Value of South Australia's National Parks and Reserves

Study 2: Recreational and Wellbeing Benefits of Metropolitan Parks

Willingness to Pay and Reduced Healthcare Costs associated with Adelaide Metropolitan Parks

Final Report

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A/Prof Adam Loch

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Snapshot: Recreation and wellbeing benefits for SA's metropolitan national parks:

1.45 M visits per year to Adelaide's 20 most popular metropolitan parks

4% reduction in healthcare costs ($140 M) by those that visit metro national parks in SA more than others

$48 M total travel cost values associated with metro national park use

13km

Adelaide parks are as accessible as the average commute to work

$562 M

Total South Australian regional and metro park benefits from tourism and recreation direct revenue, indirect travel costs plus reduced healthcare costs

1 Introduction

1.1 Nature-based recreation

Nature-based outdoor recreation is of considerable social, ecological and economic importance (Spalding et al., 2017). By attracting domestic and international visitors, outdoor nature-based tourism contributes to destination economic growth via household spending, foreign exchange earnings, employment opportunities, and improved infrastructure (Morse et al., 2022).

Many things motivate people's enjoyment or fulfilment of desires for freedom and natural experience in outdoor spaces, including health maintenance and improvement. However, possible 'health benefits' are therefore not additive separately across many individuals. Further, benefits of being fit that accrue to an individual come at a cost to them of lost time, but they prefer outdoor activity to staying indoors because the perceived benefits are greater. Exercise and recreation in nature has been shown to be important and research has traced the perceived benefits to actual savings to community when access to parks has helped some people become less sick. The avoided health costs associated with improved population health thereby add to society's productivity, lowering the healthcare burden carried by the community by reducing the public funding required to provide medical services for chronic diseases.

As publicly-owned assets, parks and reserves thus offer something to all elements of communities no matter their socio-economic status. These public assets also contribute important positive impacts to individual health where those that engage with parks and reserves report higher levels of general health compared to non-users (FIT, 2018). Improved health and wellbeing can positively motivate individuals to spend an increased part of their discretionary income on visiting parks and reserves. Spending time in parks and reserves can also lead to higher reported levels of wellbeing and general health by contrast to others in the population, leading to less private expenditure on health costs (e.g. visits to a GP) and/or a lower reliance on public health services (e.g. treatment by publically funded hospitals/clinics). Together, these **preference values** provide robust estimates of what parks and reserves are worth to society and can assist governments to better account for the external costs and benefits of alternative investments to ensure an optimal provision of park and reserve public goods (Campbell et al., 2014).

While value can be derived from a variety of sources (e.g. functional, social, cultural and psychological) a form of value estimation that most of us are very familiar with is monetary or economic value. Economic values are useful because they are commonly defined and understood; that is, while functional values may differ between individuals, the value of a dollar is uniformly measured, agreed, fungible and continuously updated by enormous numbers of daily adjustment through transactions. This helps us understand why environmental valuation techniques have been developed to assign monetary values to changes in public or common pool goods (e.g. parks and reserves). Monetary values are used as a measure of individual **preferences** and **welfare.**.

This report builds upon two earlier studies of nature-based tourism and wider regional and rural economic values associated with South Australia's regional national parks (authored by the Department for Environment and Water (DEW, 2021) and Loch et al. (2021, 2022)). In this report, the focus is on national parks and reserves within and surrounding the **metropolitan** areas of Adelaide. Metropolitan national parks and reserves were left out of the previous studies because data availability was limited making analysis of economic values challenging at the time. However, this limitation has now been overcome so that we can estimate, via a series of similar and different **economic valuation approaches**, individual **willingness to pay (WTP)** values for nature-based park and reserve recreation for the 2018-19 period.

The original study has been extended by using data from an annual survey of park and reserve visitors conducted by DEW. The survey has been conducted annually since 2015 and respondents are asked a suite of questions about themselves and national park visitation, including questions about their income, park visit frequency, self-reported health status and life satisfaction.[1] The survey data enables us to contrast the general health of park visitors' with the health census data for South Australia to determine if any notable differences exist between them. While parks may be incidentally but not instrumentally associated with general reported health outcomes, the comparison enables a subsequent estimation of **reduced healthcare costs (RHC)** associated with park visits across different socio-economic groups, based on associated differences in levels of the ten most-frequently experienced chronic diseases treated in the public health system.

Greater access to parks and reserves has significant potential to reduce health inequalities (Rigolon et al., 2021) and create wider triple-bottom line returns: that is, economic, environmental and social benefits to individuals and society. To reinforce the multiple benefits produced of parks and reserves, and optimise public investment in producing whole-of-government outcomes, government choices need to be well-informed (Li et al., 2018). This study assists that process by compiling an intersecting evidence base and exploring the benefits generated by metropolitan parks and reserves for people's physical and mental health, and their willingness to pay for those benefits.

[1] The Department of Environment and Water South Australian Parks Visitation Survey Report, conducted annually by McGregor Tan Research between 2015 and 2021 (Ref 11642).

2 Previous studies and lessons

2.1 Background to estimates of nature-based recreation values

Parks and reserves in metropolitan areas are usually free to access and use. This makes it difficult to quantify the importance of parks and reserves to people in monetary terms as no direct price for access is revealed. This leaves the managers of parks and resevers with limited information from which to assemble compelling business cases for optimising investment for whole-of-governement benefits. Yet parks and reserves <u>are</u> highly important public assets that provide a variety of social benefits, including for example:

- Contributions to preventative health
- Reductions to future health expenditure by authorities
- Reduced health inequality across sectors of society, and
- Increased social cohesion and equality (FIT, 2018).

The relevance of parks as a possible source of increased public health is of interest to DEW as those assets may enhance the **wellbeing** of South Australians. Positive wellbeing is associated with being comfortable, happy or healthy and can result from a range of risk, protective and contextual factors (Oxford University Press, 2019). More broadly, a person's education, employment, skills, secure housing, social networks and health status all influence wellbeing outcomes (AIHW, 2023). Hence understanding the nature of the park and reserve system's contribution of public wellbeing may be improved by attempting to measure such benefits. This study is an attempt to measure such benefits using the 20 most visited National Parks and Reserves in the Adelaide metropolitan area (Figure 1).

The value of public goods and services takes a central position in economic approaches to preferences and their valuation—although such concepts are not necessarily easy to quantify and relate to wellbeing, as they are context dependent. Estimates should (ideally) be based on representative samples of the target population, and any valuations carefully interpreted in order to provide meaningful information to authorities charged with decision-making (Schläpfer, 2021).

For example, in many European contexts, users of outdoor sites have been shown to be those from higher socioeconomic groups such as older people (with older children) who have strong preferences for access to green spaces like the countryside (see for example Halkos et al., 2022). By contrast, those from lower socioeconomic groups, people with younger children, and immobile people have been shown to hold lower preferences for green spaces (Swanwick, 2009). For these reasons, simple surveys may be used to explore differences in preferences amongst users of green spaces.

With an improved understanding of people's **preferences** we may be better-positioned to maximize society's **welfare**; broadly defined as wellbeing at an aggregate level based on prosperity and standard of living. As people's preferences vary, and people try to make their own situation better, often individual decisions may cause undesirable impacts on society. For instance, developers may not allocate adequate public space in new developments because that can reduce the land available to build houses. Hence, government has a key role in intervening to improve social welfare by using limited public resources to provide those services that the private sector may not provide adequately to meet people's preferences.

In developing business cases in government, it is necessary to be able to quantify challenging variables such as how individuals value their health, leisure time, benefits gained from enjoying environmental assets, and other social factors (DTF, 2013). These already complex measurement challenges are further complicated by the increasing appreciation of the importance of green spaces to health, leisure and social interactions as well as providing key habitat for biodiversity and other ecosystem services.

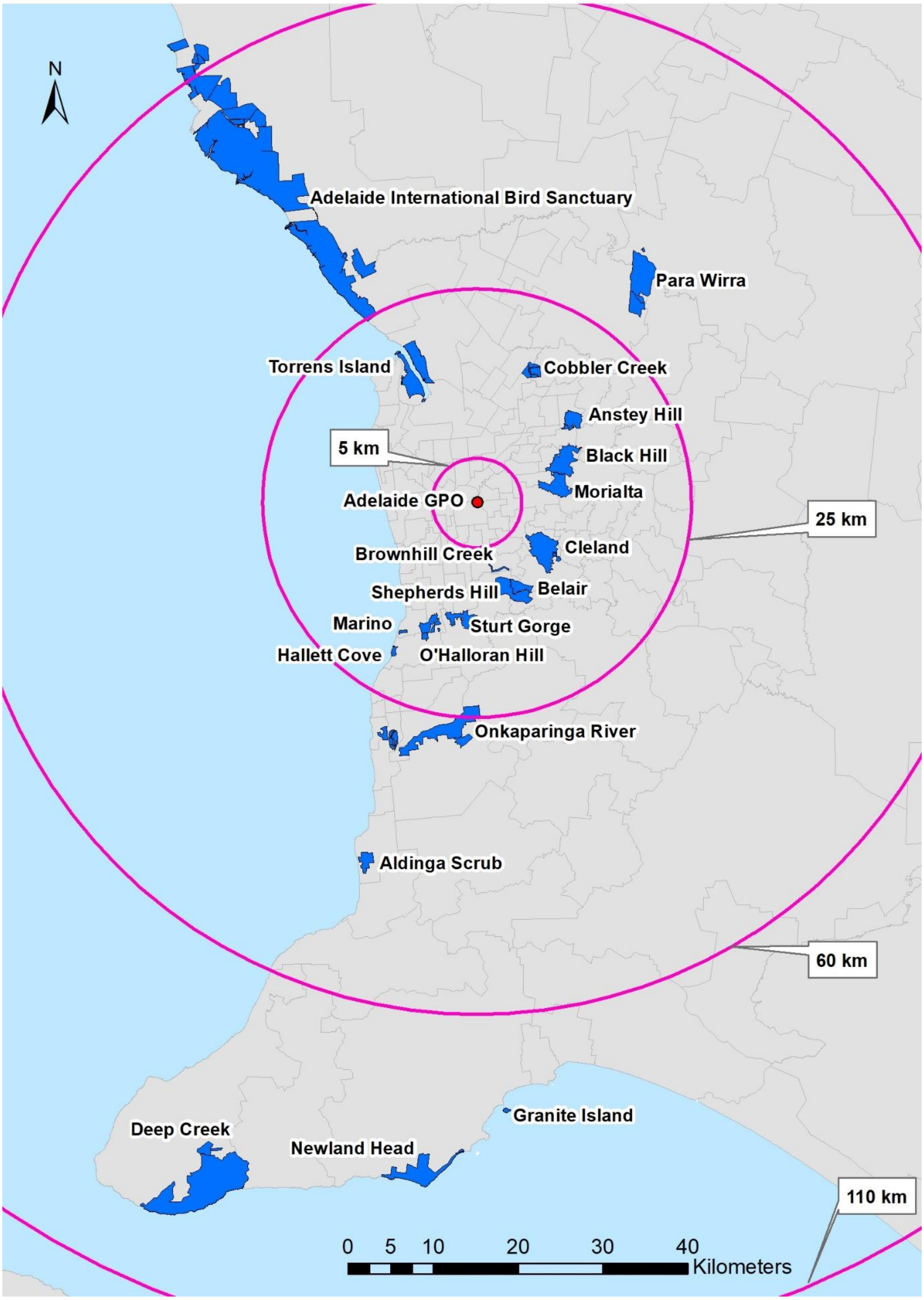


Figure 1: Location of studied metropolitan parks (royal blue) relative to Adelaide GPO - City Centre (DEW supplied)

People are increasingly concerned that metropolitan planning objectives to increase urban density and reduce service costs may have undermined environmental services essential for good quality of life and social wellbeing. Furthermore, almost 50% of all social, cultural and economic output by cities depends on natural systems that are threatened by climate change and biodiversity loss (Khatri, 2022). By contrast, one estimate suggests that only 0.3% of public spending on urban infrastructure goes towards 'nature-based solutions' or efforts that use ecosystems to mitigate pollution, reduce flood and storm risk, provide healthy water, air and food, and improve healthy living conditions (WEF, 2022). Governments are therefore looking for reliable evidence to rebalance investment priorities, where possible.

2.2 The role of economic analysis in balanced decisions

Addressing these issues requires a good understanding of the economic, social and ecological aspirations/preferences of people and how to achieve an appropriate balance amongst such priorities. While economics is often viewed as a discipline focussed solely on money, the focus of economics is to enhance social wellbeing and do so by balancing different aspects of wellbeing in each individual context that relates to decision-making. Natural resource economics, in particular, has evolved over the recent decades to better facilitate such understanding through informed analysis. Therefore, Hundloe (2021) argues that economics is useful to natural resource analysis in both a radical and necessary way.

It is **radical** because many people consider economic development the driver of poor ecological outcomes. While that may be true, advances in natural resource economics have highlighted the trade-offs between financial and ecological outcomes and how the changing preferences of people are influencing behaviours towards achieving such a balance (Mallawaarachchi and Quiggin, 2001).

Advances in economics is also **necessary** because a common major reason that we make slow progress in addressing environmental conflicts is a lack of understanding of the related economic drivers; for example, the need to create jobs and maintain production to meet consumption needs. Putting private interests against broader public interests, such as maintaining biodiversity and providing for public amenities like national parks that are also known as public goods, is often complex and requires us to confront a number of conflicts and trade-offs in our values. Resolving such conflicts involves an understanding of how different people place their values on environmental goods and services and how they develop their preferences for them. Public policies can then be designed to help people better express those preferences, or modify them where relevant through the use of economic signals (e.g. incentives to use parks for recreation). The process thereby seeks to more closely connect to public values in improving net social welfare.

2.3 Recent studies of the value of green spaces on social welfare

In support of this objective, recent studies have explored the role of economic analyses in understanding values placed by people who use parks and reserves, and how such uses contribute to overall social values and preferences towards them.

For example, some studies have focused on what might happen to social welfare if we encouraged and provided opportunities for people to be more **physically active**. Such actions often relate to government objectives for addressing issues such as obesity and chronic illness associated with reduced physical activity related to modern lifestyles. In such a context, parks and reserves can be considered a social service that offer free-to-access locations for physical activity, providing emotional wellbeing and mental health benefits for a wide range of the population. The overall value that the population draws from such free-to-access services will depend on individual preferences discussed above. Those benefits could also mean cost savings in other areas of government activity, such as healthcare.

In a wide-ranging study of economic impacts for Victoria, *Deakin University Health Economics* concluded that making every Victorian physically active over their lifetime would deliver healthcare annual benefits in the order of $245 million , together with workplace productivity benefits of $3.1 billion[2] due to lower early deaths and/or disability reductions to output. Household labour production benefits would also be worth around $125 million for the same population. These benefits are predicted because physical activity was expected to reduce the risks of cardiovascular disease, ischaemic stroke, diabetes mellitus, colon and other cancers, osteoporosis, fall-related injury, obesity, high cholesterol and hypertension, and mental health problems across broad sectors of the community (Ding et al., 2016). Figure **2** illustrates health expenditure by the Australian public on long-term chronic diseases for 2018-19. In terms of the total economy, Ding et al. (2016) suggest that a 1% increase in active recreation would create around 1,300 full-time equivalent jobs (FTEs) and generate, on average, an extra $160 million in gross state product (GSP) per year for Victoria.

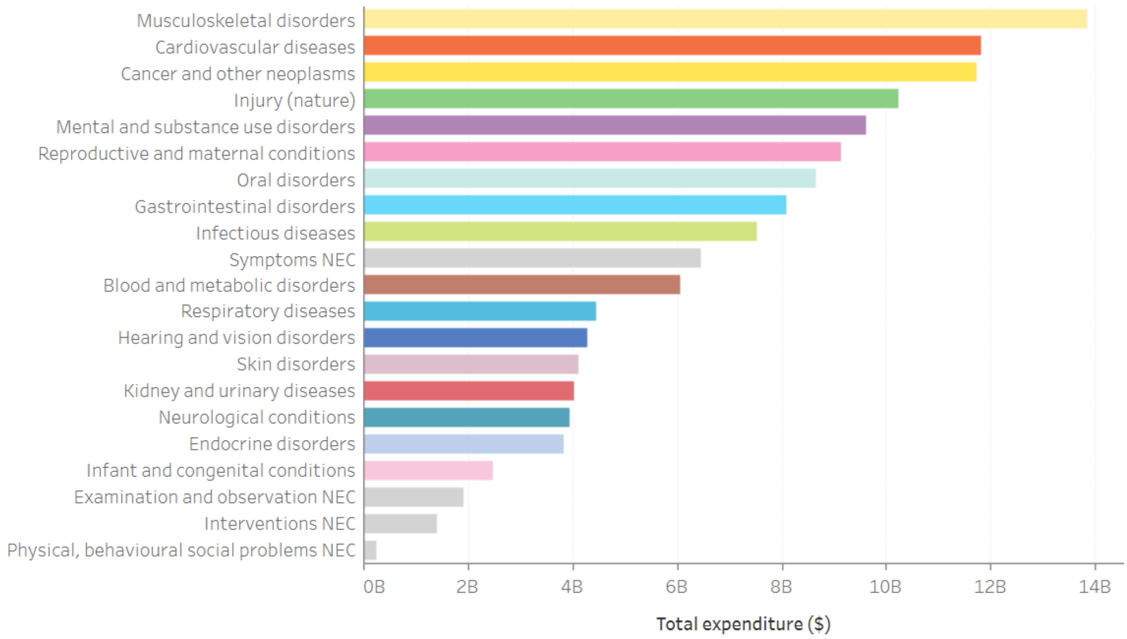


Figure 2: Public expenditure by Australian burden of disease groups 2018-19 (AIHW, 2021)

Supporting this view, Marsden Jacobs Associates (2018) argue that we know little about the economic benefits that active recreation creates. Nor do we know much about how those benefits are distributed **between individuals**, groups, businesses and governments. Active recreation is defined as individual activities engaged in for relaxation, health and wellbeing or enjoyment—which may extend to group benefits—and should involve at least 120 to 300 minutes of weekly moderate/intense activity (Commonwealth of Australia, 2011, White et al., 2019).

In the Marsden Jacobs Associates' (2018) study the benefits to society by way of direct and indirect revenue and employment for recreational retail sales, tourism and event and activity participation, as well as the value of health, wellbeing and social benefits were estimated. The study found that around $8.3 billion was spent each year on active recreation in Victoria—an $8.1 billion value-add to GSP—with this expenditure having the capacity to support around 51,000 direct and indirect FTE jobs.

The study also highlighted that, historically, active recreation has not attracted adequate government policy focus and investment with respect to sporting activity, despite active recreation being a far greater proportion of *total* activity (Marsden Jacob Associates, 2018). A comparable study of **recreational activity** in South Australia found that, for the 2018 period, nature-based outdoor activity (i.e. leisure pursuits conducted outdoors in natural and semi-natural settings) was worth an estimated $865 million per annum through the purchase of gear and travel costs. Activity in parks included walking, cycling, running and swimming-based recreation. Nature-based outdoor activity also generated a further $148

[2] Measured in 2016 dollars.

million in secondary recreational benefits for those living in South Australia (Marsden Jacob Associates, 2020). The majority of this activity stemmed from metropolitan parks in Adelaide (i.e. 32.0 out of 38.9 total million activity hours in SA), illustrating the relative importance of these sites. Therefore, continued good access to, and the condition of associated outdoor sites and infrastructure, were viewed as key drivers of nature-based activity participation rates in South Australia (ibid.)

2.4 Reduced healthcare costs as a consequence of increased activity

In their study, Marsden Jacobs Associates (2020) concluded that welfare benefits from recreational activity include **better physical and mental health** which they argued could be reflected in reduced total healthcare costs, increased recreation benefits (e.g. consumer surplus WTP estimates), and production or productivity impacts from lower absenteeism. For example, if the maximum a person was willing to pay to engage with a metro park was $20 per day, and the amount they had to pay was only $15 per day, then the consumer surplus would be $5 per day, increasing total social welfare.

Building on this study in South Australia, Eckermann et al. (2020) surveyed around 3,000 South Australians on their active recreation patterns and self-reported health. They then used this data to compare two groups: those that meet less than the recommended weekly activity target (i.e. <149 minutes a week) and those that exceed that target (i.e. > 150 minutes a week). Those that exceed the 150 minutes/week reported better overall health, required fewer health services, enjoyed better mental health and had better social connections. Eckermann et al. (2020) recommended increasing physical activity as a result of their study, and as a state government policy objective.

The current study draws on the above referenced studies to note that adult users of parks and reserves can be considered relatively more active than the general population. And, if their self-reported health status is known, that data could be used that to derive **reduced healthcare costs.** For example, Ding et al. (2016) estimated that the 42% of the adult population not meeting the weekly activity targets add about $1,625 in healthcare costs per person, or approximately $937 million in total. In Queensland, Buckley and Chauvenet (2022) found a 3.9% improvement in health associated with visiting park spaces. Physical and mental health is also important as people age (Figure 3), and thus regardless of socioeconomic status, the more people are active in later life the less burden is added to public health expenditure.

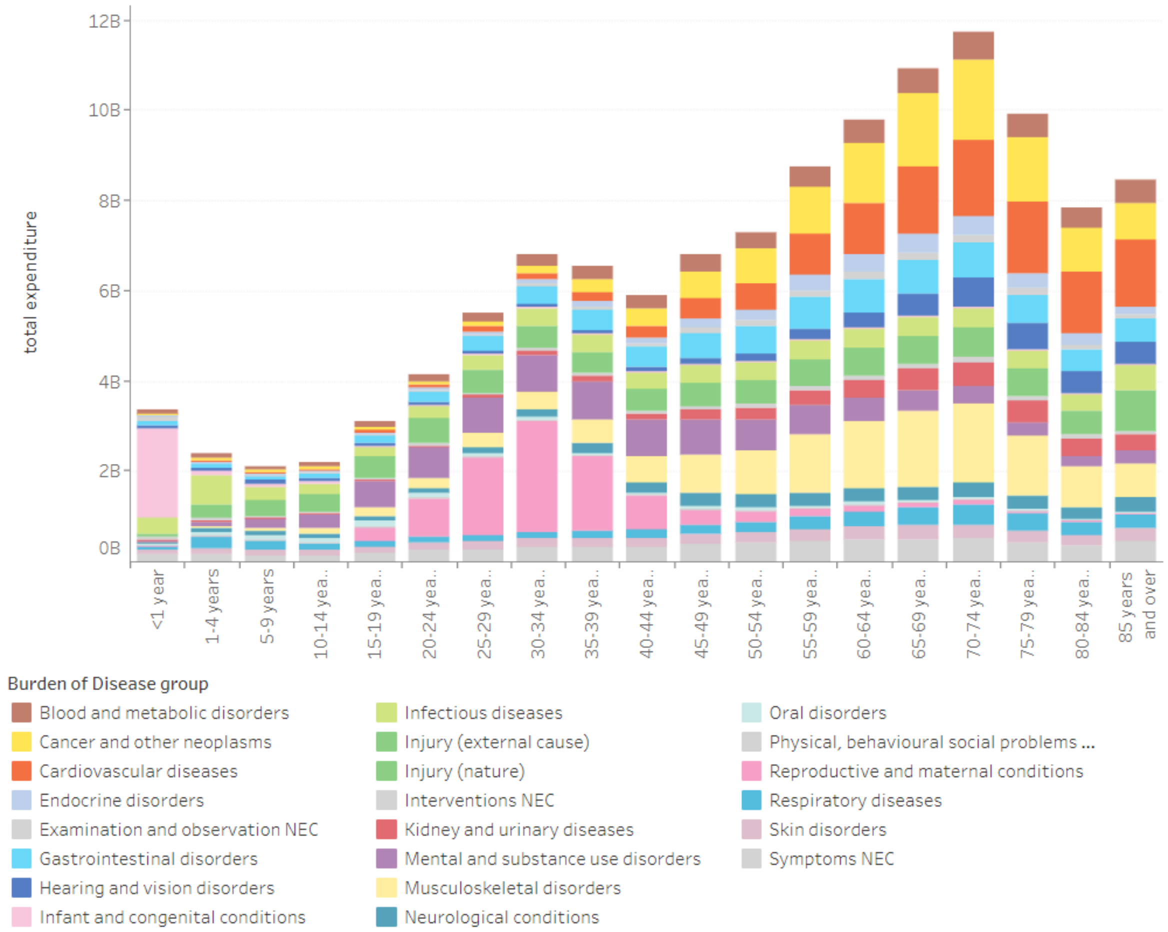


Figure 3: Public health expenditure: all areas by demographic and disease groups 2018-19 (AIHW, 2021)

2.5 Summary of findings and key research gaps

Prior research studies into economic benefits associated with increased wellbeing through visits and activities in green space highlight a number of key questions which will inform the focus of this study:

1. Do different socioeconomic strata have separate willingness to pay in terms of both opportunity cost and travel cost values?
2. Does the frequency of park and reserve visitation change those values?
3. Are there patterns of park use by different groups regardless of what site(s) they visit?
4. How does the general health of park and reserve visitors differ from the general census data?
5. What does that differential mean for reduced public healthcare costs in South Australia?

2.6 What methods should be used?

2.6.1 Different willingness to pay (WTP) estimations

Total economic values for parks and reserves, as well as insight into how to accommodate trade-offs in allocating resources between them, can be informed by evaluating the net economic demand or values generated at each site (Richardson et al., 2018). However, without proper assessments of relative benefits and costs, public investments may be misdirected and limited public financial resources can be misallocated from the point of view of the public (Bharali and Mazumder, 2012). Thus, estimating the economic benefits of parks and reserves will assist in prioritising public investments by way of evaluating options, and communicating and supporting park management choices (Loomis, 2002).

In economic terms, benefits represent gains over costs incurred, and are measured as the difference between demand for a good and the cost of that good (Benson et al., 2013). This is no different for an individual. In simple terms, where a person makes a conscious decision to expend their limited disposable income according to their preferences this is a signal of the relative opportunity costs and benefits of that (public or private) good to the individual. This is then described as one form of their willingness to pay (WTP) for that good. It must be noted, however, that in the case of public goods, more than one person may access the good at the same time, and one's use may not measurably diminish the value for subsequent or concurrent users, except in cases of overcrowding and misuse. For example, a charge on individuals entering a park may thus represent partial WTP for the services provided by the park.

As such, many WTP values can be misreported and total recreation or tourism values for park networks can remain uncertain and less suitable for comparison purposes (Heagney et al., 2019), especially where visitation data is incomplete or entry fees are absent. Studies of individual parks often offer limited insights for managers whose networks encompass tens or even hundreds of individual park sites (Pendleton, 1999). Further, studies that focus on a small or incomplete number of parks may also ignore context-specific attribute differences, remoteness and local community factors, in addition to the availability of substitute sites within the surrounding region (Heagney et al., 2018). This is because most WTP studies usually involve on-site data collection undertaken at high-profile and thus highly-visited sites. This bias is problematic as estimates at high-profile sites may obscure the attributes which drive visitation, and limit informed decision-making (Heagney et al., 2018).

A final technical note for context in the present study is that many random population surveys which yield, for example, population health information or park visitation information, return non-trivial levels of zero-value responses for some questions. Population surveys containing useful information about individual health and park visitation may contain a large number of cases where the respondent has not visited a park, and hence the full record of information is incomplete. This necessitates application of econometric analysis techniques capable of handling high rates of zero-value responses (e.g. zero-one inflated beta techniques, see Loch et al. (2014) for an example), and may reduce the overall cost-effectiveness of survey techniques for park managers where high response rates are returned but limited useable observations are included. Moreover, value estimates from on-site surveys cannot be easily scaled up to provide a total estimate of tourism and recreation without robust data on total visitor numbers; and such data is usually absent from parks or public sources (Heagney et al., 2019).

In response to these issues, Bestard and Font (2010) recommend simultaneous valuation of all relevant sites within a network to address scaling and aggregation complexities. In support of this, Heagney et al. (2018) argue that a broader range of park sites and methods be included in WTP assessments to account for substitution effects, as well as a more diverse set of contexts to better inform management choices and the non-trivial zero-inflated responses resulting from large-scale population surveys. These recommendations were followed to derive multiple WTP values for the metropolitan parks and reserves of South Australia.

2.6.2 WTP: Travel Cost Approach

Consistent with the approach undertaken for South Australian regional National Parks and Reserves by Loch et al. (2022) for spatially different park users in 2018-19, this current study also uses travel costs as an estimate of park users willingness-to-pay or an indicator of the 'price' they would pay for a visit. Travel cost approaches (TCA) are widely used to value recreational and other (e.g. amenity) services provided by park sites. TCA was first proposed in 1947 as a method for estimating the value of protected areas (Hotelling, 1949). The basic premise is that a proxy for a person's preference value of a site can be revealed from the maximum travel expenditure incurred by them to visit. The revealed preference method thus elicits value estimates from the person's actual behaviour. TCA has emerged as a powerful tool for measuring the values of a wide range of environmental assets and the most commonly applied implicit market tool for valuing natural resource/environmental amenities (Hanley and Spash, 1995, Chizinski et al., 2005). The approach has been used for valuations ranging from whitewater kayaking sites in Ireland (Hynes et al., 2009) and ice-climbing destinations in the northwestern United States (Anderson, 2010) to protected areas in Spain (Martín-López et al., 2009) and a World Heritage Area in Australia (Fleming and Bowden, 2009). The approach can be challenging and context dependent in design and Loomis and Ng (2012) provide a comprehensive description of potential challenges found when using the approach in different contexts. The explantation, methods and discussion below outline how the method was applied here and how limitations were navigated.

TCA is commonly used to measure the demand for recreational activities. Economists interpret this context as a special case of the household production function, because recreational experiences are associated with both direct payments on travel associated inputs and time spent (Bockstael and McConnell, 1981, Damigos et al., 2016). However, in the case of metropolitan parks the **distances** associated with travel to these sites is relatively small for most visitors (see Figure 4 for example), as they are close to Adelaide city and the populations that mainly engage with them. Conversely, for interstate/international visitors the travel costs will be higher based on larger distances to be (potentially) travelled, and higher relative travel costs than domestic residents (e.g. cost to hire a car as opposed to local residents who have their own transport options). In either case however, revealed (as opposed to stated) travel origin/destination data allows us to estimate travel distances and expenditure—as well as any relevant accommodation, incidental meal or other expenses for those visitors from interstate or overseas—as a baseline for our study of metropolitan parks. In aggregate, these values form the basis of our metropolitan park TCA estimates. The context reflects the economics notion of substitution, where the decision to travel was motivated by the users as they are unable to provide the recreational benefit of nature's experience themselves, and hence value the public provision of the park. Hence, the expenditures attached to the visit can be regarded as **opportunity costs**, or the value of the forgone alternative consumption opportunities.

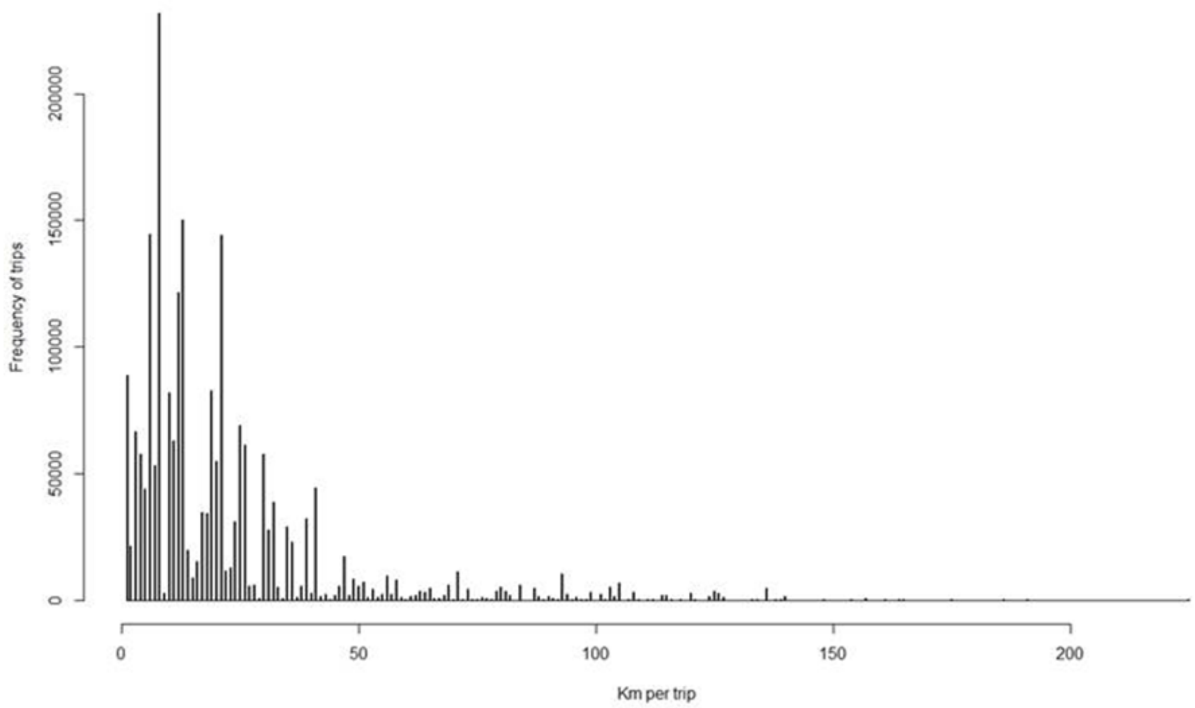


Figure 4: Histogram of distance travelled (km) by all IRSD[3] decile groups, 2018-19

2.6.3 WTP: Marginal Opportunity Cost

In addition to the aggregate travel costs, the marginal amount of disposable income that South Australians are willing to pay to engage with metropolitan parks can also be calculated. This is a point of difference with the Stage 1 study, where the opportunity cost of people's time was excluded from value estimates on the advice of an external peer assessor. Their argument was that, since visitors to regional parks were assumed to be on holiday, they had already discounted the opportunity cost of their time to zero. In the case of metropolitan parks however, individual's do have an opportunity cost of their time that should be accounted for in the value estimates (Gürlük and Rehber, 2008)—although there is no uniformly agreed way of doing so (Chae et al., 2012).

As such, the study focused on deriving opportunity cost WTP estimates for metropolitan park benefits by broadly following the life satisfaction analysis (LSA) approach (see Ambrey and Fleming, 2014 for an example of this analysis technique) as shown below:

$$WTP = \frac{\frac{\partial U_{r,k}}{\partial a_k}}{\frac{\partial U_{r,k}}{\partial y_{r,k}}} = \frac{\partial y_{r,k}}{\partial a_k} = \bar{y}\frac{\widehat{\beta_3}}{\widehat{\beta_1}}$$

where in this case using the central part of the equation the change δ in an individual's household income $y_{r,k}$ between the periods of interest is divided by the change δ in that same individual's park or reserve use a_k across those same time periods. This is broadly similar to Bleichrodt and Quiggin (2013) in terms of using changes in health and wealth to estimate WTP values for parks—where Ambrey & Fleming (2014) examined green spaces. Further, because, the interest is not in what individual characteristics may drive these WTP preferences (e.g. individual time preferences, lifestyle choices, employment status, marital status), the study constrained the model to simple WTP estimates as an outcome. Opportunity cost is strictly an internal cost used for strategic contemplation; it is not included in accounting profit.

2.6.4 Reduced healthcare cost estimates

Finally, general health measures obtained through a survey of annual visitors can be used to estimate partial reduced healthcare costs to the state attributable to metropolitan parks. Where calculated, these values can be used additively alongside WTP estimates without any risk of double-counting (FIT, 2018). Methods to achieve these observations include asking people about their general wellbeing (e.g. life satisfaction score) and/or gathering their self-reported level of general health and whether they visit National Parks and Reserves. Comparing these scores between those that do or don't visit metropolitan parks isolates the reduction in healthcare costs associated with metropolitan parks—although this will still only return a small proportion of the total associated physical and mental health improvements that could be achieved via higher park or reserve use (ibid.)

An alternative approach, if we are interested in estimating wellbeing benefits or reduced healthcare costs, is to look at quality adjusted life years (QALY) to evaluate the worth of healthcare—including activity undertaken by individuals to maintain good health. However, there are concerns that the conditions under which QALYs represent preferences are unlikely to hold in general (Bleichrodt and

[3] The Index of Relative Socio-economic Disadvantage (IRSD) is a general socio-economic index that summarises a range of information about the economic and social conditions of people and households within an area. www.abs.gov.au

Quiggin, 2013). For example, QALY values estimate health improvements in terms of additional years of life linked to the use of goods (e.g. metropolitan parks or reserves) which a person may use to achieve a valuable or extended life. If policy is aimed at increasing individual capability to maximise their opportunity sets to improve health, there may be an overreliance on examining unstable preferences, and reported social welfare may be misinterpreted as increased overall (ibid.)

In any case, data limitations constrain our capacity to undertake QALY analysis for this study. While we have a subjective self-measure of health quality for survey respondents we do not have a full picture of the opportunity sets available to individuals (e.g. decision weights would not be easily attributed). However, using the McGregor Tan survey data we can measure a change in health and wealth by different sectors of the community using their Index of Relative Socio-economic Disadvantage (IRSD) group membership; which provide differentiated WTP and reduced healthcare cost estimates for those groups.

3 Methods

In many of the studies cited above insufficient detail was provided to determine what methods or techniques had been employed, and/or how a similar follow-up study might be attempted in other contexts. While direct comparisons between benefit estimation studies should not be attempted, it is our view that the results from similar previous studies should be consdidered to offer some basis for assessing the benefits in this case and whether they are reasonable. This section aims to provide adequate detail for others to replicate this work in future, if needed.

3.1 Data sources and preparation

A number of sources—both private and public—provided the data basis for our study. These are broadly described as follows:

3.1.1 The McGregor Tan annual Parks Visitation Survey

Data was drawn from the annual survey of South Australian National Park and Reserve visitors. The objectives of this survey are to measure South Australians' perceptions about their health, overall satisfaction with their life, the number of times they have visited a park or reserve in the last year, which sites they have visited, and the general values they place on parks and reserves (i.e. what activities they use parks for, and what experiences are of value to them from engaging with parks and reserves), and their residential postcode details.

The survey is conducted online using CATI software, usually within the month of June. The survey does not comprise a panel dataset (i.e. different people are surveyed in each year). Participants are provided with three reminders to engage before being discarded from the random selection process. The final sample is obtained as evenly as possible from across all 196 postcodes and all South Australian Natural Resource Management (Landscape Board) regions. Final data are then weighted by age group and gender following benchmarks derived from the 2016 Australian Census figures.

The full database comprises a larger sample of the South Australian population (n = 5,720 observations). In this study we reduce our focus down to the 2017 to 2019 periods only (n = 3,557). Some simple statistics of interest are provided by the baseline year (2018/19) include:

- 75% of South Australians had visited a state managed park.
- 56% had visited a park or reserve in the Adelaide and Mt. Lofty Ranges NRM (up from 55%).
- The average median visitation rate was 4.0 times in 2019 with a pattern of visiting 1-3 times p.a. (41%), 4-11 times p.a. (43%), and some 12 or more times (16%).
- Only 1% stated that parks were not important. Protection of native plants and animals, as well as cultural heritage was viewed by 53% as the main reason they valued parks while another 46% enjoyed the community recreation and health benefits that parks and reserves offer.
- The most common activities undertaken in parks and reserves was experiencing nature and scenery followed by walking, socialising with friends/family, learning about nature and simply taking time for oneself.
- In terms of general health 83% self-reported as being in excellent, very good or good health and an average life satisfaction score of 7.3 (out of 10).

To prepare the Excel database for calculating park and reserve WTP values in 2018-19, the 2017 to 2019 survey data was cleaned of missing values, especially those related to income or park visitation records which are essential to the WTP estimation.

Next, the Australian Bureau of Statistics (ABS) *Socio-Economic Indexes for Australia (SEIFA) 2016* datasets provided an IRSD Decile score for each South Australian postcode in the survey. This attached a coarse IRSD score of between 1 (highly disadvantaged area) and 10 (highly advantaged area) to the survey database—where ultimately these were consolidated further into five IRSD decile groups (i.e. 1-2, 3-4, 5-6, 7-8 and 9-10) to improve model interpretability. As the survey data did not feature a balanced (consistent) panel of respondents over time, the use of IRSD deciles allowed us to group respondents and then compare changes within those groups (rather than across time for individuals) as a basis for the WTP comparisons. IRSD grouping was also relevant for the subsequent reduced healthcare cost model, where national/state data on health costs is generally provided by IRSD score.

Figure 5 provides an interpolation derived from multiple mapping sources for coarse IRSD boundaries in the Adelaide area (provided by DEW). The survey data was then ready to be incorporated into the WTP models (see below).

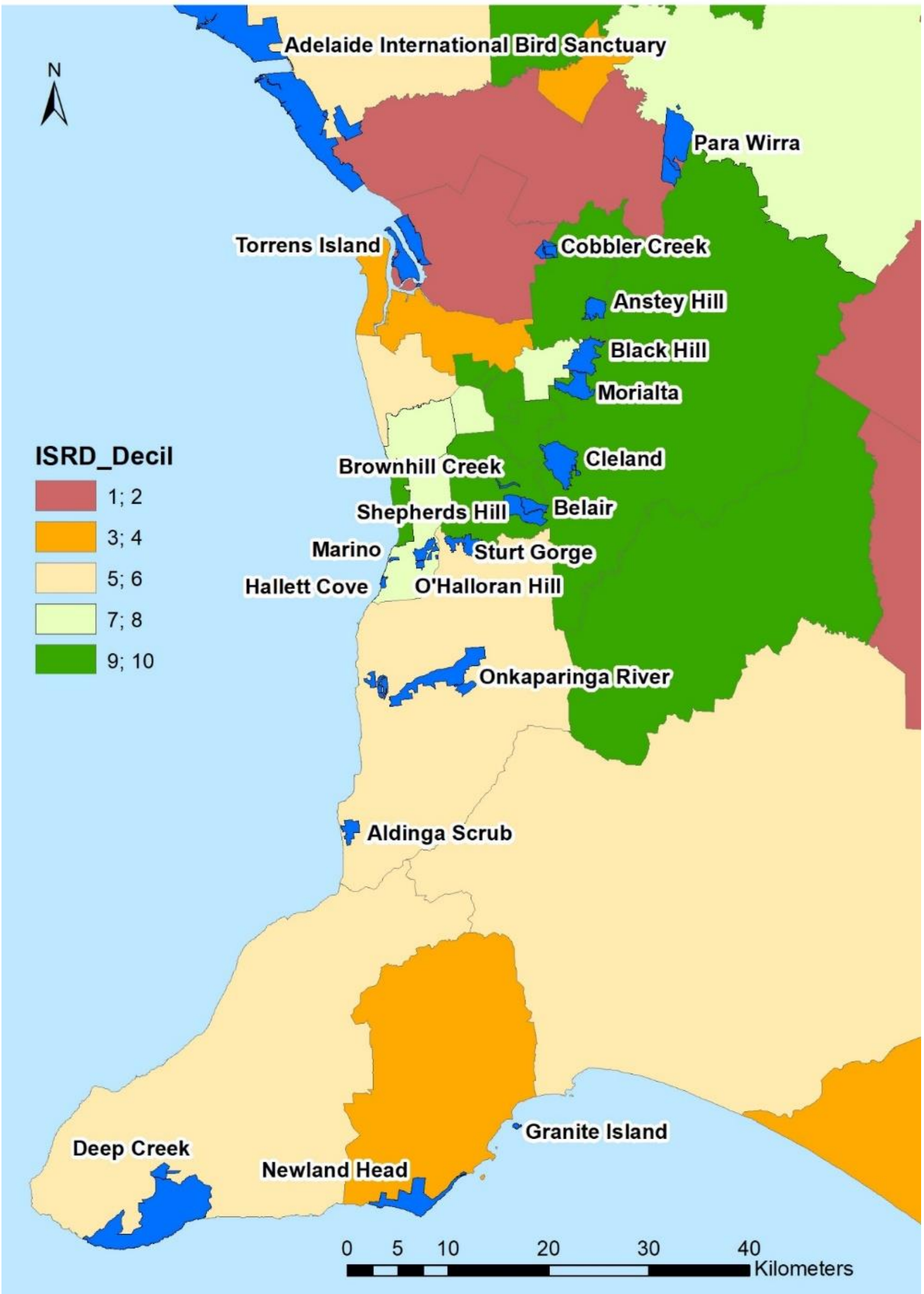


Figure 5: Map of ISRD distributions (by Local Government Area) for the Adelaide metropolitan area (source: DEW data interpolation – park sites shown as royal blue areas)

3.1.2 Australian health datasets

To prepare for the reduced healthcare cost (RHC) model a number of publicly available datasets were employed, consistent with previous studies (e.g. Ding et al., 2016).

The ABS *2017-18 National Health Survey – Australia IRSD* dataset was used to collate observations on all long-term health conditions by IRSD decile for the entire Australian population. As this data is also available in subsets for each state and territory we also collected observations for South Australia (i.e. the ABS *2017-18 National Health Survey by State and Territory and IRSD*). This data enables a calculation of the average health burden experienced by citizens in each IRSD group, across a range of long-term chronic conditions (i.e. arthritis, asthma, back problems, cancer, cardiovascular and other pulmonary disease, diabetes, heart and vascular disease, kidney disease, mental health problems, and osteoporosis). Further, the *Australian Institute of Health and Welfare* (AIHW) website offered important data on the total costs of health procedures and other population-level data (e.g. the *AIHW HWE-81 Disease Expenditure in Australia 2018-19*). In this case, all health procedure costs were selected excluding the costs of private hospitalisation as it does not constitute a public health expense. Specialist medical expenses and dental costs were included, again consistent with earlier research approaches.

3.1.3 Mobility data to determine total number of visitors to each of the 23 sites

Accurate data on total numbers of visitors to a majority of metropolitan parks and reserves is not available, with some visitation statistics partially available for only 5 of the total 23 sites examined in this study, making aggregation challenging. To address that gap, the study used **mobility data** to estimate visitation and visitor origins. Mobility data describes information generated by activity, events, or transactions using GPS-enabled mobile devices or services (e.g., smartphones). These recorded events can be allocated to individual sites, indicating visits. Importantly, information regarding the *origin* of visitors (i.e. visitors' home postcode and other demographic information) is also available through analysis of these data.

Mobility data utilise geolocation data whereby a device using mobile applications (apps) periodically transmits the device location via pings or periodic connections to cell-towers. These applications are used by millions of people, yielding terabytes of location information available through the recording of these pings. Pings are harvested and on-sold by mobile phone app developers. Information derived via these data yields (depersonalised) details from the phone/device which can be used to inform visitation statistics. The collection of location data transmitted by devices can therefore be viewed as another means of sampling a population in space and time (Xu et al., 2016). As with any population sampling regime, the information gained via these data represents only a fraction of the population. Ideally, that proportion sampled is representative of the entire population, but this is rarely the case in so-called big data applications (Athey et al., 2021).

To improve the robustness of estimates **Bayesian** modelling techniques are predominately employed in analyses of movement data supplied via device location updates (pings), as focused on by the present study. Bayes' Theorem describes the probability of an event based on prior knowledge of conditions, which in this case equates to estimating the number of metropolitan park visitors based on the number of mobility ping data, conditioned on known visitation to a number of sites (e.g., bookings or ticket sales to approximately 20% of all sites in the study area). Hereafter these sites are referred to as *training sites*.

A hierarchical Bayesian model was derived to scale these sub samples up to a population level estimate. The overall task of the model is to estimate visitor numbers, and their origin, at sites that NPWS/DEW does not have any visitor statistics for, based on data from a limited number of sites where that information is known (I.e., training data sites). This process enabled the calibration and development of bounded park visitation levels to aggregate the final WTP values. DEW engaged Dr John MacLean (University of Adelaide School of Mathematics) to derive this model and provide the visitation estimates. At training sites, the model sought to understand visitation statistics by estimating

$$p(\propto_{ij} \mid y_{ijk}, n_{ijk}).$$

In this expression, α is the likelihood of a mobile device being recorded, y is an aggregate count of visitors from mobility records, and n is the known total number of visitors at a training site. Subscripts i refer to a particular site, subscripts j refer to the origin of a visitor (meaning their LGA if the visitor was from SA), and subscripts k refer to the month in which the visitor was observed.

The model used data from sites with known visitation to estimate the likelihood α of a device being recorded, including an uncertainty measure for that estimate. Sites with incomplete visitation data were assigned a range of possible values of α by grouping them with the most similar training site (derived through expert advice, mobile phone reception, among other factors):

Table 1: Overview of hit rate groupings for Bayesian model. Non-training site parks were grouped with those sites for which visitation data was available, to enable prediction based on hit rates (bold headings = training site data sets)

Cleland	**Belair**	**Para Wirra** *Moderate hit rate*	**Newland Head** *Low Hit Rate*	**Deep Creek** *V. Low Hit Rate*
Cleland only	Belair only	Anstey Hill	Torrens Island	Granite Island
		O' Halloran Hill	Morialta	Adelaide Botanic Gardens
		Black Hill	Marino	Mount Lofty Botanic Gardens
		Cobbler Creek	Brownhill Creek	Wittunga Botanic Gardens
		International Bird Sanctuary	Onkaparinga	Hallett Cove
		Aldinga Scrub		
		Shepherds Hill		
		Sturt Gorge		

In the model's prediction step, total visitors at the above sites were estimated by upscaling the mobile counts, using the assigned range of values of α. Resulting median visitation estimates for all 23 sites were supplied to the current study (Table 2). The model A estimated visits to 20 national parks and reserves was 1,453,271; visits to botanic gardens was 1,389,232 and the total for all sites was 2,842,503 visits. On average, upper and lower 95% CI bounds fall within 3.3% of the median.

Table 2: Modelled estimate for NPWS & Botanic Gardens sites. Model A median estimates indicated (highlighted). Average dwell time by visitors for each site, also repeat visitation proportions indicated

Site	Model A median visitor estimate	Average dwell time	Proportion of repeat visitors (>1 visit per year)
Adelaide Int'l Bird Sanctuary	**14,908**	209 min	26%
Aldinga Scrub	**11,983**	188 min	28%
Anstey Hill	**36,049**	201 min	41%
Belair	**223,444**	208 min	19%
Black Hill	**47,372**	195 min	27%
Brownhill Creek	**88,344**	352 min	46%
Cleland	**316,051**	115 min	16%
Cobbler Creek	**47,865**	222 min	10%
Deep Creek	**42,395**	264 min	18%
Granite Island	**89,950**	81 min	4%
Hallett Cove	**80,641**	97 min	3%
Marino	**29,567**	244 min	34%
Morialta	**99,003**	139 min	21%
Newland Head	**4,749**	244 min	23%
O'Halloran Hill	**66,547**	170 min	26%
Onkaparinga River	**165,031**	223 min	29%
Para Wirra	**9,973**	271 min	26%
Shepherds Hill	**28,528**	245 min	26%
Sturt Gorge	**43,339**	233 min	28%
Torrens Island	**7,532**	182 min	21%
Adelaide Botanic Gardens	**875,121**	158 min	11%
Wittunga Botanic Gardens	**225,696**	251 min	30%
Mt Lofty Botanic Gardens	**288,415**	163 min	20%

3.2 Modelling processes

Both the aggregate TCA calculations and opportunity cost WTP modelling were undertaken in Excel with all datasets included as embedded sheets (i.e. there were no external links or macros employed). The raw survey data provided a basis for selecting across IRSD groups and bringing in the relevant distance/cost/health status observations. A brief summary of each analysis approach is provided in the following sections.

3.2.1 Aggregate TCA calculations

In total there are 20 metropolitan parks (and three Botanic gardens separately assessed in Appendix C) within the local government areas (LGAs) relevant to our study of South Australian metropolitan national parks and reserves, where these LGAs can be matched to IRSD groups using the ABS data. In each case, using the McGregor Tan survey database as the source of our observations the centroids for LGA post office and metropolitan parks provided a basis for calculating travel distances between the two. The South Australian Tourism Commission (SATC) characterises any travel greater than 50 kilometres (or more than 1 hrs travel) as tourism; while all travel below that threshold is considered recreational in nature. We limited our TCA calculations to South Australian metropolitan park visits located within a 60 kilometre radius of the Adelaide CBD GPO, which represented around 90% of all visitors.

The travel cost method described above has the potential for incorporation of a wide range of costs associated with travel (e.g. accommodation and hospitality associated costs). In Stage 1 of this research program comprehensive travel cost models were applied for estimation of WTP to visit regaional National Parks (Loch et al 2021). However, the short distrances travelled by South Australians visiting metropolitan parks mean that incidental expenditures are likely to be sporadic and more difficult to calculate. Several examples of travel costs associated with visiting metropolitan parks are provided here for which the number and amount of expenditures is difficult to estimate. Example 1: A proportion of metropolitan based visitors to Deep Creek Conservation Park will have stayed in accommodation and accrued expenses related to hospitality, however the proportion and average expenitures are difficult to estimate. Example 2: A proportion of friends groups who meeting at Morialta Conservation Park for a walk and subsequent lunch at a nearby café make a suite of expenditures which is difficult to characterise and estimate accurately. To reduce potential overestimate of travel cost expenditures where information was poor or missing, a conservative approach to valuation was taken and only costs associated with transport to parks was included in the analysis. For residents of South Australia the cost of travel could be estimated to be at least the per kilometre rate derived from the Australian Tax Office's (ATO) 2019/11 travel determination data for 2018-19, available on the ATO website[4]. The applicable vehicle rate for that period was $0.68 cents/kilometer. This rate incorporates decline in vehicle value, registration, insurance, maintenance, repairs and fuel costs and is indicative of generating service industry benefits, but undervalues service industry expenditures for the purpose of not overestimating the value of national parks. Further, we did not aggregate total distances travelled at an individual level. This is because the National Park and Wildlife Service (NPWS) division of DEW estimates that each car entering metropolitan parks carries an average of 2.3 visitors. We therefore divided total visits by 2.3 to conservatively reduce the total kilometers travelled, and the associated travel costs. However, the final set of estimated travel costs were then doubled to account for return-trip journeys.

Finally, we used this data to identify frequency bins for distances travelled by South Australian visitors to metropolitan parks, the distribution of kilometres travelled by each IRSD decile group, median and quartile groups for travel distances (Figure 6), and individual metropolitan park profiles for distances travelled relative to the associated percentage of travel costs (see Appendix A and B).

[4] Australian Tax Office's (ATO) 2019/11 travel determination data for 2018-19 https://www.ato.gov.au/law/view/document?docid=TXD/TD201911/NAT/ATO/00001 For interstate/international travellers accommodation and incidental meal expenses do apply, and were accounted for as explained below.

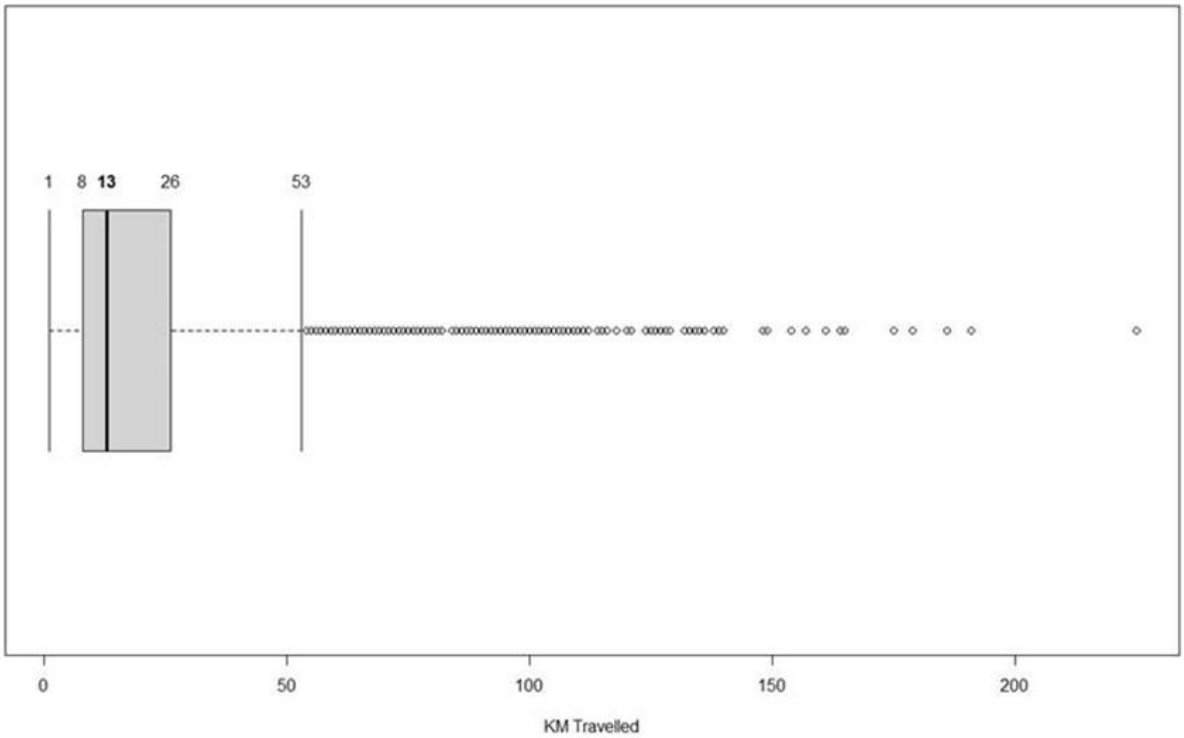


Figure 6: Median and quartile distribution of distances travelled, all IRSD deciles 2018-19 *Note metropolitan residents within 60km capture a majority of journeys, with 13km the Median distance. Figures withing the grey box highlights 50% of all visits range between 8 to 26km.

For visitors from international origins we assume that all of these people would have arrived by flights into Adelaide, starting any visits to parks or reserves from the Adelaide GPO. For interstate visitors we assume that a visit to a Metropolitan park is a recreational event and not the primary purpose for travel to SA and therefore travel is also assessed from the Adelaide GPO. However, not all visitors will stay in commercial accommodation, as some will instead stay with friends and relatives at little to no cost. Several studies have attempted to estimate the relative proportions of these groups, with wide variations. The most common proportion reported for those that stay with friends and family is around 20% (see for example Seaton and Palmer, 1997, Backer, 2012); hence we adopt that number in the model to reduce the total population of interstate/international visitor estimates.

For the remaining interstate/international visitors included in the model we assume that they would need to rent a vehicle or pay a premium to travel to the park site (taxi or ride-share cost), inflating their costs above that of a local resident. To model those expenses we again first turn to the Australian Tax Office's 2019/11 travel determination data for 2018-19 (Australian Taxation Office, 2021), and apply the Adelaide City full rates for one night's accommodation and Tier Two meals and incidentals (Table 3) at varied proportions again based on a fair allocation of costs per park (e.g. closer parks attract lower proportions of the full ATO rate) to provide a basis for calculating a complete set of weighted WTP inflation factors (Table 4).

To calculate the final WTP weighting we determined the actual distance in kilometres to each park site centroid (central location coordinates) and then multiplied that distance by the associated travel charge[5] The WTP travel weighting thus factors the higher costs of vehicle rental/hire into the WTP for interstate and international park visitors. These weights are then applied park by park to arrive at a set of specific WTP values to include in the modelling.

Table 3: Expenditure estimates – Interstate/International park visitors

Example secondary expenditure	Rate applied
Adelaide accommodation	$157/night
Adelaide meals & incidentals	$133.75/day
Adelaide City full rate	**$290.75**

Table 4: Park sites by distance – Interstate/International park visitors

Weighted travel costs	Sites @ Within 5km	Sites @ 5 – 25 KMS	Sites @ 25 – 60 KMS	Sites @ 60 - 110 KMS
% of total Visitors	80%	80%	80%	80%
ATO proportional costs	33%	33%	67%	100%
WTP travel weighting	Actual distance to park centroid x Average per km charge			

[5] The average WTP is for a single individual visit based on a South Australian residents across all IRSD deciles in the *Once in the last year* frequency group. Thus, it is quite low in relative terms ($0.90) for 2018, and is applied to those visitors who could walk to their park site from the City Centre. All other park travel costs apply a taxi fare calculation based on weekday rates (more expensive on weekends) of $3.70 flag fall plus $1.87 per km thereafter. For the most distant sites (e.g. Deep Creek) average hire car rates are applied. In all cases, the 2022 base rates are discounted back to 2018 dollars.

3.2.2 Opportunity cost model

Using the McGregor Tan Survey database we calculated the differentials δ by IRSD group in annual income and metropolitan park visitation rates. The aim was to compute the marginal willingness to spend a higher proportion of disposable income on metropolitan parks using the equation shown in section 2.6.3. This process was then repeated to allow for subsequent WTP computations:

- For individual years (e.g. 2019)
- By frequency of park/reserve visitation
- As a proportion of mean disposable annual income in 2018 dollars, and
- An annual WTP estimate for each IRSD decile and visitation frequency group.

As discussed, these opportunity cost values are in addition to the TCA expenses and can therefore be summed overall to obtain a total WTP amount in aggregate. However, in the case of opportunity costs, we report individual values for single metropolitan park visits across the IRSD decile groups, and increasing visitation frequency groups, to highlight differentials in the patterns of park use and welfare signalling.

3.2.3 Threshold for visit frequency on self reported health scores

Finally, to test if a threshold number of minimum visits per annum statistically significantly affected self-reported health scores a one way ANOVA was conducted, followed by a Tukey's pairwise comparison test of each of the possible combinations of visit frequency values. Five years of repeated Parks Visitation survey data was examined (2015-2020) to provide a robust test of any relationship between the two factors. Self-reported visit frequencies ranged from 0 visits to >350 visits per annum. The ANOVA demonstrated a significant difference between one or more of the combinations (F Value = 4.454; P = <0.001). However, when 1,432 combinations of visit frequency pairs were examined with the Tukey test, only 9 pairs demonstrated a significant relationship between health score and visit frequency. These significant pairs are detailed in Table 5 below:

Table 5: Park visitation frequency analysis results (DEW interpolation)

Frequency of visit comparison	P Value
6 vs 0	0.000
5 vs 0	0.000
4 vs 0	0.000
10 vs 0	0.000
12 vs 0	0.001
20 vs 0	0.003
40 vs 0	0.003
3 vs 0	0.012
6 vs 1	0.028

The only pattern which appears to be significant between visitation and self-reported health score is found in those respondents who did visit, versus those who did not. However, no statistically significant threshold exists regarding the *frequency* of visitation in relation to improved health self-reporting.

3.3 Reduced healthcare cost (RHC) model

Having split the McGregor Tan survey data into IRSD vistor/non-visitor groups we calculated the proportion of membership across each health status category. This allowed for the calculation of reported health status differentials. An estimation of the South Australian proportion of total national health costs (i.e. around $4.3 billion in 2018) was used to calculate the proportion of costs (roughly 8.7% of national costs), which was added back into the ABS *National Health Survey by State-Territory and IRSD* dataset to estimate proportional costs for each long-term chronic disease category in 2017-18.

The 2018 period data was selected as a base for the final comparisons, as the timing of that census (i.e. December 2018) fell closest to a mid-point for the period of interest (i.e. 2018-19). Having computed the differentials in health status scores by IRSD category for the survey sample groups an annual differential percentage between the financial year 2017 to 2018 and 2018 to 2019 became clear. This provided the basis for estimating health score gaps between the survey and general population groups.

Finally, knowing the total South Australian health expenditure in 2018-19 across each of the 10 long-term chronic disease categories, the average burden of disease across each IRSD decile group, and the average difference in health score between visitors versus non-visitors revealed within the survey (i.e. approximately 2-5%) we computed the reduced health costs by chronic disease category, IRSD decile group, and total reduction to state public healthcare costs. This approach relies on the set of assumptions set out above as well as an assumption that self-reported health scores provide sufficient information to infer differences in actual health status from differences in health scores.

The health score used in the McGregor Tan survey is drawn from the much used and studied SF-36 questionnaire developed by the Rand Corporation[6]. A search using the research search engine Scopus[7] shows that a blanket search for the term "SF-36 Health Survey" found 11,973 items. The questionnaire and indices derived from the results have been evaluated as a measure of health many times (e.g. McHorney, et al., 1993; Ware and Sherbourne, 1992), and subsequently used in relation to assessing health outcomes and access to green space in particular (e.g. Stigsdotter, et al., 2010).

Additionally, the methods described above explain how complex data about individual characteristics from several unmatched sources are collapsed into categories for the purpose of analysis. This approach reduces the sensitivity of some analysis but should not change the direction or magniture of estimations. This modelling approach is necessary to overcome information gaps and because direct study of the relationship between national park visitation behaviours, costs and health outcomes is unfeasible. At all stages the results are presented in the context of the data underlying the models and with a bias towards conservative estimations of outcomes and costs.

The South Australian Population Health Study (Adults) asks the same SF-36 General Health question and in 2019 showed that 75.6% of adult South Australians report their health as good or better (SA Health, 2019). This figure is slightly lower than for the same question in the McGregor Tan survey where 83% of respondents reported their health as good or better. This difference may be partially explained by slightly different sampling frames used by the two surveys. If the McGregor Tan survey data evenly overestimate the self-reported general health status of South Australians, estimates of differences in health status between those who did go to a metropolitan national park in the preceeding year, and those who did not, may be biased to produce a more conservative estimate of differences in health

[6] https://www.rand.org/health-care/surveys_tools/mos/36-item-short-form.html

[7] Search conducted 26 February 2023

status due to the higher proportion of individuals in the higher categories on the 5-category health scale.

4 Results

In keeping with the sections above, we report results across three major analyses: the willingness to pay estimates, the mobility data calibration, an aggregation of WTP calculations, and finally the reduced healthcare cost estimates for the 2018-19 period. Further, an exploration of distances travelled by individual ISRD groups to a selection of sites is examined to provide a better understanding of spatial relationships between proximity of parks relative to ISRD groups and the frequency of visitation.

4.1 Willingness to pay: Opportunity cost + Travel cost

4.1.1 2018-19 aggregate WTP for metropolitan parks

Using the weighting approach detailed above, and applying that to the total 2018-19 visitation estimates derived from mobility data, we can aggregate a WTP value for each park. In total, the 2018 /19 travel cost value of metropolitan parks was $48 million spread across the three main value categories as shown in Table 6.

Table 6: 2018-19 Aggregate WTP for metropolitan parks by domestic, interstate and international visitors

Metropolitan Park:	SA Travel Cost	Interstate Travel Cost	International Travel Cost	Total Travel Cost	SA Opport. Cost
Aldinga Scrub	$126,191	$165,321	$102,288	$393,800	$9,495
Anstey Hill	$181,734	$159,788	$48,812	$390,334	$32,504
Belair	$2,068,101	$292,579	$44,735	$2,405,415	$209,587
Black Hill	$241,791	$141,101	$59,526	$442,418	$42,189
Brownhill Creek	$387,181	$1,398,262	$117,878	$1,903,321	$68,138
Cleland	$2,263,936	$1,759,084	$13,216,189	$17,239,209	$163,877
Cobbler Creek	$333,699	$189,199	$138,415	$661,313	$41,610
Deep Creek	$1,745,011	$1,151,342	$136,963	$3,033,316	$34,245
Granite Island	$890,931	$417,999	$350,750	$1,659,680	$67,221
Hallett Cove	$2,597,193	$5,006,471	$666,775	$8,270,439	$64,014
International Bird Sanctuary	$310,904	$331,079	$129,364	$771,347	$11,193
Marino	$191,584	$287,126	$30,869	$509,579	$24,371
Morialta	$820,277	$732,722	$121,196	$1,674,195	$84,366
Newland Head	$179,865	$153,471	$39,438	$372,774	$3,707
O'Halloran Hill	$594,594	$321,124	$131,650	$1,047,368	$56,216
Onkaparinga	$1,696,045	$3,048,981	$330,130	$5,075,156	$130,433
Para Wirra	$128,581	$559,133	$22,975	$710,689	$6,215
Shepherd's Hill	$189,301	$189,176	$47,768	$426,245	$24,591
Sturt Gorge	$525,762	$234,766	$110,416	$870,944	$36,231
Torrens Island	$90,779	$91,944	$51,289	$234,012	$5,528
Total	**$15,563,460**	**$16,630,668**	**$15,897,426**	**$48,091,554**	**$1,115,731**

South Australian travel costs for return trips between LGAs and National Parks and Reserves sites were $15.5 million in 2018-19. The picture for interstate and international visitors who travel to metropolitan parks is different with respect to their travel costs, but similar in terms of broad WTP. Again, this is based on assumptions of potentially higher travel costs for those types of visitors because they do not have access to their own transport and expend at least some money on accommodation and incidental costs as part of their park engagement. In 2018-19, the estimated travel costs by interstate visitors to travel to metropolitan parks was $16.63 million, while for international visitors to Adelaide the estimated total WTP was $15.9 million. If we think about these numbers relative to the regional national park values estimated in the Stage 1 study (i.e. total secondary economic benefits of $358 million in 2018-19 as estimated by Loch et al., 2022) this may seem quite low. However, we must remember the relatively low median distances travelled in each case (i.e. between 9 and 35 kilometres) and that only basic vehicle costs are reflected here, as opposed to the general assumption of full travel costs (i.e. accommodation, meals, fuel and vehicle costs) in the Stage 1 analysis.

The opportunity cost is also quite low, reflecting the moderate costs for people to engage with (largely free to access and use) metropolitan parks. The estimated opportunity cost WTP values for domestic visitors to National Parks and Reserves totalled $1.1 million in 2018-19. This tells us that, relative to the next-best alternative expense on which South Australians could spend their disposable income (e.g. going to the cinema), those engaging with metropolitan parks are willing to spend more money to do so; but again the cost is not high to engage with metropolitan parks, which is a good social welfare outcome. As noted previously opportunity cost is a strictly an internal cost used for strategic contemplation; it is not included in accounting profit and so will not will not be included in the total financial benefits estimate.

Of the 20 parks studied eight account for a majority of this travel cost value, which should be of little surprise to those who are familiar with them: Cleland National Park (including Cleland WP) tops the list ($17,24 million). The next highest WTP parks are Hallett Cove ($8.27 million), Onkaparinga ($507 million), Deep Creek ($3.03 million), and Belair National Park ($2.4 million).

While these aggregate estimates are useful we can also learn a lot from examining individual WTP values across different IRSD decile groups and visitation frequencies, as reported below.

4.1.2 WTP for a single park or reserve visit

In this section we report an individual's WTP value for any one visit to a park or reserves in general, broken down by IRSD decile grouping and then again into visitation frequency groups (e.g. Table). The frequency labels in parentheses provide a link to SA Health data analysis (SA Health, 2018), enabling some very limited comparison between the results of both studies. While distance versus frequency of visitation results show some differences in IRSD groups, the WTP values appear to be similar across the IRSD and/or visitation frequency groups. This is important for dispelling any perception that, for example, any one single socioeconomic group (e.g. IRSD 9-10 decile) engages with metropolitan parks more highly than those from other groups. In any of the 2018-19 park examples dominant WTP values may emerge from any one IRSD group.

For example, in the *At least monthly* visitation category the highest WTP values for 2018-19 come from the IRSD 3-4 group, while in the *At least weekly* category the highest WTP is in the IRSD 7-8 group. It should be strongly noted that these values hold only for the 2018-19 period, and will change in alternative years, again diluting efforts to suggest visitation emphasis by any one IRSD group. Analysis of the data for 2017-18, used as a robustness test, returned completely different patterns and opportunity cost values, signifying limited capacity to make assumptions about value consistency over time and a requirement to assess these values regularly (e.g. every 3-5 years) in order to keep track of changes where necessary.

Interestingly though, the distribution of WTP values in these groups/categories do not vary significantly. The variation spans values of between $0.00 and $3.35 per visit which, in 2018 dollars, suggests roughly homogenous preferences for parks and reserves at the individual visitation level. However, when we look more closely at the annual expenditure, and what that represents as a proportion of mean disposable annual income for Australians, the results become more differentiated (see further below).

Table 7: 2018-19 Individual Visit WTP, by IRSD and Visitation Frequency

	IRSD Decile Group				
Visit Frequency	**1-2**	**3-4**	**5-6**	**7-8**	**9-10**
1-3 times per annum (Once in last year)	$1.52	$1.28	$1.40	$1.09	$1.14
4-6 times per annum (Occasional visitor)	$1.83	$1.12	$0.86	$1.31	$1.16
7-24 times per annum (At least monthly)	$1.52	$1.62	$1.03	$0.79	$1.35
25-52 times per annum (At least weekly)	$1.00	$1.04	$1.12	$3.35	$0.95
53+ times per annum (Daily visitor)	$-	$0.23	$1.68	$0.70	$2.10

4.1.3 Annual and Average Park Visitation WTP values

If we take the single park visit WTP values above and then multiply them by the visitation frequencies we can arrive at a rough estimate of the annual WTP values, again across the different IRSD decile groups (Table). In some cases (e.g. those that have only visited parks once in the last year) the annual WTP values do not appear differ significantly—as we might expect. However, in other instances (e.g. those that visit parks at least weekly) the annual WTP values can fluctuate significantly across the IRSD groups with WTP ranging up to$171.02 p.a. (IRSD 7-8). The other IRSD groups spend around $53/year each.

Table 8: 2018-19 Annual and Average Visit WTP, by IRSD and Visitation Frequencies

	IRSD Decile Group					
Visit Frequency	**1-2**	**3-4**	**5-6**	**7-8**	**9-10**	**Average**
1-3 times per annum (Once in last year)	$4.55	$3.85	$4.21	$3.28	$3.42	$3.86
4-6 times per annum (Occasional visitor)	$11.01	$6.70	$5.16	$7.86	$6.97	$7.54
7-24 times per annum (At least monthly)	$36.57	$38.89	$24.75	$18.97	$32.32	$30.30
25-52 times per annum (At least weekly)	$51.00	$52.91	$57.23	$171.02	$48.33	$76.10
53+ times per annum (Daily visitor)	$-	$33.98	$252.63	$105.41	$315.00	$141.40

Again, this is very interesting as, for the 2018-19 data at least, the annual WTP results for *At least weekly* visits suggest those in the relatively lower IRSD decile groups are at least as willing to spend their money to visit and engage with parks and reserves as most other groups. This is perhaps as a relatively cheap form of exercise, interaction with nature, play space for children, and an opportunity to socialise either with family or friends. Given the results of the annual McGregor Tan surveys, the results here make intuitive sense—at least for 2018-19, as explained earlier.

4.1.4 WTP as a proportion of Mean Disposable Income

As a final set of individual WTP value results, we also sought to determine what these reported values meant as a proportion of mean annual disposable income; that is, the amount of a person's income left over to spend on discretionary items after all other requisite (e.g. rent, electricity, school fees etc.) have been paid for.

We used the ABS *Weekly Household Income, Australia 2001-01 to 2019-20* dataset to identify the mean annual disposable income for the 2017-18 period, and compare that to general health statistics from SA Health (for example, SA Health, 2021). Mean disposable income for that period was 47.36% of total (Figure 7), which we applied to the WTP modelling. This calculation provided proportional estimates by IRSD decile and visitation frequencies.

As we might expect, for those that visit metropolitan parks or reserves only occasionally the proportional WTP is extremely low at around 0.0053% (i.e. about one-half of 1 per cent) on average across each IRSD group. For those that are highly frequent visitors to metropolitan parks and reserves the proportion is relatively greater at around 1.6% of mean disposable income, on average (Table)—or a relatively low impact on total disposable income. Thus, for these types of park visitor, the proportion is a relatively meaningful component of their financial allocation decisions given all of the other things on which they could spend their disposable income.

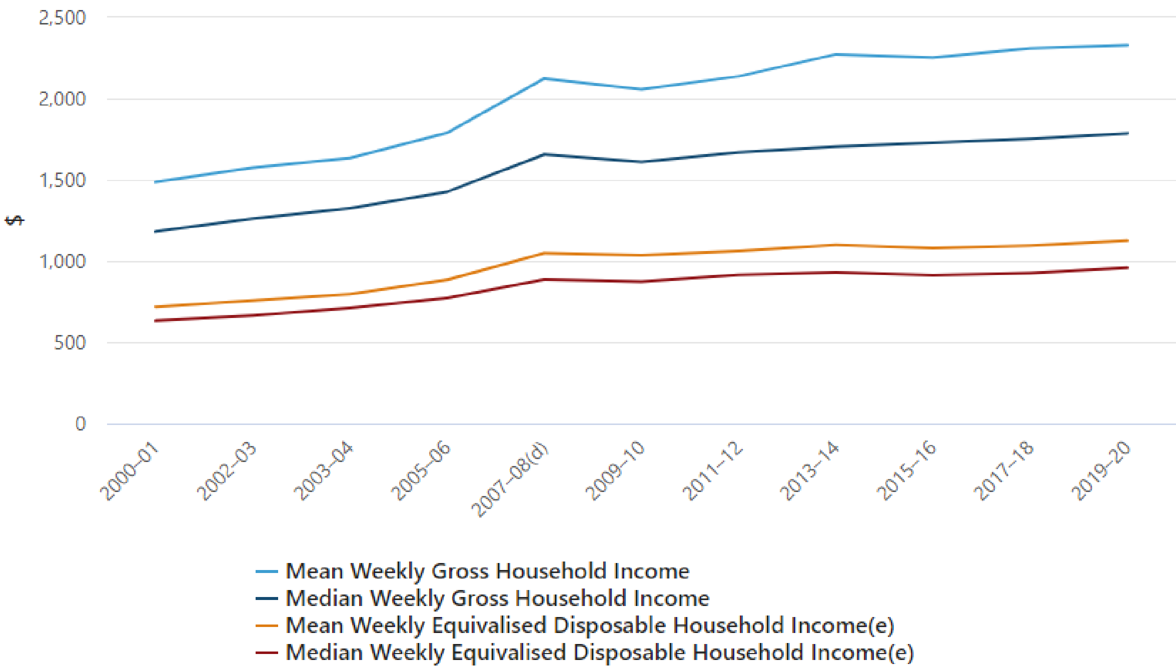


Figure 7: Household income and wealth, 2000-01 to 2019-20 (ABS, 2022)

Table 9: 2018-19 Proportion of Mean Disposable Income, by IRSD and Visitation Frequencies

	IRSD Decile Group					
Visit Frequency	**1-2**	**3-4**	**5-6**	**7-8**	**9-10**	**Average**
1-3 times per annum (Once in last year)	0.0069%	0.0055%	0.0063%	0.0038%	0.0040%	0.0053%
4-6 times per annum (Occasional visitor)	0.0176%	0.0087%	0.0069%	0.0101%	0.0065%	0.0100%
7-24 times per annum (At least monthly)	0.0523%	0.0478%	0.0257%	0.0227%	0.0319%	0.0361%
25-52 times per annum (At least weekly)	0.0784%	0.1168%	0.1643%	0.3087%	0.0473%	0.1431%
53+ times per annum (Daily visitor)	0.0000%	0.0897%	0.2808%	0.1203%	0.3326%	0.1647%

4.1.5 Assessing the motivation of ISRD groups to travel to a park

While the above WTP investigation does not indicate patterns regarding the 'price' values by different socioeconomic groups, the TCA investigation does reveal both the amount of money spent visiting parks *plus the distances travelled* by representatives from each ISRD group, with some clear patterns. Distance is important to explore, as it may yield some information about the accessibility of parks to each of the groups within the metropolitan region.

Figure 5 demonstrates that a majority of parks sites fall within the highest socioeconomic classification (IRSD 9-10 group). Only six sites are within 15km of an LGA which is classified as group 1-2, while a small number of sites are local to the mid-range ISRD decile LGAs. Given that the median distance travelled to a site across the 1.3 million visits (within 60km of the GPO) was 13km (Figure 6), it is prudent to explore this apparent discrepancy in availability of sites to lower socioeconomic groups to better understand if this distance travelled is equitable among groups (Figure 8).

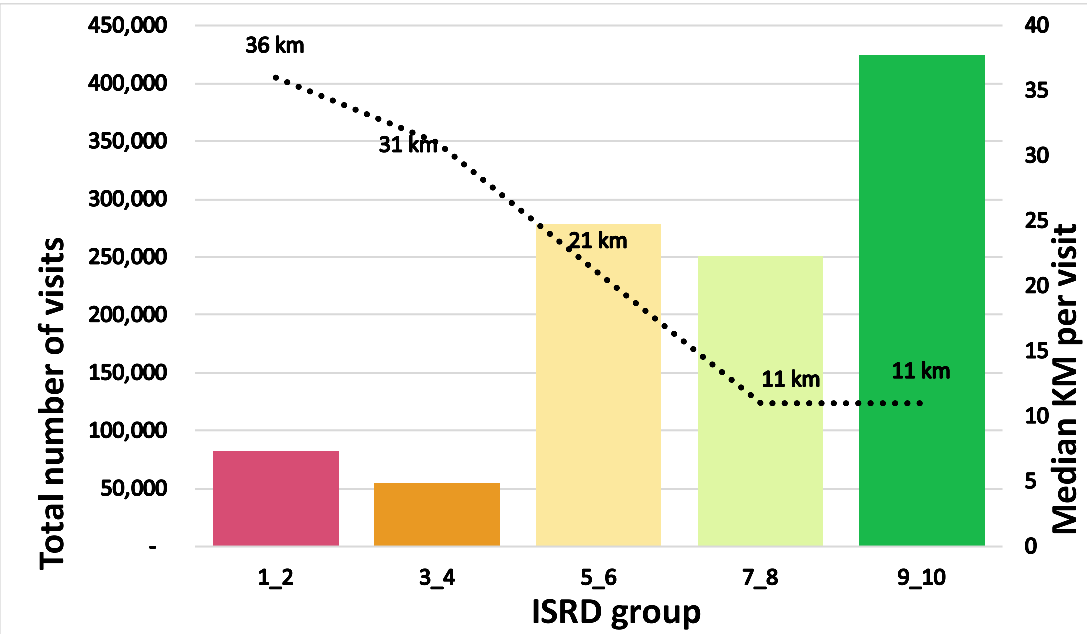


Figure 8: Total number of visits (coloured bars, left axis) and median distance travelled (dotted line, right axis) by each ISRD decile group

As anticipated, Figure 8 reflects the fact that residents of LGAs which fall within ISRD 1-2 (on average) must travel the farthest to visit a park (36km). IRSD groups 7-8 and 9-10 both have the same median distance to travel (11km), however IRSD group 9-10 demonstrates a higher TCA contribution – indicating residents from these LGAs embark on more visits. Figure 9 below demonstrates travel distances as bins (i.e. 1 – 15km; 16 – 30km; 31 – 50km; and >51km). The proportion of journeys taken within each bin by the different ISRD groups are demonstrated. Again, it is evident that the highest socioeconomic groups take the largest proportion of short trips, while group 1-2 represent a significant proportion of all journeys >50km.

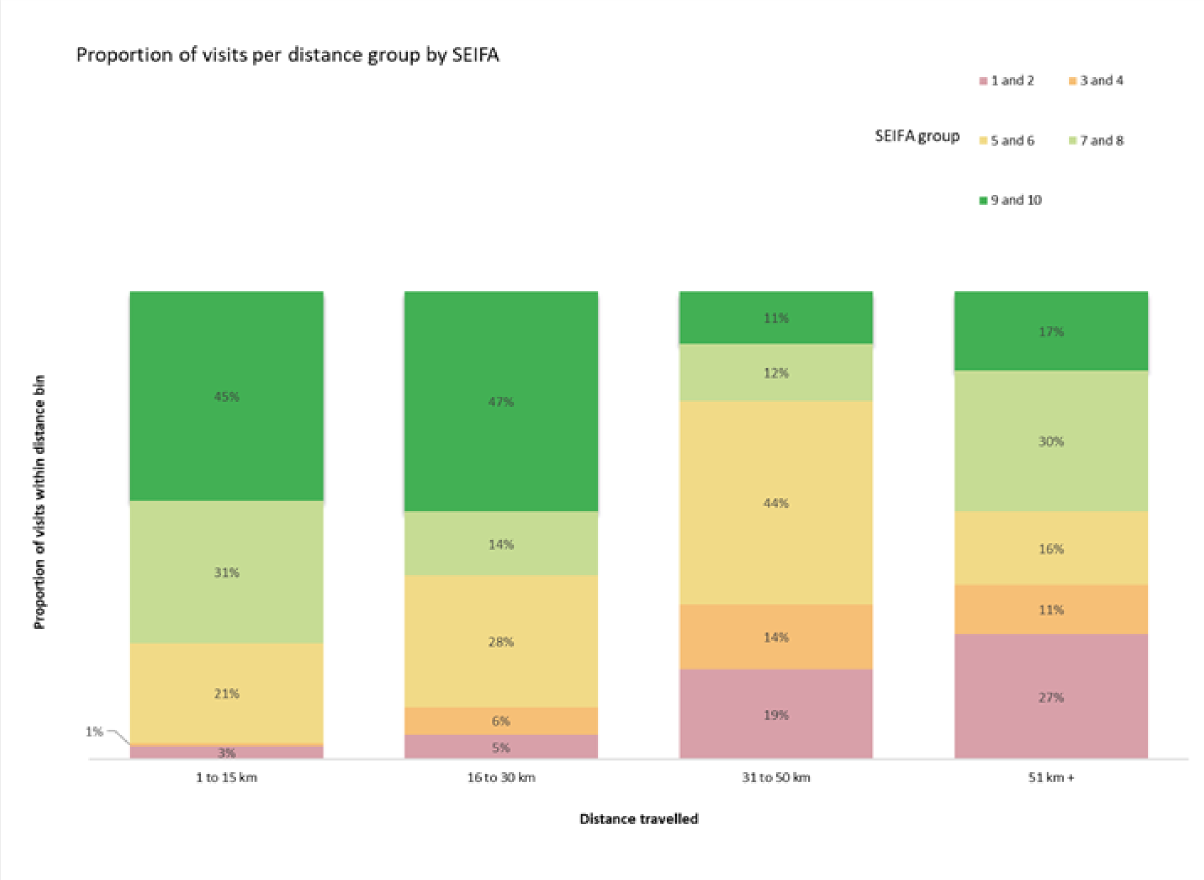


Figure 9: Binned distances of journeys undertaken to visit all sites by each ISRD group

These simple investigations infer that the effect of proximity (to a selected site), or put more broadly park accessibility may be a primary driver which motivates visitation across the socioeconomic groups. Although a general assumption that proximity drives a higher WTP for metropolitan parks is not supported by the WTP analyses for any single IRSD decile group, when investigating this distribution of visitation by different groups spatially a clearer understanding of different group's motivation to travel to visit a site relative to the availability of sites within their local area emerges. One such pattern that emerges is that visitors from higher socioeconomic groups need to travel shorter distances than lower socioeconomic groups to access parks. This may simply indicative the paucity of sites in close proximity to ISRD group 1-2 (Figure 8), or may alternatively be a function of facilities available at parks visited (e.g. a small recreation park *vs* a wildlife park) in combination with the relative distance required to get there.

To further investigate this relationship between park types Figure 10 below examines a number of selected sites in terms of distance travelled by individual ISRD groups and their proximity to those groups' LGAs:

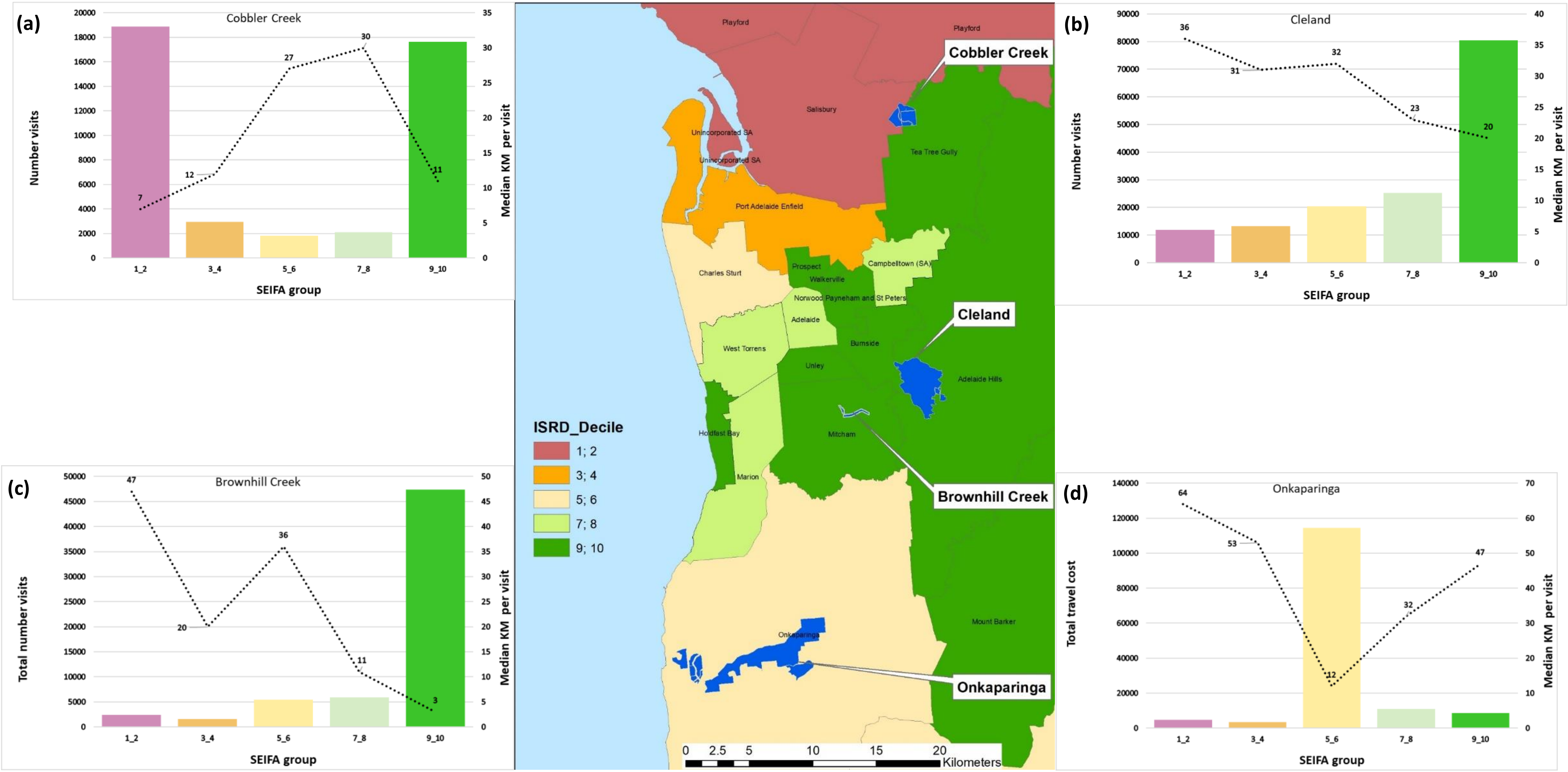


Figure 10: Examination of distances travelled, number of visits to four sites: Cobbler Creek (a); Cleland (b); Brownhill Creek (c); and Onkaparinga (d)

In all cases above, the prevailing driver of visitation frequency appears to be proximity to a site, with distances between 3–15km demonstrating high visitor frequency, regardless of ISRD. The only site examined above which borders directly onto an LGA representing ISRD group 1-2 is Cobbler Creek, which demonstrates a clear preponderance of visitors from that group. Interestingly, the LGA on the Eastern border of this site represents ISRD 9-10 which is the second highest visitation group to that site. This pattern is demonstrative of equity between ISRD groups regarding accessibility to this site. This relationship is also clear for the drawcard Cleland Park site, with an inverse relationship evident between visit frequency (by ISRD group). However, median distances are higher indicating that people are willing to travel further to experience the unique facilities present at the Wildlife Park.

As Onkaparinga is situated within a large LGA which is representative of ISRD group 5-6 there is a significant preference by that group to visit the park (see Figure 10(d)). However, this particular LGA (Onkaparinga Council) is diverse in terms of socioeconomic groups within its boundaries. This provides a good candidate for examining the relationship between proximity and the willingness to travel on a finer scale. Figure 11 below examines the Onkaparinga site with ISRD classifications at the postcode level (as opposed to the aggregated LGA).

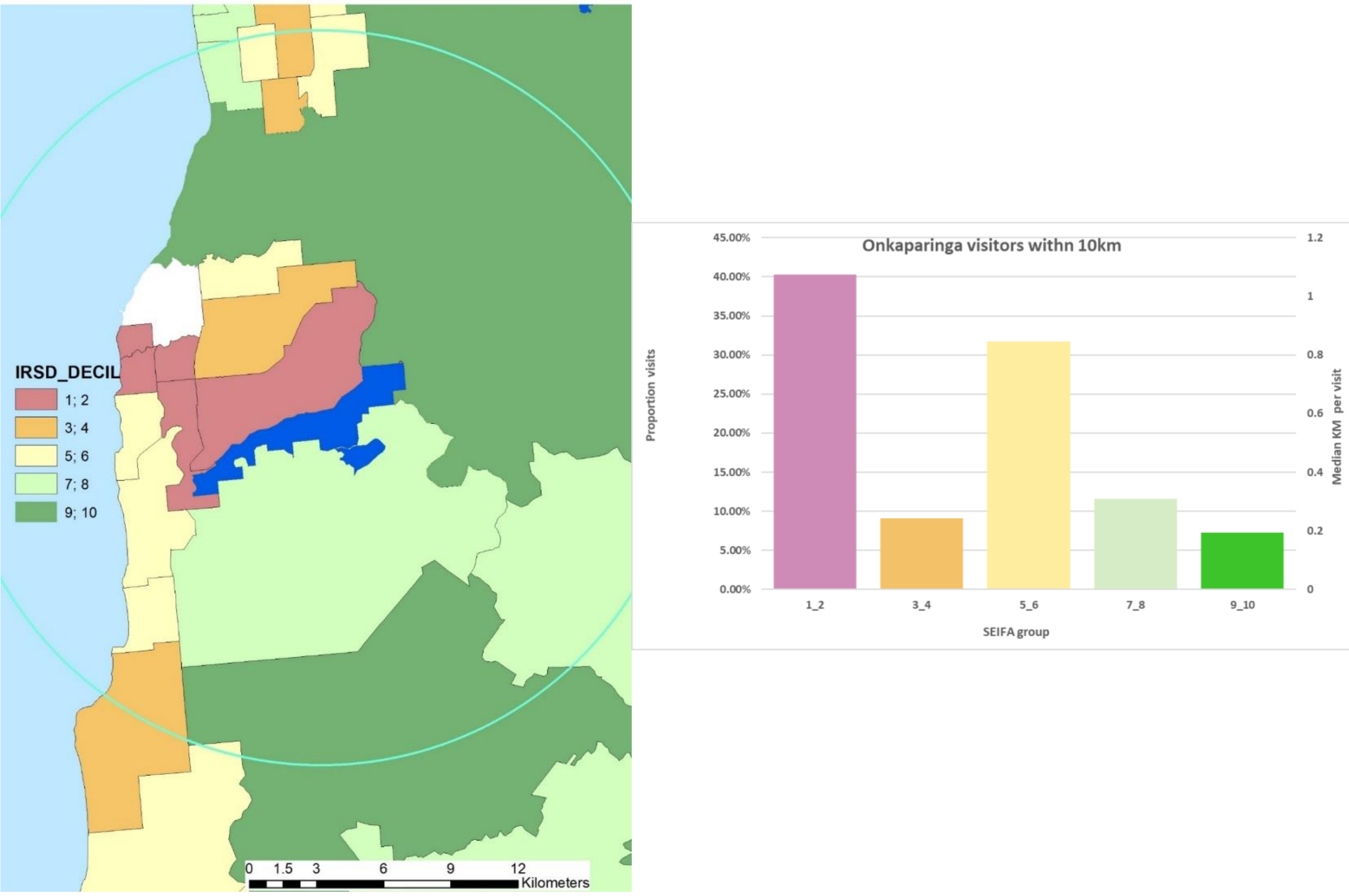


Figure 11: ISRD classification of postcodes within a 10 km radius (blue circle) of Onkaparinga site (royal blue), with proportions of visitors within that area from each ISRD group

Onkaparinga demonstrates a clear preference by ISRD group 1-2 to visit (40% of visits from all groups within 10 km) owing to the proximity of numerous postcodes representing that group. Interestingly, this site is less favoured by the highest ISRD groups (1.e., group 7–10), despite proximity to those postcodes.

These analyses demonstrate a number of patterns revealed in the relationship between ISRD groups, their proximity to a site, and the level of visitation made by each group:

- All socioeconomic groups are more likely to visit (in greater numbers) if a site is close to their location. This is true for both smaller local parks and larger drawcard sites.
- Lower relative socioeconomic groups appear to be more likely to visit if a site is close to their home location, but are also more likely to travel farther to visit owing to their distance from a majority of metropolitan sites. This is reflected in Figure 9 which demonstrates that, despite having (on average) the farthest distance to travel to visit a site, they have not generated the higher TCA figures.
- Group 9-10 have the widest selection of close sites to choose from, which is reflected in both the sheer number of visits undertaken, and the highest TCA figures generated.
- While lower socioeconomic groups are visiting, and are prepared to travel, a lack of parks within their location (e.g. within 10-15km) may limit the opportunity for these groups to engage with parks—and in turn, improve their health cost benefits as discussed below. The Onkaparinga ISRD by postcode example demonstrates that this group visit in large numbers when a site is closer.

Contrasts such as those provided by the above cases are important to better understand motivations for different socioeconomic groups in regarding visiting a park, in addition to economic consequences of this visitation. For example, when comparing Granite Island and Cleland Wildlife park (Appendices A and B) it is observed that Granite Island generated higher total travel cost values in 2018-19. This differential is predominately representative of its distance from the Adelaide GPO (>100km). In the case of Cleland, the largest proportion of visitors was from people who reside in LGAs representing ISRD 9-10 (which surround the site, as in Figure 10). Conversely, equal visitation across ISRD groups is evident for significant distant sites (e.g., Granite Island, around 100km), which may indicate a similar preference across ISRD groups to access such sites. In short, where parks are equally close to certain ISRD groups, or where they are equally distant (e.g. on the Fleurieu Peninsula), equity of use is demonstrated. This reveals a lack of any inherent preference for visiting parks by any one IRSD group. However, the opportunity to engage with parks is further reduced given a greater distance to travel.

4.2 Reduced healthcare costs (RHC)

As noted above, there are ten major long-term chronic disease categories in Australia that contribute a significant proportion of the annual total public health expenditure (AIHW, 2021). Table 10 provides the national health expenditure across these ten chronic diseases together with the South Australian portion of those costs (ABS, 2020). Total health expenditure for Australia was $41.2 billion in 2017-18 Census, of which South Australia represented $3.59 billion or approximately 8.7%. The most expensive community chronic diseases are back problems, cancer, diabetes, heart and vascular diseases, kidney disease, and mental health. As argued earlier, where metropolitan parks are preferred by individuals as a source of increased physical and mental health-related activities those sites may be beneficial for reducing some of these health costs (e.g. diabetes, heart disease and mental health issues—or around 67% of the most expensive chronic diseases). These health differentials across the chronic diseases health costs form the basis for our RHC model, where the differential in self-reported health scores between park and reserve visitors and non-visitors from the McGregor Tan survey data are used to calculate what impact—if any—park visitation has on reduced health expenditure.

Table 10: 2018-19 Chronic disease condition list of health expenditure (AIHW, 2021)

	Arthritis (c)	Asthma	Back Problems	Cancer	Respiratory Disease	Diabetes Melitus	Heart and Vascular Disease	Kidney Disease	Mental Health	Osteoporosis
National health costs	$880,744,530	$787,400,472	$2,124,399,770	$9,204,263,326	$858,615,344	$3,758,346,169	$9,253,309,732	$3,161,717,591	$9,574,971,168	$1,619,973,570
South Australia portion of total costs	$76,624,774	$68,503,841	$184,822,780	$800,770,909	$74,699,535	$326,976,117	$805,037,947	$275,069,430	$833,022,492	$140,937,701
IRSD Decile										
1-2	$17,302,437	$14,558,431	$37,728,959	$190,792,697	$20,319,758	$88,071,395	$179,710,280	$63,626,941	$179,525,828	$29,766,215
3-4	$17,720,839	$15,119,542	$40,320,632	$184,836,242	$17,660,751	$78,002,931	$199,500,012	$53,460,338	$179,886,184	$31,388,142
5-6	$14,707,494	$12,164,186	$37,920,762	$151,703,461	$13,158,991	$55,127,603	$136,367,979	$52,774,949	$165,763,668	$26,352,446
7-8	$14,821,604	$13,900,839	$36,957,071	$155,053,967	$11,773,834	$58,363,895	$153,231,061	$52,660,717	$170,362,495	$28,159,736
9-10	$12,072,401	$12,760,843	$31,895,356	$118,384,542	$11,786,201	$47,410,292	$136,228,615	$52,546,486	$137,484,318	$25,271,162
Total South Australian health costs – chronic diseases	$3,586,465,526									

As shown in Figure 12, where health scores for survey respondents who visit parks are taken away from those that do not, a pattern of differences emerges. That is, the health for those that visit parks is less likely to be *Poor* or *Fair*, about equally likely to be *Good*, but far more likely to be *Very Good* and *Excellent* by comparison. There are some distinct differences across the IRSD groups as we might expect, but this is helpful for our analysis of the reduced healthcare costs as discussed below.

Figure 12: Proportion of those that visited metropolitan parks for a given health score *minus* those that did not

Finally, Table 12 presents the model estimates for reduced healthcare costs in 2018 associated with park and reserve visitation and separated by IRSD decile group. Those in the lower relative socioeconomic groups (i.e. IRSD decile 1-2 and 3-4) share a large proportion of the total health burden. These groups also experience the highest total health costs in 2018-19 at approximately $800 million in each case. However, they also self-reported the highest levels of health difference from that of non-park visitors; that is, between around 2 and 5%. This drives significant healthcare cost reductions of around $62 million—or approximately 44% of the estimated benefits from park and reserve activity. In total for the 2018-19 period, all IRSD decile groups generated $139.96 million worth of reduced healthcare costs, or around 4% of the total healthcare budget in 2018-19.

Table 12: Average disease burden by IRSD decile, total costs and percentage reduction, 2018-19

IRSD Decile	Average Disease Burden	Total Costs	% Reduction	Avoided Health Costs
1-2	23%	$821,402,939	2.41%	$19,825,789
3-4	22%	$817,895,614	5.13%	$41,976,653
5-6	19%	$666,041,539	2.60%	$17,301,903
7-8	19%	$695,285,218	5.68%	$39,458,641
9-10	17%	$585,840,215	3.65%	$21,395,903
			3.89%	
Total reduced healthcare costs, South Australia 2018-19				**$139,958,889**

The estimated benefits from reduced healthcare costs associated with park visitation and use therefore **has an *invisible* wellbeing effect**—or one that must be drawn out from analysis such as this. Further, while the reduced healthcare cost results for IRSD groups 1-2 and 3-4 amount to approximately 44% of the total 2018 health costs for South Australia they invest relatively higher costs to visit parks for recreation. These represent key messages from the study: that the main beneficiaries of health outcomes are those of lower relative socioeconomic status-who have the lowest opportunity to engage with parks (due to travel distances required), and therefore visit the least.

4.3 Total value of metropolitan parks, 2018-19

In total the combined willingness of metropolitan park visitors to incur travel and the health costs avoided by state authorities resulting from that activity, suggest an estimated value of $188 million in the 2018-19 period.

The report concludes with some of the key findings and lessons that have emerged.

5 Discussion

5.1 Key question results

At the start of this study we outlined a set of key questions. Returning to them now one at a time, let us add what has been revealed by our analysis:

1. Do different socioeconomic strata have separate willingness to pay in terms of both opportunity cost and travel cost values?

In essence, no for opportunity costs but yes for travel costs. While particular preferences and values for different metropolitan parks may change across IRSD groups for the period in question, the average individual **opportunity cost WTP appears to be quite homogenous**. That is, **there is no general socioeconomic group that can be thought of as holding higher opportunity cost values for metropolitan park visits than others**. The only exception in our data is those from the IRSD group 7-8 who visit metropolitan parks weekly or more. In that case, the values they held for metropolitan parks in 2018-19 was demonstrably higher than other users both within the same visitation frequency group, and across other frequency/IRSD groupings. More importantly the positive opportunity costs that people hold for recreation are not large in terms of impact on their disposable income. But, as we have seen differences do exist between the travel distances and costs invested by different groups to travel to and visit metropolitan park sites which can inflate the total WTP value. While smaller than the travel costs involved in regional park visits, these WTP are positive signalling people's preferences to visit and use them.

2. Does the frequency of park and reserve visitation change those values?

Again, generally no. There are two exceptions to this for 2018-19: those IRSD 7-8 group members in the weekly visitation frequency group as above, and the IRSD 5-6, 7-8, and 9-10 groups in the daily metropolitan park visitation frequency categories. These all held noticeably higher opportunity cost values for metropolitan parks than other members of the community. This is in part reflected by the increased times they engage with metropolitan parks, but the values are also inflated by the sample visit data captured in the McGregor Tan survey. This suggests that, **for those who choose to visit metropolitan parks more frequently the relative value they ascribe to that activity is more positive** than other groups.

3. Are there patterns of park use by different groups regardless of what site(s) they visit?

Broadly speaking, yes there are. There are distinct patterns in the median distances travelled overall to metropolitan parks (i.e. less than 60km, in line with STAC tourism versus recreational trip thresholds) **with corresponding patterns in the associated travel costs across park sites**, the distribution of park visitors across IRSD groups, and in the proximity drivers of park use—particularly proximity to smaller park sites. The findings clearly illustrate that **metropolitan parks in South Australia are easy to access, with low travel or opportunity costs, and that people are willing to spend to visit and recreate at these sites**. Further, the fact that much of the metropolitan park engagement requires travel times/distances of less than 30 minutes (13 km) improves metropolitan park access and increases the incentives to visit them. By comparison the Australian Bureau of Statistics study (2018) shows that across Australia's capital cities people working in Adelaide and Darwin had the shortest average commuting distance, with Adelaide commuters on average travelling 13.5 km to their place of work. This highlights a key lifestyle value that Adelaide Metro parks are as accessible to the community as people's place of work.

Parks are also a clear source of tourist attraction for interstate and international visitors. Despite their distance from the Adelaide CBD (e.g. Granite Island), metropolitan parks still attract significant visitor numbers and in turn high WTP values for park assets.

4. How does the general health of metropolitan park and reserve visitors differ from the state health census data?

On the basis of our analysis, in 2018-19 the broad positive self-reported health differential between South Australians that visited metropolitan parks and those that do not was **around 2-5%**. There are distinct patterns across the IRSD groups, where some gain more benefit than other in the 2018-19 period. However, it is clear that for all groups those that visit metropolitan parks reported better health than those who do not. Better future data may address some of the limitations experienced in this research.

5. What is the total health cost reduction value of metropolitan parks and reserves for the South Australian population?

This health difference between individuals who visit metropolital parks and those who do not may not seem very high on face value. But it is the scope of annual public health expenditure in South Australia, and the large number of park visits, that makes this difference meaningful in monetary terms. With a total public health budget of around $3.59 billion to address chronic diseases in 2017-18 **that 2-5% reduction equates to around $140 million or nearly 4% of the total 2018 public healthcare budget**. If metropolitan park use was increased, and better physical and mental health encouraged as a consequence, there is considerable scope to reduce those health costs further in the area of chronic diseases.

However, distance effects may not be clearly observable in the data, making conclusions challenging. The fact that there are no entry costs to metropolitan parks ('largely free to access and use') could mean that the cost is only transactional and the opportunity cost of time, requiring a more complete scope of values to the community for these parks to be investigated in future. This is because metropolitan parks are generally well spread out in the landscape—despite some being more popular than others, attracting higher visitor numbers and costs for some groups to attend. Yet the analysis shows many are happy to do just that: give up time and money they could devote to alternative activities, and expend a relatively small amount to engage with a metropolitan park site. For those individuals, the benefits, including health, they obtain from those choices clearly outweigh the costs involved.

That said, there appears to be a somewhat higher cost burden per individual and per lower relative IRSD group membership. Thus, any projects or programs the state government can undertake to increase the accessibility of metropolitan parks, possibly even creating additional parks in those areas with relatively lower socio-economic groupings, should accrue increased **positive benefits for the state** in terms of meeting people's preferences, raising the activity in metropolitan park landscapes, and further reducing total public healthcare costs for the population.

5.2 Broader insights from the study

Apart from the answers to our specific key questions some broader insights can be drawn from this work.

5.2.1 Growing our understanding of total national park benefits

First, an estimate for metropolitan parks in South Australia can now be added to the measurable benefits of regional national parks and reserves reported during the Stage 1 work. While that study focused on travel costs and regional economic multipliers, in both cases the objective is to use economic valuation techniques to arrive at estimates of people's preferences for these state assets—manifest in different ways. Here, the focus has been on travel costs, opportunity costs, and reduced healthcare cost estimates.

By adding these benefit estimates to the original study findings, a total economic value (TEV) for South Australian metropolitan, regional national park and reserve assets can be recorded for administrative and planning purposes. However, these estimates do not represent the full scope of values of these parks to community. Those (possibly even larger) values associated with existence (i.e. the simple fact that these areas exist), bequest (i.e. ensuring parks survive for future generations) and natural capital benefits (i.e. the worth of these areas as a source of biodiversity and ecological function) of these areas in South Australia remain unmeasured. At present, estimated **South Australian park benefits for tourism and recreation direct revenue, indirect travel costs plus reduced healthcare costs to be worth around $562 million in 2018-19**; a significant amount for the state. It is likely that the natural capital values of these assets is far higher, as expected, making the argument for their protection, proper management and future existence compelling.

5.2.2 Adelaide as a National Park City

Adelaide has recently obtained the important title of *National Park City*, facilitating greater connections between people and nature. This study sheds light on the part metropolitan parks play in those connections, and the high preferences people have for them across all socioeconomic groups. Beyond the benefits of the *National Park City* status, Adelaide's metropolitan parks can also contribute much to promoting the attainment of three major international *Sustainable Development Goals*: namely *SDG 3 – Good Health and Wellbeing*, *SDG 10 – Reduced Inequalities* and *SDG 11 – Sustainable Cities and Communities*. Positive progress on all three of these SDGs is possible through Adelaide's metropolitan parks, as highlighted by this study.

5.2.3 The egalitarian nature of metropolitan national parks

Even at the highest individual annual average opportunity cost WTP level for this study (i.e. $315.00 p.a. for those in IRSD decile 9-10 for those in the daily park visitation category), the relative opportunity cost to engage in metropolitan park visits expenditure is far lower than what people may invest into traditional mental health and/or physical exercise goods (e.g. annual gym membership rates, purchasing personal exercise equipment, or psychological consultations). As such, metropolitan parks offer highly egalitarian sources of physical and mental health goods/services that contrast positively to substitutes in our economy. Parks are therefore an affordable good, decreasing the often higher-cost characteristics of private physical and mental health services, and creating spaces for all to use and enjoy together.

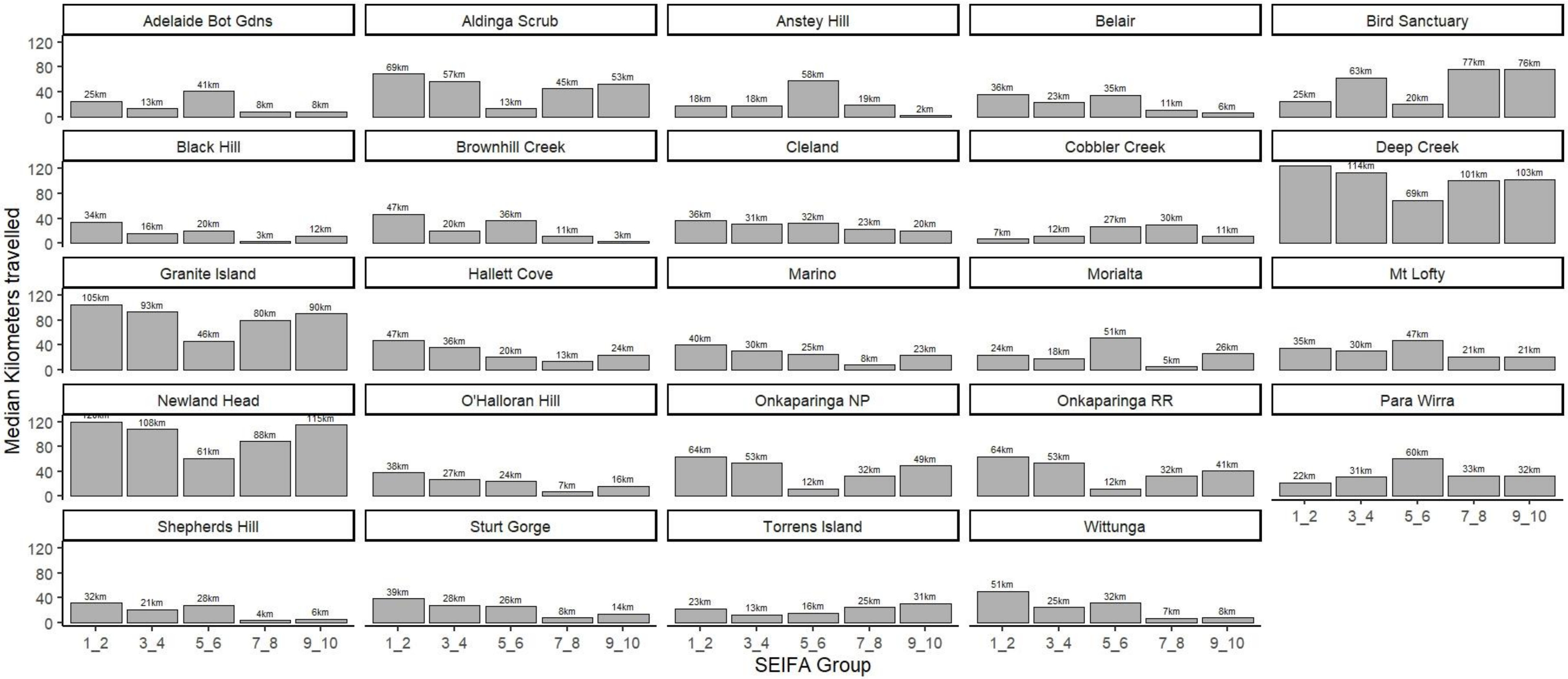
The fact that many of these spaces are also increasingly the main way in which many of us interact with natural settings—and experience the outdoors—as urban migration grows over time also highlights the importance placed on preserving them for current and future generations. Properly developed (e.g. with biodiversity and species habitat objectives incorporated into metropolitan park design and composition), managed and maintained these metropolitan parks have significant potential to grow natural outcomes for all of us.

5.2.4 The equalising nature of metropolitan national parks

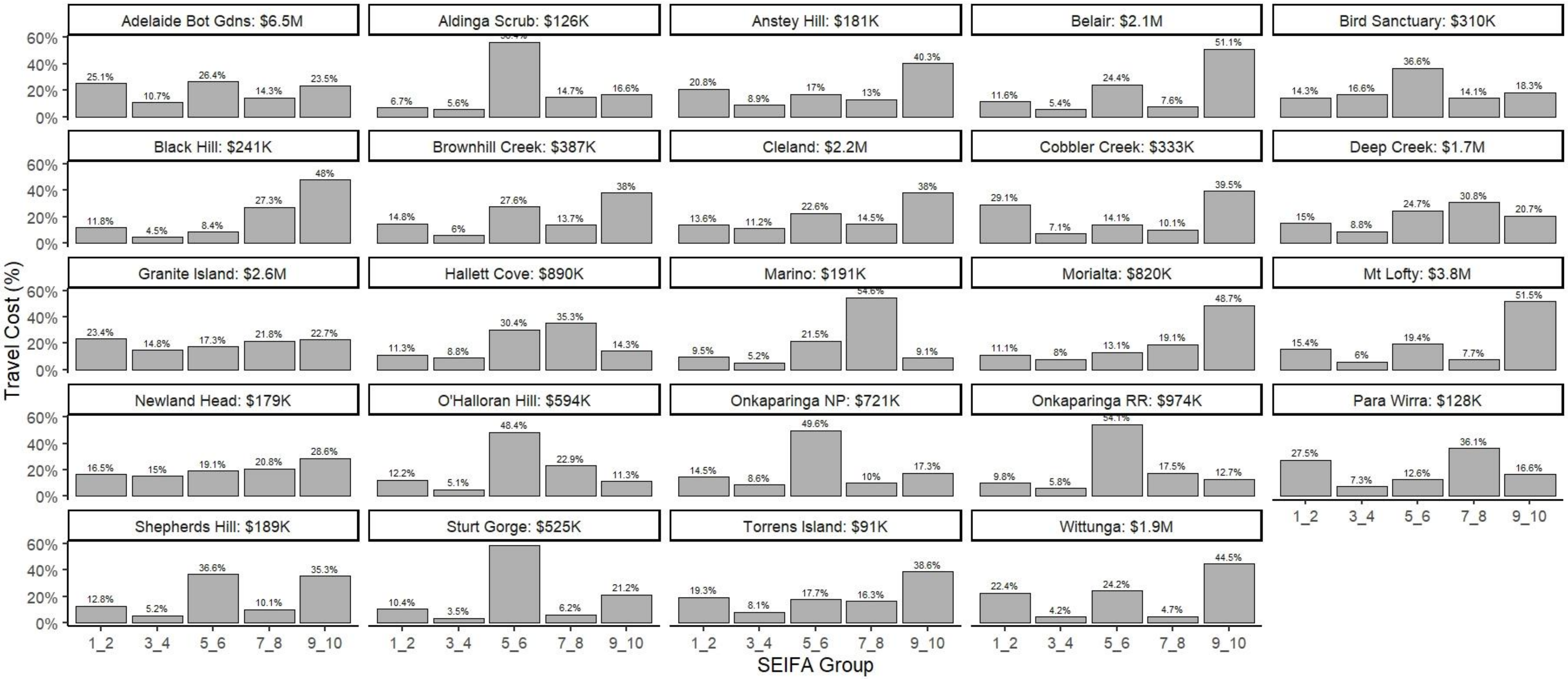
Finally, metropolitan parks also increase health equality, as shown by the RHC analysis. As seen, the lower relative IRSD decile groups appear to share a higher burden of chronic diseases and their costs. These groups will also have a higher probability of needing to rely on the public health system by contrast to other IRSD decile groups. And yet when the relatively lower IRSD groups use metropolitan parks they may improve their health; again at a higher relative rate to other IRSD groups as might be expected and in line with other jurisdictions (e.g., Queensland).

As such, metropolitan parks provide a clear equality benefit across IRSD groups to reduce the relative differences between them—as a truly public good with communal benefits. If the total health cost burden on society is further reduced , welfare can be increased elsewhere (e.g. education and transport) with flow-on benefits across all community socioeconomic groups. As flagged above, this is possibly the first such example of equality impacts from green spaces such as parks, which is an important finding.

Appendix A: Median kilometers travelled by IRSD Decile – by metropolitan park



Appendix B: Relative travel cost percentage by IRSD Decile – by metropolitan park



Appendix C: Botanic Gardens

Of the three gardens studied the Adelaide Botanical Gardens yielded by far the highest travel cost WTP value($17.44 million).), Mt. Lofty Botanical Gardens ($5.92 million), and Wittunga ($2.89 million).

Botanic Gardens Site:	SA Travel Costs	SA Opport. Cost	Interstate visitors	International visitors	Total WTP
Adelaide Botanical Gardens	$6,516,404	$678,852	$8,066,932	$1,929,590	$17,444,259
Mt Lofty Botanical Gardens	$3,816,238	$255,964	$1,528,819	$240,838	$5,920,720
Wittunga Botanical Gardens	$1,922,436	$208,457	$658,208	$40,751	$2,888,179
Grand Total	**$12,255,078**	**$1,143,273**	**$10,253,959**	**$2,211,179**	**$26,253,158**

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