffs in urban green space management. *Science of the Total Environment*, 849, 157801. <https://doi.org/10.1016/j.scitotenv.2022.157801>
- Berdejo-Espinola, V., Zahnow, R., Suárez-Castro, A. F., Rhodes, J. R., & Fuller, R. A. (2022). Changes in green space use during a COVID-19 lockdown are associated with both individual and green space characteristics. *Frontiers in Ecology and Evolution*, 10, 804443. <https://doi.org/10.3389/fevo.2022.804443>
- Besser, L. M., Meyer, O. L., Streitz, M., Farias, S. T., Olichney, J., Mitsova, D., & Galvin, J. E. (2023). Perceptions of greenspace and social determinants of health across the life course: The Life Course Sociodemographics and Neighborhood Questionnaire (LSNEQ). *Health & Place*, 81, 103008. <https://doi.org/10.1016/j.healthplace.2023.103008>
- Birch, J., Rishbeth, C., & Payne, S. R. (2020). Nature doesn't judge you – how urban nature supports young people's mental health and wellbeing in a diverse UK city. *Health & Place*, 62, 102296. <https://doi.org/10.1016/j.healthplace.2020.102296>
- Blokland, T., Vief, R., Krüger, D., & Schultze, H. (2023). Roots and routes in neighbourhoods. Length of residence, belonging and public familiarity in Berlin, Germany. *Urban Studies*, 60(10), 1949-1967. <https://doi.org/10.1177/00420980221136960>
- Boulton, C., Dedekorkut-Howes, A., & Byrne, J. (2021). Governance factors shaping greenspace provision: from theory to practice. *Planning Theory & Practice*, 22(1), 27-50. <https://doi.org/10.1080/14649357.2021.1879240>
- Braun, V., & Clarke, V. (2023). Thematic Analysis. In F. Maggino (Ed.), *Encyclopedia of Quality of Life and Well-Being Research* (pp. 7187-7193). Springer International Publishing. https://doi.org/10.1007/978-3-031-17299-1_3470
- Bray, I., Reece, R., Sinnett, D., Martin, F., & Hayward, R. (2022). Exploring the role of exposure to green and blue spaces in preventing anxiety and depression among young people aged 14–24 years living in urban settings: A systematic review and conceptual framework. *Environmental Research*, 214, 114081. <https://doi.org/10.1016/j.envres.2022.114081>

- Buckley, R., & Westaway, D. (2020). Mental health rescue effects of women's outdoor tourism: A role in COVID-19 recovery. *Annals of tourism research*, 85, 103041. <https://doi.org/10.1016/j.annals.2020.103041>
- Burns, A. C., Saxena, R., Vetter, C., Phillips, A. J. K., Lane, J. M., & Cain, S. W. (2021). Time spent in outdoor light is associated with mood, sleep, and circadian rhythm-related outcomes: A cross-sectional and longitudinal study in over 400,000 UK Biobank participants. *Journal of Affective Disorders*, 295, 347-352. <https://doi.org/10.1016/j.jad.2021.08.056>
- Cainie, C., Riswanda, R., & Kian, L. (2023). Implementation of Green Open Space Policy in the Urban Area of Malinau. *Journal of Social Research*, 2(9), 3071-3083. <https://doi.org/10.55324/josr.v2i9.1328>
- Cameron, R. W. F., Brindley, P., Mears, M., McEwan, K., Ferguson, F., Sheffield, D., Jorgensen, A., Riley, J., Goodrick, J., Ballard, L., & Richardson, M. (2020). Where the wild things are! Do urban green spaces with greater avian biodiversity promote more positive emotions in humans? *Urban Ecosystems*, 23(2), 301-317. <https://doi.org/10.1007/s11252-020-00929-z>
- Carmona, M. (2021). *Public places urban spaces: The dimensions of urban design*. Routledge. <https://doi.org/10.4324/9781315158457>
- Castañeda-Babarro, A., Arbillaga-Etxarri, A., Gutiérrez-Santamaría, B., & Coca, A. (2020). Physical Activity Change during COVID-19 Confinement. *International Journal of Environmental Research and Public Health*, 17(18), 6878. <https://doi.org/10.3390/ijerph17186878>
- Chang de Pinho, I., Giorelli, G., & Oliveira Toledo, D. (2024). A narrative review examining the relationship between mental health, physical activity, and nutrition. *Discover Psychology*, 4(1), 1-8. <https://doi.org/10.1007/s44202-024-00275-7>
- Chen, K., Yang, M., Zhou, X., Liu, Z., Li, P., Tang, J., & Peng, C. (2022). Recent advances in carbon footprint studies of urban ecosystems: Overview, application, and future challenges. *Environmental Reviews*, 30(2), 342-356. <https://doi.org/10.1139/er-2021-0111>

- Chen, S., Haase, D., Xue, B., Wellmann, T., & Qureshi, S. (2021). Integrating Quantity and Quality to Assess Urban Green Space Improvement in the Compact City. *Land*, 10(12), 1367. <https://doi.org/10.3390/land10121367>
- Chen, W. (2021). Disaster avoidance green space planning in urban green space system planning based on public psychology. *Psychiatria Danubina*, 33(suppl 7), 114-115.
- City of Adelaide. (2025a). *Adelaide Park Lands Usage*. Retrieved 14 April from <https://www.cityofadelaide.com.au/about-adelaide/the-adelaide-park-lands/parklands-usage/>
- City of Adelaide. (2025b). *Kaurna place naming*. Retrieved 30 March from <https://www.cityofadelaide.com.au/community/reconciliation/kaurna-place-naming/>
- City of Holdfast Bay. (2025). *Recreation & Sport for the Community*. Retrieved 31 March from <https://www.holdfast.sa.gov.au/communities/recreation-sport/community-sport>
- City of Tea Tree Gully. (2024). *Habitat restoration*. Retrieved 2 May from <https://www.teatreegully.sa.gov.au/community-and-recreation/gardening-and-environment/habitat-restoration>
- Codina, O., Maciejewska, M., Nadal, J., & Marquet, O. (2022). Built environment bikeability as a predictor of cycling frequency: Lessons from Barcelona. *Transportation Research Interdisciplinary Perspectives*, 16, 100725. <https://doi.org/10.1016/j.trip.2022.100725>
- Cowan, S., Lim, S., Alycia, C., Pirotta, S., Thomson, R., Gibson-Helm, M., Blackmore, R., Naderpoor, N., Bennett, C., & Ee, C. (2023). Lifestyle management in polycystic ovary syndrome—beyond diet and physical activity. *BMC endocrine disorders*, 23(1), 14. <https://doi.org/10.1186/s12902-022-01208-y>
- Dang, L., Seemann, A. K., Lindenmeier, J., & Saliterer, I. (2022). Explaining civic engagement: The role of neighborhood ties, place attachment, and civic responsibility. *Journal of community psychology*, 50(3), 1736-1755. <https://doi.org/10.1002/jcop.22751>
- Davies, J., McKenna, M., Bayley, J., Denner, K., & Young, H. (2020). Using engagement in sustainable construction to improve mental health and social connection in disadvantaged and hard to reach groups: a new green care approach. *Journal of Mental Health*, 29(3), 350-357. <https://doi.org/10.1080/09638237.2020.1714001>

- De Luca, C., Libetta, A., Conticelli, E., & Tondelli, S. (2021). Accessibility to and Availability of Urban Green Spaces (UGS) to Support Health and Wellbeing during the COVID-19 Pandemic—The Case of Bologna. *Sustainability*, 13(19), 11054.
<https://doi.org/10.3390/su131911054>
- DeCaro, D. A., Boamah, E. F., Rudolph, M. A., & Adusei, G. A. (2025). State-reinforced co-provision of community-governed greenspace in racially marginalized neighborhoods: lessons from Chicago's innovative NeighborSpace Land Trust and Partnership. *Ecology and Society*, 30(2). <https://doi.org/10.5751/ES-15783-300202>
- Department of Sustainability and Environment. (2025). *Safer Design Guidelines for Victoria*. https://www.planning.vic.gov.au/data/assets/pdf_file/0014/4631/Safer_Design_Guidelines.pdf
- DSM Geodata. (2024). *Urban tree canopy, green spaces and built environment data analysis and reporting 2022* (Survey Area Technical Report, Issue.
- Eastwood, A., Juárez-Bourke, A., Herrett, S., & Hague, A. (2023). Connecting young people with greenspaces: The case for participatory video. *People and Nature*, 5(2), 357-367.
<https://doi.org/10.1002/pan3.10236>
- EPA. (2018). *Current Air Quality*. <https://www.epa.sa.gov.au/soe-2018/air-quality/south-australias-current-air-quality>
- EPA. (2025). *Liveability: Green Space*. Retrieved 23 Dec from
<https://soe.epa.sa.gov.au/environmental-themes/liveability/green-space>
- Esri. (2024). *ArcGIS Pro*. In (Version 3.4)
- European Space Agency. (2024). *Sentinel 2*. In
https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-2
- Fan, Y., Wang, J., Obradovich, N., & Zheng, S. (2023). Intraday adaptation to extreme temperatures in outdoor activity. *Scientific reports*, 13(1), 473.
<https://doi.org/10.1038/s41598-022-26928-y>
- Fei, W., Lu, D., & Li, Z. (2023). Research on the layout of urban disaster-prevention and risk-avoidance green space under the improvement of supply and demand match: The

case study of the main urban area of Nanjing, China. *Ecological Indicators*, 154, 110657.

<https://doi.org/10.1016/j.ecolind.2023.110657>

- Fioravanti, G., Casale, S., Benucci, S. B., Probst, A., Falone, A., Ricca, V., & Rotella, F. (2021). Fear of missing out and social networking sites use and abuse: A meta-analysis. *Computers in Human Behavior*, 122, 106839. <https://doi.org/10.1016/j.chb.2021.106839>
- Fisher, J. C., Irvine, K. N., Bicknell, J. E., Hayes, W. M., Fernandes, D., Mistry, J., & Davies, Z. G. (2021). Perceived biodiversity, sound, naturalness and safety enhance the restorative quality and wellbeing benefits of green and blue space in a neotropical city. *Science of the Total Environment*, 755, 143095. <https://doi.org/10.1016/j.scitotenv.2020.143095>
- Fluhrer, T., Chapa, F., & Hack, J. (2021). A methodology for assessing the implementation potential for retrofitted and multifunctional urban green infrastructure in public areas of the global south. *Sustainability*, 13(1), 384. <https://doi.org/10.3390/su13010384>
- Fröhlich, C., & Pap, J. (1989). Multi-spectral analysis of total solar irradiance variations. *Astronomy and Astrophysics (ISSN 0004-6361)*, vol. 220, no. 1-2, Aug. 1989, p. 272-280., 220, 272-280.
- Fusar-Poli, P., Salazar de Pablo, G., De Micheli, A., Nieman, D. H., Correll, C. U., Kessing, L. V., Pfenning, A., Bechdolf, A., Borgwardt, S., Arango, C., & van Amelsvoort, T. (2020). What is good mental health? A scoping review. *European Neuropsychopharmacology*, 31, 33-46. <https://doi.org/10.1016/j.euroneuro.2019.12.105>
- Gao, H., Su, H., Cai, Y., Wu, R., Hao, Z., Xu, Y., Wu, W., Wang, J., Li, Z., & Kan, Z. (2021). Trajectory prediction of cyclist based on dynamic Bayesian network and long short-term memory model at unsignalized intersections. *Science China Information Sciences*, 64(7), 172207. <https://doi.org/10.1007/s11432-020-3071-8>
- Gao, Z., Song, K., Pan, Y., Malkinson, D., Zhang, X., Jia, B., Xia, T., Guo, X., Liang, H., Huang, S., Da, L., Van Bodegom, P. M., & Cieraad, E. (2021). Drivers of spontaneous plant richness patterns in urban green space within a biodiversity hotspot. *Urban forestry & urban greening*, 61, 127098. <https://doi.org/10.1016/j.ufug.2021.127098>
- Geneshka, M., Coventry, P., Cruz, J., & Gilbody, S. (2021). Relationship between green and blue spaces with mental and physical health: a systematic review of longitudinal

observational studies. *International Journal of Environmental Research and Public Health*, 18(17), 9010. <https://doi.org/10.3390/ijerph18179010>

- Government of South Australia. (2024). *Bushfire Protection Areas* (
- Government of South Australia. (2025). *Cycling Maps*. Retrieved 31 March from <https://www.sa.gov.au/topics/driving-and-transport/cycling/cycling-maps>
- Graddy, E. A. (1998). Multivariate regression analysis in public policy and administration. *Handbook of research methods in public administration*, 377-408.
- Green Adelaide. (2023). *Urban Greening Strategy for Metropolitan Adelaide*. Adelaide, Australia: South Australian Government Retrieved from https://cdn.environment.sa.gov.au/greenadelaide/images/Discussion-paper_Urban-greening-strategy_March-2023_V2.pdf
- Grigore, E., Garrick, N., Fuhrer, R., & Axhausen, I. K. W. (2019). Bikeability in Basel. *Transportation Research Record*, 2673(6), 607-617. <https://doi.org/10.1177/0361198119839982>
- Han, S., Ye, Y., Song, Y., Yan, S., Shi, F., Zhang, Y., Liu, X., Du, H., & Song, D. (2022). A systematic review of objective factors influencing behavior in public open spaces. *Frontiers in public health*, 10, 898136. <https://doi.org/10.3389/fpubh.2022.898136>
- Hansen, R., Buizer, M., Buijs, A., Pauleit, S., Mattijssen, T., Fors, H., van der Jagt, A., Kabisch, N., Cook, M., Delshammar, T., Randrup, T. B., Erlwein, S., Vierikko, K., Nieminen, H., Langemeyer, J., Soson Texereau, C., Luz, A. C., Nastran, M., Olafsson, A. S., . . . Konijnendijk, C. (2023). Transformative or piecemeal? Changes in green space planning and governance in eleven European cities. *European Planning Studies*, 31(12), 2401-2424. <https://doi.org/10.1080/09654313.2022.2139594>
- Haverkamp, B. F., Wiersma, R., Vertessen, K., van Ewijk, H., Oosterlaan, J., & Hartman, E. (2020). Effects of physical activity interventions on cognitive outcomes and academic performance in adolescents and young adults: A meta-analysis. *Journal of Sports Sciences*, 38(23), 2637-2660. <https://doi.org/10.1080/02640414.2020.1794763>

- Henderson, L., Tipper, L., Willicombe, S., & Gattis, M. (2024). Shared time in nature increases feelings of social connection amongst university students. *Journal of Environmental Psychology*, 102343. <https://doi.org/10.1016/j.jenvp.2024.102343>
- Hoffner, C. A., & Bond, B. J. (2022). Parasocial relationships, social media, & well-being. *Current Opinion in Psychology*, 45, 101306. <https://doi.org/10.1016/j.copsyc.2022.101306>
- Houlden, V., Jani, A., & Hong, A. (2021). Is biodiversity of greenspace important for human health and wellbeing? A bibliometric analysis and systematic literature review. *Urban forestry & urban greening*, 66, 127385. <https://doi.org/10.1016/j.ufug.2021.127385>
- Hovland, J. F., Langeland, E., Ness, O., & Skogvang, B. O. (2023). Experiences with physical activity, health and well-being among young adults with serious mental illness. *International Journal of Qualitative Studies on Health and Well-being*, 18(1), 2221911. <https://doi.org/10.1080/17482631.2023.2221911>
- Howlett, M. (2023). *Designing public policies: Principles and instruments*. Routledge. <https://doi.org/10.4324/9781003343431>
- Hu, X., & Lima, M. F. (2024). The association between maintenance and biodiversity in urban green spaces: A review. *Landscape and Urban Planning*, 251, 105153. <https://doi.org/10.1016/j.landurbplan.2024.105153>
- Hu, Y., Dai, Z., & Guldmann, J.-M. (2021). Greenspace configuration impact on the urban heat island in the Olympic Area of Beijing. *Environmental Science and Pollution Research*, 28, 33096-33107. <https://doi.org/10.1007/s11356-020-12086-z>
- Huang, K., Beckman, E., Ng, N., Dingle, G., Han, R., James, K., Walker, E., Stylianou, M., & Gomersall, S. (2024). Effectiveness of physical activity interventions on undergraduate students' mental health: systematic review and meta-analysis. *Health Promotion International*, 39(3). <https://doi.org/10.1093/heapro/daae054>
- Huang, S., Tang, L., Hupy, J. P., Wang, Y., & Shao, G. (2021). A commentary review on the use of normalized difference vegetation index (NDVI) in the era of popular remote sensing. *Journal of Forestry Research*, 32(1), 1-6. <https://doi.org/10.1007/s11676-020-01155-1>

- Humble, N., & Mozelius, P. (2022). Content analysis or thematic analysis: Similarities, differences and applications in qualitative research. *European conference on research methodology for business and management studies*,
- Indrajat, H., Destia, F., Kurnia Drajat, D., & Juantara, B. (2022, 12/14). *Analysis of Walhi's Advocacy Strategy in Green Open Space Policy in Bandar Lampung City* Iapa Proceedings Conference; 2022: Proceedings IAPA International Conference and International Indonesia Conference on Interdisciplinary Studies,
<https://journal.iapa.or.id/proceedings/article/view/682>
- Jain, N. (2021). Survey versus interviews: Comparing data collection tools for exploratory research. *The Qualitative Report*, 26(2), 541-554. <https://doi.org/10.46743/2160-3715/2021.4492>
- James, G., Witten, D., Hastie, T., Tibshirani, R., & Taylor, J. (2023). Linear regression. In *An introduction to statistical learning: With applications in python* (pp. 69-134). Springer.
- Karageorghis, C. I., Bird, J. M., Hutchinson, J. C., Hamer, M., Delevoeye-Turrell, Y. N., Guérin, S. M. R., Mullin, E. M., Mellano, K. T., Parsons-Smith, R. L., Terry, V. R., & Terry, P. C. (2021). Physical activity and mental well-being under COVID-19 lockdown: a cross-sectional multinational study. *BMC Public Health*, 21(1), 988. <https://doi.org/10.1186/s12889-021-10931-5>
- Kemel, P. N., Porter, J. E., & Coombs, N. (2022). Improving youth physical, mental and social health through physical activity: a systematic literature review. *Health Promotion Journal of Australia*, 33(3), 590-601. <https://doi.org/10.1002/hpja.553>
- Kim, M., Jun, M., & Han, J. (2023). The relationship between needs, motivations and information sharing behaviors on social media: Focus on the self-connection and social connection. *Asia Pacific Journal of Marketing and Logistics*, 35(1), 1-16.
<https://doi.org/10.1108/APJML-01-2021-0066>
- Klotz, A. C., McClean, S. T., Yim, J., Koopman, J., & Tang, P. M. (2023). Getting Outdoors After the Workday: The Affective and Cognitive Effects of Evening Nature Contact. *Journal of Management*, 49(7), 2254-2287. <https://doi.org/10.1177/01492063221106430>

- Kolhar, M., Kazi, R. N. A., & Alameen, A. (2021). Effect of social media use on learning, social interactions, and sleep duration among university students. *Saudi Journal of Biological Sciences*, 28(4), 2216-2222. <https://doi.org/10.1016/j.sjbs.2021.01.010>
- Krokstad, S., Weiss, D. A., Krokstad, M. A., Rangul, V., Kvaløy, K., Ingul, J. M., Bjerkeset, O., Twenge, J., & Sund, E. R. (2022). Divergent decennial trends in mental health according to age reveal poorer mental health for young people: repeated cross-sectional population-based surveys from the HUNT Study, Norway. *BMJ open*, 12(5), e057654. <https://doi.org/10.1136/bmjopen-2021-057654>
- Kwak, M. J., Lee, J. K., Park, S., Lim, Y. J., Kim, H., Kim, K. N., Je, S. M., Park, C. R., & Woo, S. Y. (2020). Evaluation of the importance of some East Asian tree species for refinement of air quality by estimating air pollution tolerance index, anticipated performance index, and air pollutant uptake. *Sustainability*, 12(7), 3067. <https://doi.org/10.3390/su12073067>
- Lackey, N. Q., Tysor, D. A., McNay, G. D., Joyner, L., Baker, K. H., & Hodge, C. (2021). Mental health benefits of nature-based recreation: a systematic review. *Annals of Leisure Research*, 24(3), 379-393. <https://doi.org/10.1080/11745398.2019.1655459>
- Lai, H., Flies, E. J., Weinstein, P., & Woodward, A. (2019). The impact of green space and biodiversity on health. *Frontiers in Ecology and the Environment*, 17(7), 383-390. <https://doi.org/10.1002/fee.2077>
- Leese, C., & Al-Zubaidi, H. (2024). Urban green and blue spaces for influencing physical activity in the United Kingdom: A narrative review of the policy and evidence. *Lifestyle Medicine*, 5(1), e96. <https://doi.org/10.1002/lm2.96>
- Lei, Y., Davies, G. M., Jin, H., Tian, G., & Kim, G. (2021). Scale-dependent effects of urban greenspace on particulate matter air pollution. *Urban forestry & urban greening*, 61, 127089. <https://doi.org/10.1016/j.ufug.2021.127089>
- Leota, J., Presby, D. M., Le, F., Czeisler, M. É., Mascaro, L., Capodilupo, E. R., Wiley, J. F., Drummond, S. P. A., Rajaratnam, S. M. W., & Facer-Childs, E. R. (2025). Dose-response relationship between evening exercise and sleep. *Nature Communications*, 16(1), 3297. <https://doi.org/10.1038/s41467-025-58271-x>

- Lin, L., Zhao, Y., Zhao, J., & Wang, D. (2024). Comprehensively Assessing Seasonal Variations in the Impact of Urban Greenspace Morphology on Urban Heat Island Effects: A Multidimensional Analysis. *Sustainable Cities and Society*, 106014. <https://doi.org/10.1016/j.scs.2024.106014>
- Lindquist, E. A., & Wellstead, A. (2021). The policy cycle: From heuristic to a theory-informed research and advice. In *Handbook of public administration* (pp. 303-322). Routledge.
- Liu, W., Zuo, B., Qu, C., Ge, L., & Shen, Q. (2022). A reasonable distribution of natural landscape: Utilizing green space and water bodies to reduce residential building carbon emissions. *Energy and Buildings*, 267, 112150. <https://doi.org/10.1016/j.enbuild.2022.112150>
- Lo, A. Y. H., & Jim, C. Y. (2010). Differential community effects on perception and use of urban greenspaces. *Cities*, 27(6), 430-442. <https://doi.org/10.1016/j.cities.2010.07.001>
- Lowe, M., Adlakha, D., Sallis, J. F., Salvo, D., Cerin, E., Moudon, A. V., Higgs, C., Hinckson, E., Arundel, J., & Boeing, G. (2022). City planning policies to support health and sustainability: an international comparison of policy indicators for 25 cities. *The Lancet Global Health*, 10(6), e882-e894. [https://doi.org/10.1016/S2214-109X\(22\)00069-9](https://doi.org/10.1016/S2214-109X(22)00069-9)
- Lowry, M. B., Furth, P., & Hadden-Loh, T. (2016). Prioritizing new bicycle facilities to improve low-stress network connectivity. *Transportation Research Part A: Policy and Practice*, 86, 124-140. <https://doi.org/10.1016/j.tra.2016.02.003>
- Lu, J., & Misni, A. (2024). The Relationship between Outdoor Environment and Recreational Activities of the Elderly Based on Behavioral Mapping A Case Study at Beishan Park, Qingdao City, China. *International Review for Spatial Planning and Sustainable Development*, 12(4), 202-224. https://doi.org/10.14246/irspsd.12.4_202
- Lyons, R., Colbert, A., Browning, M., & Jakub, K. (2022). Urban greenspace use among adolescents and young adults: An integrative review. *Public health nursing*, 39(3), 700-718. <https://doi.org/10.1111/phn.13010>
- Mallawaarachchi, S. R., Anglim, J., Hooley, M., & Horwood, S. (2022). Associations of smartphone and tablet use in early childhood with psychosocial, cognitive and sleep

factors: a systematic review and meta-analysis. *Early Childhood Research Quarterly*, 60, 13-33. <https://doi.org/10.1016/j.ecresq.2021.12.008>

- Maniei, H., Askarizad, R., Pourzakarya, M., & Gruehn, D. (2024). The Influence of Urban Design Performance on Walkability in Cultural Heritage Sites of Isfahan, Iran. *Land*, 13(9), 1523. <https://doi.org/10.3390/land13091523>
- Martens, D., Öztürk, Ö., Rindt, L., Twarok, J., Steinhardt, U., & Molitor, H. (2022). Supporting biodiversity: Structures of participatory actions in urban green spaces. *Frontiers in Sustainable Cities*, 4, 952790. <https://doi.org/10.3389/frsc.2022.952790>
- Martins, L. C. G., Lopes, M. V. d. O., Diniz, C. M., & Guedes, N. G. (2021). The factors related to a sedentary lifestyle: A meta-analysis review. *Journal of advanced nursing*, 77(3), 1188-1205. <https://doi.org/10.1111/jan.14669>
- Mattijssen, T. J. M., van der Jagt, A. P. N., Buijs, A. E., Elands, B. H. M., Erlwein, S., & Laforteza, R. (2017). The long-term prospects of citizens managing urban green space: From place making to place-keeping? *Urban forestry & urban greening*, 26, 78-84. <https://doi.org/10.1016/j.ufug.2017.05.015>
- Mazhar, S. A., Anjum, R., Anwar, A. I., & Khan, A. A. (2021). Methods of data collection: A fundamental tool of research. *Journal of Integrated Community Health*, 10(1), 6-10. <https://doi.org/10.24321/2319.9113.202101>
- McCrorie, P. R., Fenton, C., & Ellaway, A. (2014). Combining GPS, GIS, and accelerometry to explore the physical activity and environment relationship in children and young people-a review. *International Journal of Behavioral Nutrition and Physical Activity*, 11, 1-14. <https://doi.org/10.1186/s12966-014-0093-0>
- McNeilly Smith, R., Tavares, S., & Stevens, N. (2024). Urban design and planning for extreme heat: an empirical study of built environment professionals' perceptions in South East Queensland, Australia. *Cities & Health*, 8(4), 653-665. <https://doi.org/10.1080/23748834.2023.2290901>
- Mohapatra, B., & Mohamed, A. R. (2013). Place attachment and participation in management of neighbourhood green space: a place-based community management.

<https://doi.org/10.1504/IJSSOC.2013.054715>

- Moreira-Almeida, A., Mosqueiro, B. P., & Bhugra, D. (2021). *Spirituality and mental health across cultures*. Oxford University Press.
- Moseley, M. J. (2023). *Accessibility: the rural challenge*. Routledge.
<https://doi.org/10.4324/9781003429333>
- Nagata, J. M., Cortez, C. A., Cattle, C. J., Ganson, K. T., Iyer, P., Bibbins-Domingo, K., & Baker, F. C. (2022). Screen time use among US adolescents during the COVID-19 pandemic: findings from the adolescent brain cognitive development (ABCD) study. *JAMA pediatrics*, 176(1), 94-96. <https://doi.org/10.1001/jamapediatrics.2021.4334>
- NASA EarthData. (2025). *Vegetation Index*. Retrieved 23 April from
- National Research Council. (2015). Young Adults in the 21st Century. In R. Bonnie, C. Stroud, & H. Breiner (Eds.), *Investing in the Health and Well-Being of Young Adults*. National Academies Press.
- Nguyen, Q.-V., & Liou, Y.-A. (2024). Greenspace pattern, meteorology and air pollutant in Taiwan: A multifaceted connection. *Science of the Total Environment*, 914, 169883.
<https://doi.org/10.1016/j.scitotenv.2024.169883>
- Noseworthy, M., Peddie, L., Buckler, E. J., Park, F., Pham, M., Pratt, S., Singh, A., Puterman, E., & Liu-Ambrose, T. (2023). The effects of outdoor versus indoor exercise on psychological health, physical health, and physical activity behaviour: a systematic review of longitudinal trials. *International Journal of Environmental Research and Public Health*, 20(3), 1669. <https://doi.org/10.3390/ijerph20031669>
- Nur, A. C., Nur, A. I., Koliopoulos, T., Munandar, A., & Gani, H. A. (2024). Implementation Performances of Green Open Space Policy in Makassar City, Indonesia. *International Journal of Environmental Engineering and Development*, 2, 12-26.
<https://doi.org/10.37394/232033.2024.2.2>
- O'Regan, A. C. (2024). *Integrating air quality modelling, low-cost sensing and greenspace quantification for enhanced urban air quality and net-zero cities* [PhD Thesis, University College Cork].

- Oikonomaki, E., Papadaki, I., & Kakderi, C. (2024). Promoting green transformations through smart engagement: an assessment of 100 citizen-led urban greening projects. *Land*, 13(4), 556. <https://doi.org/10.3390/land13040556>
- Paköz, M. Z., Sözer, C., & Doğan, A. (2022). Changing perceptions and usage of public and pseudo-public spaces in the post-pandemic city: the case of Istanbul. 27(1), 64-79. <https://doi.org/10.1057/s41289-020-00147-1>
- Pradenas, D., Oyanedel, J. C., da Costa, S., Rubio, A., & Páez, D. (2021). Subjective well-being and its intrinsic and extrinsic motivational correlates in high performance executives: A study in Chilean managers empirically revisiting the bifactor model. *International Journal of Environmental Research and Public Health*, 18(15), 8082. <https://doi.org/10.3390/ijerph18158082>
- Pritchard, R., Frøyen, Y., & Snizek, B. (2019). Bicycle Level of Service for Route Choice—A GIS Evaluation of Four Existing Indicators with Empirical Data. *ISPRS International Journal of Geo-Information*, 8(5), 214. <https://www.mdpi.com/2220-9964/8/5/214>
- Qin, F., Song, Y., Nassis, G. P., Zhao, L., Dong, Y., Zhao, C., Feng, Y., & Zhao, J. (2020). Physical Activity, Screen Time, and Emotional Well-Being during the 2019 Novel Coronavirus Outbreak in China. *International Journal of Environmental Research and Public Health*, 17(14), 5170. <https://doi.org/10.3390/ijerph17145170>
- Rega-Brodsky, C. C., Aronson, M. F., Piana, M. R., Carpenter, E.-S., Hahs, A. K., Herrera-Montes, A., Knapp, S., Kotze, D. J., Lepczyk, C. A., & Moretti, M. (2022). Urban biodiversity: State of the science and future directions. *Urban Ecosystems*, 25(4), 1083-1096. <https://doi.org/10.1007/s11252-022-01207-w>
- Restuccia, R., Perani, F., Ficarra, G., Trimarchi, F., Bitto, A., & di Mauro, D. (2021). Irisin and vascular inflammation: beneficial effects of a healthy lifestyle beyond physical activity. *Current pharmaceutical design*, 27(18), 2151-2155. <https://doi.org/10.2174/1381612827666210208154105>
- Ricciardi, E., Spano, G., Lopez, A., Tinella, L., Clemente, C., Elia, G., Dadvand, P., Sanesi, G., Bosco, A., & Caffò, A. O. (2022). Long-term exposure to greenspace and cognitive

function during the lifespan: a systematic review. *International Journal of Environmental Research and Public Health*, 19(18), 11700. <https://doi.org/10.3390/ijerph191811700>

- Rodríguez-Romo, G., Acebes-Sánchez, J., García-Merino, S., Garrido-Muñoz, M., Blanco-García, C., & Díez-Vega, I. (2023). Physical Activity and Mental Health in Undergraduate Students. *International Journal of Environmental Research and Public Health*, 20(1), 195. <https://doi.org/10.3390/ijerph20010195>
- Ryan, S. C., Sugg, M. M., Runkle, J. D., & Thapa, B. (2024). Advancing understanding on greenspace and mental health in young people. *GeoHealth*, 8(3), e2023GH000959. <https://doi.org/10.1029/2023GH000959>
- Salaripour, A., Adejoke, A. B., Zahra, S. R., & Taleb Valialah, N. (2023). Investigating the relationships between quality of life, attachment and participation in small towns (case study: Sangar Town). *Journal of Human Behavior in the Social Environment*, 33(7), 967-990. <https://doi.org/10.1080/10911359.2022.2117255>
- Sarofah, R., & Herliana, P. A. (2023). Analysis of Government Policy on Green Open Space in Bekasi City. *Jurnal Studi Ilmu Pemerintahan*, 4(1), 167-178. <https://doi.org/10.35326/jsip.v4i1.3224>
- Schamilow, S., Santonja, I., Weitzer, J., Strohmaier, S., Klösch, G., Seidel, S., Schernhammer, E., & Papantoniou, K. (2023). Time Spent Outdoors and Associations with Sleep, Optimism, Happiness and Health before and during the COVID-19 Pandemic in Austria. *Clocks & Sleep*, 5(3), 358-372. <https://doi.org/10.3390/clockssleep5030027>
- Seaman, P. J., Jones, R., & Ellaway, A. (2010). It's not just about the park, it's about integration too: why people choose to use or not use urban greenspaces. *International Journal of Behavioral Nutrition and Physical Activity*, 7, 1-9. <https://doi.org/10.1186/1479-5868-7-78>
- Semeraro, T., Scarano, A., Buccolieri, R., Santino, A., & Aarrevaara, E. (2021). Planning of urban green spaces: An ecological perspective on human benefits. *Land*, 10(2), 105. <https://doi.org/10.3390/land10020105>

- Sharifi, E., Larbi, M., Omrany, H., & Boland, J. (2020). Climate change adaptation and carbon emissions in green urban spaces: Case study of Adelaide. *Journal of Cleaner Production*, 254, 120035. <https://doi.org/10.1016/j.jclepro.2020.120035>
- Shekanino, A., Agustin, A., Aladefa, A., Amezquita, J., Gonzalez, D., Heldenbrand, E., Hernandez, A., May, M., Nuno, A., & Ojeda, J. (2023). Differential Stomatal Responses to Surface Permeability by Sympatric Urban Tree Species Advance Novel Mitigation Strategy for Urban Heat Islands. *Sustainability*, 15(15), 11942. <https://doi.org/10.3390/su151511942>
- Shin, J., & Yang, H. J. (2022). Does residential stability lead to civic participation?: The mediating role of place attachment. *Cities*, 126, 103700. <https://doi.org/10.1016/j.cities.2022.103700>
- Slater, H. (2022). Exploring minority ethnic communities' access to rural green spaces: The role of agency, identity, and community-based initiatives. *Journal of Rural Studies*, 92, 56-67. <https://doi.org/10.1016/j.jrurstud.2022.03.007>
- Sousa-Silva, R., Duflos, M., Barona, C. O., & Paquette, A. (2023). Keys to better planning and integrating urban tree planting initiatives. *Landscape and Urban Planning*, 231, 104649. <https://doi.org/10.1016/j.landurbplan.2022.104649>
- Stanford, H. R., Garrard, G. E., Kirk, H., & Hurley, J. (2022). A social-ecological framework for identifying and governing informal greenspaces in cities. *Landscape and Urban Planning*, 221, 104378. <https://doi.org/10.1016/j.landurbplan.2022.104378>
- Stott, D., Deutsch, J. M., Bruneau Jr, M., Nasser, J. A., Vitolins, M. Z., & Milliron, B.-J. (2024). Diet Quality is Positively Associated With Nature Relatedness in a US Population: A Pilot Study. *Preventive medicine reports*, 48, 102924. <https://doi.org/10.1016/j.pmedr.2024.102924>
- Strain, T., Flaxman, S., Guthold, R., Semenova, E., Cowan, M., Riley, L. M., Bull, F. C., & Stevens, G. A. (2024). National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5.7 million participants. *The Lancet Global Health*, 12(8), e1232-e1243. [https://doi.org/10.1016/S2214-109X\(24\)00150-5](https://doi.org/10.1016/S2214-109X(24)00150-5)

- Strohbach, M. W., Arnold, E., & Haase, D. (2012). The carbon footprint of urban green space—A life cycle approach. *Landscape and Urban Planning*, 104(2), 220-229.
<https://doi.org/10.1016/j.landurbplan.2011.10.013>
- Taherdoost, H. (2022). What are different research approaches? Comprehensive review of qualitative, quantitative, and mixed method research, their applications, types, and limitations. *Journal of Management Science & Engineering Research*, 5(1), 53-63.
<https://doi.org/10.30564/jmser.v5i1.4538>
- Tunggul, S., & Deddy, H. (2022, 2022/02/15). Implementation of Green Open Space Policy in the Utilization of Public Space in City of Medan. Proceedings of the Second International Conference on Public Policy, Social Computing and Development (ICOPOSDEV 2021),
- Uhlmann, K., Ross, H., Buckley, L., & Lin, B. B. (2022). Nature relatedness, connections to food and wellbeing in Australian adolescents. *Journal of Environmental Psychology*, 84, 101888. <https://doi.org/10.1016/j.jenvp.2022.101888>
- UN Habitat. (2024). *Cities and Climate Action: World Cities Report 2024*.
<https://unhabitat.org/sites/default/files/2024/11/wcr2024 - full report.pdf>
- Vaughn, G. F. (1964). In Search of Standards for Preserving Open Space. *Public Administration Review*, 24(4), 254-258. <https://doi.org/10.2307/973317>
- Venter, Z. S., Barton, D. N., Gundersen, V., Figari, H., & Nowell, M. S. (2021). Back to nature: Norwegians sustain increased recreational use of urban green space months after the COVID-19 outbreak. *Landscape and Urban Planning*, 214, 104175.
<https://doi.org/10.1016/j.landurbplan.2021.104175>
- Wang, C., Ren, Z., Dong, Y., Zhang, P., Guo, Y., Wang, W., & Bao, G. (2022). Efficient cooling of cities at global scale using urban green space to mitigate urban heat island effects in different climatic regions. *Urban forestry & urban greening*, 74, 127635.
<https://doi.org/10.1016/j.ufug.2022.127635>
- Wang, J., Zhou, W., Wang, J., & Qian, Y. (2019). From quantity to quality: enhanced understanding of the changes in urban greenspace. *Landscape Ecology*, 34(5), 1145-1160.
<https://doi.org/10.1007/s10980-019-00828-5>

- Wang, M., Qiu, M., Chen, M., Zhang, Y., Zhang, S., & Wang, L. (2021). How does urban green space feature influence physical activity diversity in high-density built environment? An on-site observational study. *Urban forestry & urban greening*, 62, 127129. <https://doi.org/10.1016/j.ufug.2021.127129>
- Wang, Q., Peng, J., Yu, S., Dan, Y., Dong, J., Zhao, X., & Wu, J. (2023). Key attributes of greenspace pattern for heat mitigation vary with urban functional zones. *Landscape Ecology*, 38(11), 2965-2979. <https://doi.org/10.1007/s10980-023-01763-2>
- Wang, Z., Wang, L., Lu, X., Dai, X., Zhai, F., Du, H., Xie, C., Gao, X., Yang, D., & Ji, D. (2023). The Function of Urban Green Space in Avoiding Disasters in Central Shanghai, China. *Journal of Urban Planning and Development*, 149(3), 05023017. <https://doi.org/10.1061/JUPDDM.UPENG-41>
- Warren, J. L. (1973). Green space for air pollution control.
- Wen, Y., Zhang, Y., Zhang, X., & Long, T. (2024). Toughness Evaluation and Functional Enhancement of Disaster Prevention and Avoidance of Urban Park Green Space. *Journal of Resources and Ecology*, 15(6), 1502-1517. <https://doi.org/10.5814/j.issn.1674-764x.2024.06.009>
- Why Research Ltd. (2017). *Greenspace Use and Attitudes Survey 2017*.
- Wickham, S.-R., Amarasekara, N. A., Bartonicek, A., & Conner, T. S. (2020). The big three health behaviors and mental health and well-being among young adults: a cross-sectional investigation of sleep, exercise, and diet. *Frontiers in psychology*, 11, 579205. <https://doi.org/doi.org/10.3389/fpsyg.2020.579205>
- Wicks, C., Barton, J., Orbell, S., & Andrews, L. (2022). Psychological benefits of outdoor physical activity in natural versus urban environments: A systematic review and meta-analysis of experimental studies. *Applied Psychology: Health and Well-Being*, 14(3), 1037-1061. <https://doi.org/10.1111/aphw.12353>
- World Health Organisation. (2022). *Mental Health*. Retrieved 16 April from <https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response>

- World Health Organisation. (2024). *Physical Activity*. Retrieved 16 April from <https://www.who.int/news-room/fact-sheets/detail/physical-activity>
- Wu, J., Peng, Y., Liu, P., Weng, Y., & Lin, J. (2022). Is the green inequality overestimated? Quality reevaluation of green space accessibility. *Cities*, 130, 103871. <https://doi.org/10.1016/j.cities.2022.103871>
- Wu, S., Chen, B., Webster, C., Xu, B., & Gong, P. (2023). Improved human greenspace exposure equality during 21st century urbanization. *Nature Communications*, 14(1), 6460. <https://doi.org/10.1038/s41467-023-41620-z>
- Xu, L., Fang, K., Huang, Y., & Xu, S. (2023). Demand priority of green space from the perspective of carbon emissions and storage. *Sustainability*, 15(14), 11199. <https://doi.org/10.3390/su151411199>
- Yue, T., Liu, X., Gao, Q., & Wang, Y. (2022). Different intensities of evening exercise on sleep in healthy adults: a systematic review and network meta-analysis. *Nature and science of sleep*, 2157-2177. <https://doi.org/10.2147/NSS.S388863>
- Zakharova, K., Rodela, R., & Lehtilä, K. (2025). Aesthetic perception of urban biodiversity: a review of methodologies and statistical approaches. *Cogent Social Sciences*, 11(1), 2484629. <https://doi.org/10.1080/23311886.2025.2484629>
- Zhang, S., Jia, W., Zhu, H., You, Y., Zhao, C., Gu, X., & Liu, M. (2023). Vegetation growth enhancement modulated by urban development status. *Science of the Total Environment*, 883, 163626. <https://doi.org/10.1016/j.scitotenv.2023.163626>
- Zhao, Y., Li, J., Collins, R. M., Deng, K., Wu, H., Yang, L., Chang, F., & Wan, J. (2024). Bridging the gap: Public engagement in blue-green space development for healthier urban futures. *Journal of Environmental Management*, 360, 121173. <https://doi.org/10.1016/j.jenvman.2024.121173>
- Zhong, J., Liu, W., Niu, B., Lin, X., & Deng, Y. (2022). Role of built environments on physical activity and health promotion: a review and policy insights. *Frontiers in public health*, 10, 950348. <https://doi.org/10.3389/fpubh.2022.950348>

- Zhou, Y., Yao, J., Chen, M., & Tang, M. (2023). Optimizing an urban green space ecological network by coupling structural and functional connectivity: A case for biodiversity conservation planning. *Sustainability*, 15(22), 15818. <https://doi.org/10.3390/su152215818>
- Zong, W., Qin, L., Jiao, S., Chen, H., & Zhang, R. (2024). An innovative approach for equitable urban green space allocation through population demand and accessibility modeling. *Ecological Indicators*, 160, 111861. <https://doi.org/10.1016/j.ecolind.2024.111861>

APPENDICES

Appendix 1: Greenspace and Recreation Survey

Qualtrics Survey Software

19/9/2024, 3:14 pm



How have metro Adelaide local councils influenced young people's outdoor activity?

Welcome

If you're a resident of Adelaide South Australia aged 18–30 years, the information you can provide will go a long way in helping us advocate for your mental wellbeing and urban environments.

By continuing with this survey, I acknowledge:

- I am over the age of 18 years
- I am free to withdraw at any time during the completion of this survey.
- I have read and understood the information about the research, and understand I am being asked to provide informed consent to participate in this research study. I understand that you can contact the research team if I have further questions about this research study.
- I understand that I can contact Flinders University's Research Ethics, Integrity and Compliance Office if I have any complaints or reservations about the ethical conduct of this study.
- I am not a fraudulent or imposter participant or a bot.

The Participant Information Sheet holds further details of the study, your involvement and withdrawal rights, and statements on your confidentiality and privacy is available at the bottom of this page.

Research Team :

Dr Gareth Butler
College of Humanities, Arts, and Social Sciences
Flinders University
Email: gareth.butler@flinders.edu.au
Tel: 8202 7950

Miss Emily Glew
College of Humanities, Arts, and Social Sciences
Flinders University
Email: glew0003@flinders.edu.au

The project has been approved by Flinders University's Human Research Ethics Committee 7737. Queries or concerns regarding the research can be directed to the research team. If you have any complaints or reservations about the ethical conduct of this study, please contact the Flinders University's Research Ethics, Integrity and Compliance Office via telephone (08) 8201 2543 or by emailing human.researchethics@flinders.edu.au.

[7737 hrec information sheet and consent form](#)

Demographic Questions

Which local council area do you reside in?

- ☐ City of Adelaide
- ☐ City of Burnside
- ☐ City of Campbelltown
- ☐ City of Charles Sturt
- ☐ City of Holdfast Bay
- ☐ City of Marion
- ☐ City of Mitcham
- ☐ City of Norwood Payneham & St Peters
- ☐ City of Port Adelaide Enfield
- ☐ City of Prospect
- ☐ City of Salisbury
- ☐ City of Tea Tree Gully
- ☐ City of Unley
- ☐ City of Walkerville
- ☐ City of West Torrens
- ☐ Adelaide Hills Council

What is your postcode?

What is your age?

What is your gender?

- ☐ Male
- ☐ Female
- ☐ Diverse Gender
- ☐ Prefer not to say

What is your employment status?

- ☐ Work Fulltime
- ☐ Work Parttime
- ☐ Student
- ☐ Unemployed
- ☐ Prefer not to say

Are you of Aboriginal and/or Torres Strait Islander descent?

- ☐ Yes, Aboriginal
- ☐ Yes, Torres Strait Islander
- ☐ Yes, Aboriginal and Torres Strait Islander
- ☐ No, neither Aboriginal nor Torres Strait Islander
- ☐ Prefer not to say

Greenspace Questions

These questions are about your opinions on urban greenspaces in general and local to you.

By greenspace, we mean public green or open spaces and water in urban areas, for example, parks, playing fields, play areas, allotments and community gardens, woodland and natural areas, walking paths surrounded by greenery or alongside rivers, and beaches.

In the last 12 months, how often on average have you used your local greenspace areas?

- ☐ Once a week or more often
- ☐ 1-2 times per month
- ☐ Once every 2-3 months
- ☐ Once or twice per year
- ☐ Less often or never

How far away from your home is your nearest greenspace area?

- ☐ Less than a 5 minute walk
- ☐ 5-10 minute walk
- ☐ 11-20 minute walk
- ☐ 21-30 minute walk
- ☐ More than a 30 minute walk

How much do you agree or disagree with the following statements relating to greenspaces generally?

	Strongly Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Greenspaces should be places you can relax and unwind	☐	☐	☐	☐	☐
Greenspaces should be safe places to encourage physical activity – such as walking, cycling, sports and play	☐	☐	☐	☐	☐
Greenspaces should provide opportunities to see the diversity of nature	☐	☐	☐	☐	☐
Greenspaces should be good places for people to meet others from the local community	☐	☐	☐	☐	☐
Greenspaces should make urban areas cooler	☐	☐	☐	☐	☐
Good quality greenspaces make an area a great place to live	☐	☐	☐	☐	☐
It is important to have green space in your local area	☐	☐	☐	☐	☐

How much do you agree or disagree with the following statements relating to your local greenspace?

	Strongly Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My local Greenspace is somewhere I can relax and unwind	☐	☐	☐	☐	☐
My local Greenspace is a safe place for physical activity – such as walking, cycling, sports and play	☐	☐	☐	☐	☐
The quality of my local Greenspace has been reduced in the past 5 years	☐	☐	☐	☐	☐
My local Greenspace allows me to explore the diversity of nature on my doorstep	☐	☐	☐	☐	☐
My local Greenspace is a good place for people to meet others from the local community	☐	☐	☐	☐	☐
My local greenspace makes my neighbourhood cooler	☐	☐	☐	☐	☐
I would like to have more of a say in how my local greenspace is managed	☐	☐	☐	☐	☐
My local greenspace makes the area a great place to live	☐	☐	☐	☐	☐

I am satisfied with the
quality of my local
green space

☐ ☐ ☐ ☐ ☐

Recreation questions

These questions are about the activities you engaged in in the last 7 days.

During the last 7 days, on how many days did you bicycle or walk for at least 10 minutes at a time to go from place to place?

- ☐ Never
- ☐ 1-2 days
- ☐ 3-4 days
- ☐ 5-6 days
- ☐ Every day

What time of day did this typically occur?

- ☐ Early morning (4am-8am)
- ☐ Morning (8am-10am)
- ☐ Daytime (10am-2pm)
- ☐ Afternoon (2pm-6pm)
- ☐ Evening (6pm-9pm)
- ☐ Nighttime (9pm-4am)

Was completing these tasks at this time optional?

- ☐ Yes, I could complete these tasks whenever I like
- ☐ Yes, but this time was required to align best with my schedule
- ☐ No, I was required to complete these tasks at this time

Which local council area did this activity take place in?

- ☐ City of Adelaide
- ☐ City of Burnside
- ☐ City of Campbelltown
- ☐ City of Charles Sturt
- ☐ City of Holdfast Bay
- ☐ City of Marion
- ☐ City of Mitcham
- ☐ City of Norwood Payneham & St Peters
- ☐ City of Port Adelaide Enfield
- ☐ City of Prospect
- ☐ City of Salisbury
- ☐ City of Tea Tree Gully
- ☐ City of Unley
- ☐ City of Walkerville
- ☐ City of West Torrens
- ☐ Adelaide Hills Council

These questions ask about your outdoor recreational activity.

Recreational activities mean activities done at moderate or vigorous intensity for the purpose of enjoyment or pleasure. Any additional purposes such as gaining fitness or mental wellbeing can be included. Please do not include any activities completed as a part of work or study duties.

During the last 7 days, on how many days did you complete recreational physical activities like running, bicycling, or sports outdoors?

- ☐ Never
- ☐ 1-2 days
- ☐ 3-4 days
- ☐ 5-6 days
- ☐ Every day

What time of day did this typically occur?

- ☐ Early morning (4am-8am)
- ☐ Morning (8am-10am)
- ☐ Daytime (10am-2pm)
- ☐ Afternoon (2pm-6pm)
- ☐ Evening (6pm-9pm)
- ☐ Nighttime (9pm-4am)

Was completing these tasks at this time optional?

- ☐ Yes, I could complete these tasks whenever I like
- ☐ Yes, but this time was required to align best with my schedule
- ☐ No, I was required to complete these tasks at this time

Which local council area did this activity take place in?

- ☐ City of Adelaide
- ☐ City of Burnside
- ☐ City of Campbelltown
- ☐ City of Charles Sturt
- ☐ City of Holdfast Bay
- ☐ City of Marion
- ☐ City of Mitcham
- ☐ City of Norwood Payneham & St Peters
- ☐ City of Port Adelaide Enfield
- ☐ City of Prospect
- ☐ City of Salisbury
- ☐ City of Tea Tree Gully
- ☐ City of Unley
- ☐ City of Walkerville
- ☐ City of West Torrens
- ☐ Adelaide Hills Council

These questions ask about your indoor recreational activity.

Recreational activities mean activities done at moderate or vigorous intensity for the purpose of enjoyment or pleasure. Any

additional purposes such as gaining fitness or mental wellbeing can be included. Please do not include any activities completed as a part of work or study duties.

During the last 7 days, on how many days did you complete recreational physical activities like running, bicycling, or sports indoors?

- ☐ Never
- ☐ 1-2 days
- ☐ 3-4 days
- ☐ 5-6 days
- ☐ Every day

What time of day did this typically occur?

- ☐ Early morning (4am-8am)
- ☐ Morning (8am-10am)
- ☐ Daytime (10am-2pm)
- ☐ Afternoon (2pm-6pm)
- ☐ Evening (6pm-9pm)
- ☐ Nighttime (9pm-4am)

Was completing these tasks at this time optional?

- ☐ Yes, I could complete these tasks whenever I like

- ☐ Yes, but this time was required to align best with my schedule
- ☐ No, I was required to complete these tasks at this time

Which local council area did this activity take place in?

- ☐ City of Adelaide
- ☐ City of Burnside
- ☐ City of Campbelltown
- ☐ City of Charles Sturt
- ☐ City of Holdfast Bay
- ☐ City of Marion
- ☐ City of Mitcham
- ☐ City of Norwood Payneham & St Peters
- ☐ City of Port Adelaide Enfield
- ☐ City of Prospect
- ☐ City of Salisbury
- ☐ City of Tea Tree Gully
- ☐ City of Unley
- ☐ City of Walkerville
- ☐ City of West Torrens
- ☐ Adelaide Hills Council

Do these activities normally occur indoors

- ☐ Always
- ☐ Often
- ☐ Sometimes
- ☐ Not usually

Optional: Why did you complete this activity indoors?

These questions ask about your outdoor sedentary activity.

By sedentary, we mean any activities completed seated or standing that require minimal physical exertion. By recreational, we mean activities done for the purpose of enjoyment or pleasure. Please do not include any activities completed as a part of work or study duties.

During the last 7 days, on how many days did you complete sedentary recreational activities such as reading, art, or playing music outdoors?

- ☐ Never
- ☐ 1-2 days
- ☐ 3-4 days
- ☐ 5-6 days
- ☐ Every day

What time of day did this typically occur?

- ☐ Early morning (4am-8am)
- ☐ Morning (8am-10am)
- ☐ Daytime (10am-2pm)
- ☐ Afternoon (2pm-6pm)
- ☐ Evening (6pm-9pm)
- ☐ Nighttime (9pm-4am)

Was completing these tasks at this time optional?

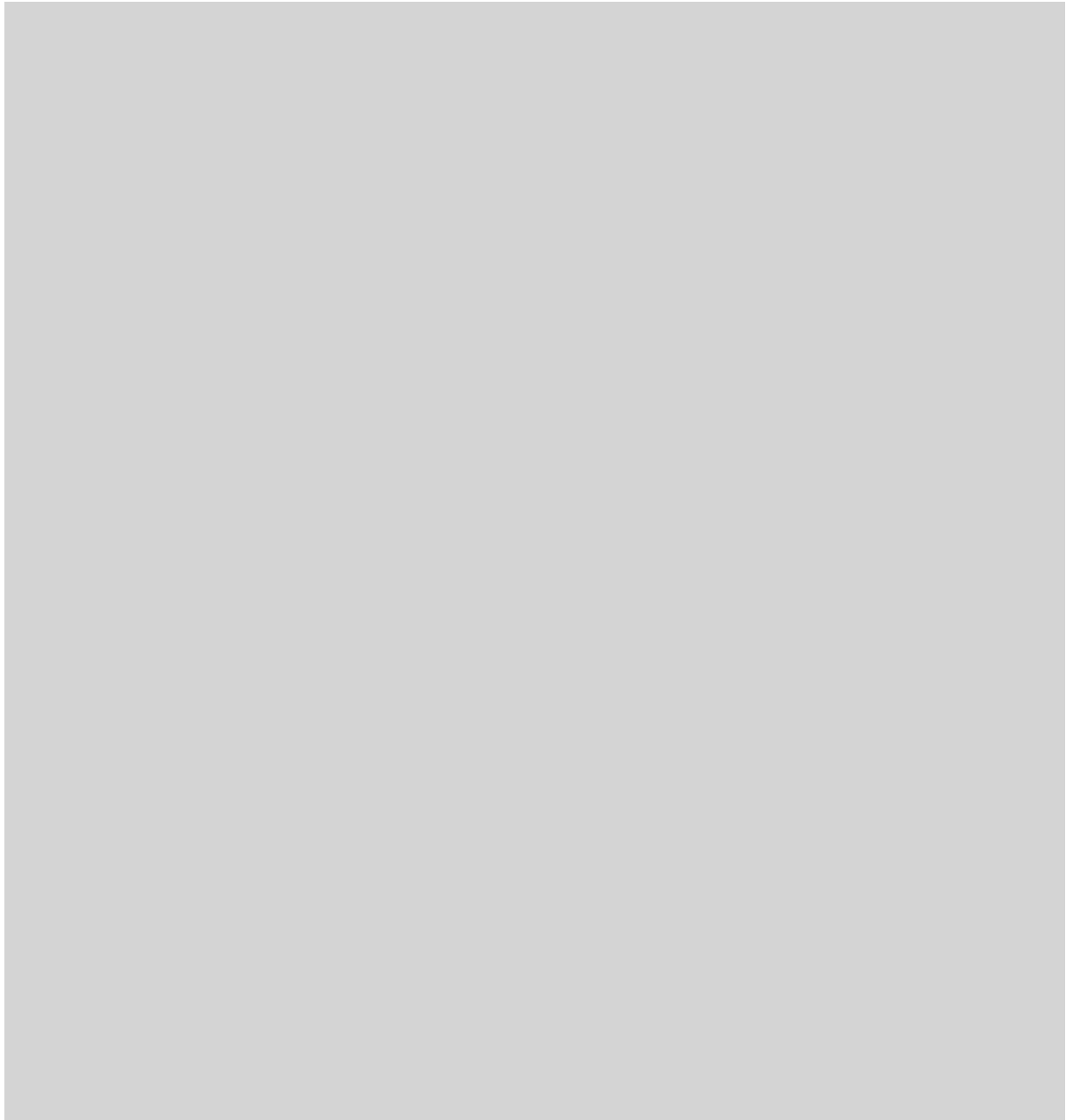
- ☐ Yes, I could complete these tasks whenever I like
- ☐ Yes, but this time was required to align best with my schedule
- ☐ No, I was required to complete these tasks at this time

Which local council area did this activity take place in?

- ☐ City of Adelaide
- ☐ City of Burnside
- ☐ City of Campbelltown
- ☐ City of Charles Sturt
- ☐ City of Holdfast Bay
- ☐ City of Marion
- ☐ City of Mitcham
- ☐ City of Norwood Payneham & St Peters
- ☐ City of Port Adelaide Enfield
- ☐ City of Prospect
- ☐ City of Salisbury
- ☐ City of Tea Tree Gully
- ☐ City of Unley

- ☐ City of Walkerville
- ☐ City of West Torrens
- ☐ Adelaide Hills Council

Powered by Qualtrics



Appendix 2: Open Space Policy Themes and Focus Areas

Health

- Physical health
 - Healthy lifestyle
 - Physical Health
- Mental wellbeing
 - Mental Health
 - Wellbeing
 - Stress relief
- Health education

Recreation

- Active recreation
 - Active recreation
 - Organised sport
- Passive recreation

Working From Home

Community

- Social connectivity
- Volunteering/engagement
- Civic pride
- Events

Green engagement

- Act to benefit environment
- Green education
- Appreciation of nature

Accessibility

- Access
- Children
 - Play spaces
 - Development
- Older adults
- Disabled access

Transport

- Reduce cars
- Increase parking & infrastructure
- Public transport access

Connectivity

- Network
 - Open space network
 - Walkability
 - Cyclability
- Navigability
- Liveability

Design

- Crime prevention
- Lighting
- Noise reduction
- Shade

Urban

- Urban appeal/character
- Streetscape

- Heritage
- Indigenous culture

Provision

- Provision
- Quality/Usability
- Access to private space
- Meets diverse needs

Open space actions

- Protect
- Maintain
- Improve

Land Acquisition

- Acquisition
- Repurposing

Housing

- Increase density

Infrastructure

- Green infrastructure
- Sustainability
- Energy Efficiency
- Maintenance

Economic

- Benefit
- Increase property value
- Tourism

Water management

- Quality
- Use
- Stormwater management
- Irrigation

Conservation

- Conservation
- Biodiversity
- Habitat corridors
- Native species
- Fire-resistant species
- Drought-resistant species
- Wildlife monitoring

Water courses

Climate change

- Carbon neutral
- Tree canopy cover
- Air quality
- Cooling/UHI

Government

- Consistent strategy review
- Resource allocation
- Community priority
- Natural/built environment cohesion
- Food/water security

Appendix 3: Visualisation of NDVI of Inner-Metropolitan Adelaide

Figure removed due to copyright restriction.