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The climate change adaptation potential of the historic Burgers Park in Tshwane and its effect on the use of the space

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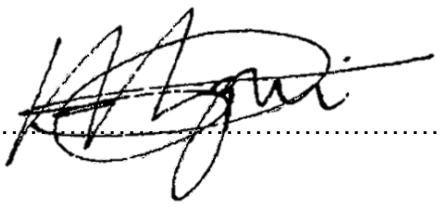
DECLARATION OF ORIGINALITY

I declare that the mini-dissertation, “The climate change adaptation potential of a historical urban green park (Tshwane’s Burgers Park) and its effect on the use of the space”, which has been submitted in fulfilment of part of the requirements for the module of DIT 801, at the University of Pretoria, is my own work and has not previously been submitted by me for any degree at the University of Pretoria or any other tertiary institution.

I declare that I obtained the applicable research ethics approval in order to conduct the research that has been described in this dissertation.

I declare that I have observed the ethical standards required in terms of the University of Pretoria’s ethical code for researchers and have followed the policy guidelines for responsible research.

Signature: ……  ……

Date: 29th September 2023 ……

Abstract

Urban parks are found in cities, and cities happen to be significant climate change contributors, accounting for 70% of emissions of greenhouse gases, this puts urban parks in a susceptible position of bearing the burden of climate change effects, which is already evident to a large extent. The report presents a qualitative case study that assesses two present-day urban challenges, climate change and public spaces. This study considers the connection between the use and climate change adaptation potential of urban public spaces by analysing a historical urban public space, Burgers Park, located in central Tshwane, South Africa. The study adopts a mixed method case study research method based on the pragmatism paradigm.

The study findings reveal that Burgers Park has been able to adapt to a pattern of rather steady change, attesting to its existence for over 150 years. However, when facing climate change effects such as increased temperatures, to that, add site-specific disturbances such as the Urban Heat Island Effect, littering, and social, economic, and management changes, this park may have an increased climate change vulnerability. However, the climate adaptation potential exists. People continue to use the Park despite evidence of degradation. The study contributes to the risk mapping and climate change adaptation discourse of public spaces, accenting the significance of climate change adaptation in the socio-ecological and socio-spatial spheres of public spaces.

Keywords

Climate change adaptation potential, historical public spaces, climate change risk, urban public park use, socio-ecology, socio-economy, socio-spatial value, ecosystem services, site-specific

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1. Introduction

1.1 Background to the study

This study's goal is to ascertain how the climate adaptation potential (present and future) of Burgers Park in Tshwane affects its use. Therefore, 'potential' is described as a deliberate or accidental role that an entity may undertake to reduce or enhance our vulnerability to climate change hazards. To undertake the study, an investigation into the two focus areas, namely public spaces in urban areas and climate change has been undertaken and outlined below.

Universally, 39% of the global energy-related carbon dioxide emissions originate from cities (UN-Habitat, 2020). It is projected that 68% of residents, globally, will be staying in cities by the time of 2050 (DESA, 2018). These unprecedented rapid changes have significant effects on the urbanisation occurring on global (Grimm et al. 2008) regional and local scales, including the environment (Li et al. 2021) and people. South Africa is one of the fastest urbanising countries globally and is expected to triple in population growth (DESA, 2018).

Concomitant to urbanisation is the construction of large office buildings, roadways, apartment blocks, and other structures often takes priority over urban green public parks, as a result, these parks are increasingly under threat (Lindley et al., 2018; Paudyal et al., 2019). Intrinsic site-specific anthropogenic disturbances also pose a threat to these spaces, and the ecological functionality of urban green parks may reach an unstable state, especially considering climate change (Coelho et al. 2020). Therefore, there is an urgent need to study the climate adaptation potential within urban spaces as a vital component towards understanding how that can impact the use of these spaces.

Urban public spaces are considered a central place where people partake in formal or informal interactions, meeting both familiar and unexpected faces to participate in a variety of activities, such as leisure, politics, sport, or commerce (Carr et al. 1992, Aelbrecht & Stevens, 2019). The deep-rooted goal for public spaces is about the sense of community, refuge, and mediating social ills (Toolis, 2017)). Recent studies on urban public spaces also reveal that open parks offer relaxation and recreational opportunities while contributing to the green infrastructure of cities (Terkenli et al., 2017)

Urban green spaces play vital roles in lowering the impacts of climate change (Coder, 1996). Furthermore, urban green parks contribute significant urban ecosystem services such as regulating, provisioning, and supporting cultural services and habitats (Bolund, 1999). These play a role in the filtering of air (regulating carbon dioxide emissions), regulating the micro-climate, the drainage of rainwater, and provisioning of a recreational and cultural space readily available to the urban dweller (Gretchen, 1997). However, they are situated in urban areas,

which contribute significantly to climate change and account for 70% of the released greenhouse gases (UN-Habitat, 2020). As a result, they are additionally likely to suffer the worst outcomes of climate change, which are largely already visible.

Even though urban public spaces offer positive aspects, they are among those at greatest risk from the effects of climate change. The environmental and infrastructural degradation (Choudhary et al. 2015) that we are witnessing and contributing to today is largely due to our devaluing of natural ecosystems within public spaces. However, they entail characteristics with the potential for adaptation measures. Designing and managing public spaces can naturally result in climate change adaptation protocols (Coelho et al. 2020). As a result, these spaces can explicitly contribute to urban life and design practices as we know them.

The two types of responses to climate change are "mitigation" (activities that lower atmospheric concentrations of greenhouse gases) and "adaptation" (altering either human or natural structures to the changing climate) (Gross et al., 2017). Through adapting urban public spaces, climate risks can be resolved and vulnerable lives and exposed assets protected (Gross et al., 2017).

In conclusion, urban public spaces will be subject to climate change. We may use public spaces as instruments for both reducing our collective contributions to climate change and dealing with its impending repercussions by studying them in terms of place and people. It is therefore crucial to study how they function within their context and the potential they have for adaptation to the changes in climate presently and in the future.

1.2 Study Rationale

To further analyse the climate change adaptation potential in an urban public space there needs to be an understanding of how it functions within its context both as a physical infrastructure and a socio-ecological system (Seto & Shepherd, 2009) as this will assist in unpacking the vital links between human actions and environmental quality. Therefore, it is crucial to determine the site-specific elements when evaluating the ecological and biodiversity value of green urban spaces. Observed disturbances that impact the park’s climate change adaptation potential include but are not limited to anthropogenic factors (such as safety concerns, poor public space management, traffic conditions, and neglect of green and built infrastructure).

1.3 Research Question

How does the climate change adaptation potential of Burgers Park in Tshwane affect its use?

1.4 Research Sub-questions

The following are the pertinent research sub-questions:

- What is the future and current adaptation potential to climate change of Burgers Park and how does it affect the climate change risk of Burgers Park itself and its immediate context?
- How does the establishment and development of Burgers Park affect its current climate change adaptation potential in its immediate neighbourhood?
- How do the spatial and material characteristics and adaptation potential to climate change affect the use of Burgers Park?

1.5 Research Objectives

Understanding Burgers Park's potential for adapting to climate change is the goal of this study, both as future and current, and whether there is any correlation with the use of the space. Potential is therefore defined as a purposeful or coincidental function that the entity can play to lower or increase our exposure to climate change hazards. As an outcome, the study targets to answer the proposed research sub-questions to ultimately answer the main research question.

1.6 Assumptions, delimitations, and limitations of the study

1.6.1 Assumptions

Assumptions that enabled the undertaking of the study are the place having a public and climate change role. Another assumption is that the findings will be based on inductive reasoning where the data will reveal information instead of approaching the study to look for specific findings. Findings from the interviews conducted were assumed to be factual experiences and views of the users and associated parties involved in the park. In undertaking the climate risk assessment, there had to be the assumption that the predicted climate hazards associated with Tshwane are factual and can be used as a baseline to map risks and vulnerabilities associated with the study area.

1.6.2 Delimitations

The study poses delimitations concerning being very specific to the subject of use and climate change adaptation potential while there are a multitude of contributing factors when dealing with public spaces. This enabled the undertaking of the study. The challenge is to make sure that one does not find themselves discussing or studying themes that in the end do not answer to the correlation of the two subjects.

1.6.3 Limitations

The limitations that were in place were the time given to collect data, if observations were conducted over a longer period or even all days of the week instead of specific days, they could have potentially revealed a variety of findings to better understand how the space operates. However, this limitation also made it feasible to undertake observational analysis as an individual researcher. The other limitation is that the study is limited to public spaces in Tshwane which required a context-specific analysis.

1.7 Ethics

The research project received ethical approval (EBIT/267/2022). The spatial study solely took into account the physical attributes of Burgers Park's immediate surroundings. The investigation avoided documenting any spatial variables that compromised the surrounding building owners' privacy in favour of concentrating on areas in the public domain. All participants in the semi-structured interviews signed a consent form detailing the study's goals and how the data would be used, and their anonymity was protected. Observational analysis required documenting activities in the park to study the use of the space, and to respect the privacy of individuals, their faces were blurred out and images were not taken in close proximity.

1.8 The structure of the document

The research report comprises an introduction section that not only highlights the study themes but also the study rationale, research problem, research objectives, and questions. The first part also consists of the study delimitations, limitations, and assumptions that enabled the undertaking of the study. Consecutively, the report entails a literature review that takes into consideration the topic of climate change on a worldwide view, a national scale, and the context of Tshwane. This section then further delves into the role of public spaces from a general point of view to a more site-specific type of public space (urban green parks) and its climate change adaptation role within the context of South Africa. Following this segment is an introduction to the study setting to understand its history and development. The document further highlights the method undertaken to conduct the study, this part includes both the data collection procedure and analysis. The report continues by unpacking the study findings based on collected data from conducting interviews, site mapping, and observations as well as desktop studies. Finally, a discussion and conclusion follow by tying up all the correlations identified in the collected data to ultimately answer the research questions.

2. Literature review

The following sections make up the chapter's structure. It starts by taking into account how serious an issue climate change is and what the present response strategies are. How climate change is affecting Southern Africa, and particularly its towns, is then discussed. It goes on to discuss the importance of public spaces and their contribution to the climate change agenda. Next, urban parks are discussed along with how they might help combat climate change and the vulnerabilities that come with it. The literature study continues by exploring the adaptation potential to climate change and how that can affect how urban parks are used in current cities. The literature review comes to a close by taking into account the use of public spaces and the South African climate change adaptation discourse, which reveals knowledge gaps that need to be filled by further studies.

2.1. Climate change: Globally

One of the world's megatrends is acknowledged to be climate change (EEA, 2015). As a result, we are seeing the effects of global warming in the form of occurrences of extreme weather like prolonged rainy periods, and extended droughts (EEA, 2015). Urbanisation and climate change effects are dangerously interacting. According to current national government projections, between 2030 and 2052, 1.5 degrees Celsius will be reached by global warming. (EEA, 2015), and by 2100, it will have increased to about 3 degrees Celsius, ultimately posing catastrophic effects on cities and their users. Urban areas are becoming warmer due to climate change, which also increases flooding and waterlogging while prolonging dry seasons (CROW, 2015).

Less than 2% of the newly built surface land is in cities, however, cities consume around 78% of the planet’s energy and are accountable for over 60% of all greenhouse gas releases associated with human activity (IPCC, 2018). Currently, over 50% of the global residents live in cities (Revi et al., 2014) and roughly a seventh of this population continues to live in unfavourable conditions with overcrowding and inadequate basic infrastructures (IPCC, 2014). Due to the rapid urbanisation in African cities, Africa is extremely vulnerable to changes in climate because the majority of the continent has seen considerable temperature increases (IPCC, 2022). In some regions, temperature rise is even happening twice as quickly as the world average (Seneviratne, 2012).

Africa has a very diversified and volatile climate (Conway, 2011). Temperature and precipitation patterns are shifting due to climate change (Henderson, 2014). Africa urgently needs methods of adaptation to climate change due to the potential that it would experience

the adverse effects of climate change earlier than other regions (Besada and Sewankambo 2009; Giordano and Bassini 2019). If global warming exceeds 4 degrees Celsius by 2100, the expense of adaptation in Africa could rise to USD 100 billion per year by 2050 (UNEP, 2015). African countries could benefit from increased financing from wealthier nations to help offset some of these expenditures. However, governments also require money for adaptation, both nationally and continentally (UNEP, 2015).

2.2. Climate change in South Africa and Tshwane

In South Africa, where temperatures are rising and the impacts of climate change are apparent. There are signs that South Africa is seeing an increase in the occurrence of extreme weather seasons, and additionally an extension in the length of dry spells, and an increase in rainfall intensity. (DEA 2017). South Africa's climate zones are now changing, ecosystems and landscapes are deteriorating, fires are happening more frequently, and natural systems in the land and sea are under stress and exploitation (DEA 2017). The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) positions that climate change will almost surely increase both the severity and frequency of many catastrophic events as well as the danger of slow-onset disasters like drought and rise of sea levels (IPCC, 2013). The potential of local societies to adapt to these repercussions depends on how these changes impact each country.

In the current climate, the city of Tshwane, which lies in South Africa's summer rainfall zone, is susceptible to the effects of strong thunderstorms and isolated flash floods. Towards the turn of the century, the climate will be 4 – 7 degrees Celsius warmer (Tshwane Vulnerability Report, 2020), these are the impacts that the study will focus on. Because it impacts both natural and human systems, change in climate makes it difficult to achieve the progress objectives of both the nation and the city. As a result, it is important to address this threat and lessen detrimental climate change effects. The repercussions of climate change are anticipated to have a considerable effect on metropolitan regions, with the urban poor likely to be the most susceptible group (Tshwane Vulnerability Report, 2020). Like many cities, the City of Tshwane struggles to meet the requirements of an expanding economy and people while seeking to combat discrimination and poverty in the setting of accelerating climate change (Tshwane Vulnerability Report, 2020).

In closing, while South African cities are and will bear the brunt of climate change effects and priority areas such as water resources, agriculture, and health, for achieving national climate change adaptation have been outlined (Department of Environmental Affairs, 2019). Context-

specific measures also need to be put in place and therefore this study is relevant in highlighting an approach to a micro study of alternative strategies for adapting to climate change.

2.3. The role and use of public spaces

Any location that is managed by or utilised by the government, free to enter, and enjoyed without consideration for financial gain is considered a public space. The physical, historical, social, environmental, and economic characteristics of each public space are unique (UN-Habitat, 2018). They are a crucial component of both social and individual well-being, the focal points of collective life in a community, diverse expressions of their shared natural and cultural wealth, and the bedrock of their sense of self. The neighbourhood takes pride in its public spaces and works to enhance its quality of space. They are made up of open places like sidewalks, squares, gardens, and parks as well as covered areas like public libraries and museums (UN-Habitat, 2018) that were built with the goal of enjoyment by all.

Public spaces that currently exist in cities are vulnerable to change while also playing an ever-more important role in the evolution of cities (Landman, 2019). While we learn more about the severity of climate change threats, it is significant to reflect on how public places might foster community cohesiveness and decrease climate change vulnerability. Public spaces present a special potential since they not only play a physical infrastructure provision role but also aid in defining the social, political, cultural, and economic utilities of cities. (UN-Habitat, 2018). They remain the first part that distinguishes a location from an informal disorderly settlement to a developed town or metropolis, yet policymakers, leaders, and developers frequently disregard or undervalue the importance of public spaces (UN-Habitat, 2018). There are several causes for this, including a lack of knowledge, resources, or ability to utilise the potential of public space as a whole, multifaceted urban system. The problem is frequently made worse by a lack of effective enabling frameworks, a deficiency of political will, and an absence of public engagement tools.

The UN-Habitat promotes five principles which include, i) suitable street space, ii) increased density (at least 15,000 people per km2), iii) diverse land use, iv) social diversity, and v) restricted land-use specialisation (UN-Habitat, 2018). These principles are supported by three essential characteristics: an active street life, walkability, and affordability (UN-Habitat, 2018). The creation of successful urban public spaces requires the promotion of socially integrated, inclusive, connected, environmentally sustainable, safe, and accessible public places (UN-Habitat, 2018). Public spaces are effective when they are well connected to other significant

locations nearby, comfortable, project a positive image, draw people there to engage in activities, provide possibility, motivation, and opportunity, as well as both mental and physical comfort (Whyte, 1980). To achieve the above attributes elements such as permeability, legibility, variety, robustness, and personalisation can be implemented (Bently et al, 1985). Understanding the study area's attributes as a successful public space will help us understand the potential for climate change adaptation within the region and the site-specific needs of the space.

Finally, the relationship between people and their surroundings can be observed in public spaces. By witnessing public activity, one can have a better understanding of the socioeconomic context in which the public space is located as well as how people interact with it and, consequently, their interest in the space's wellbeing.

2.4. The significance of urban green parks in relation to climate change

Urban areas frequently grow concurrently with losses in vegetation abundance (Arsiso et al. 2018). The demand for ecosystem services, particularly for food, fresh water, and urban green areas, would significantly increase as an outcome of climate change (IPBES, 2018). Numerous studies have discussed the crucial functions of blue and green areas in controlling the urban climate (Gunawardena, 2017). According to research conducted in Nigeria, Kano, urban blue and green space is in danger as a result of fast urbanisation and inadequate planning (Mohammed, 2019). This highlights the significance of studying these spaces in light of climate change.

The surface energy balance, atmospheric condition, and thermal characteristics of the surface are used to determine the land surface temperature (LST) (Zhang et al. 2009). The transformation of the land surface into predominantly hardscapes (i.e. brick and concrete) is what affects changes in the thermal characteristics of the urban environment, making it warmer than the nearby rural areas and resulting in urban heat islands. This is relevant to the study area because of the lack of natural land, such as forests or plantations, agricultural lands, and grasslands, and the predominance of impervious surfaces, such as roads, sidewalks, parking lots, and rooftops (Arnfield, 2003). This is a result of the area's ongoing urbanization.

Urban green parks are typically the only sufficient green places in light of rapid urbanisation. As a result, their principal function in climate adaptation is to combat the urban heat island

effect, the main driver of local climate change in that context, and its mostly adverse effects on temperature, wind, precipitation, and air quality patterns (City Parks Forum, 2007). The global population's growing urbanization will only expedite the pace of climate change. If the urban heat island effect continues to harm local climates, it could eventually cause more significant, possibly worldwide, climate change (Mohammed, 2019). This applies to Urban green parks as they absorb rainfall and in extreme cases, control soil erosion, improve local wind patterns, manage the urban heat island effect, and reduce some of the main public health challenges that are intensified by climate change, such as heat stress (City Parks Forum, 2007).

Green public spaces play multiple important roles in the urban environment. When individuals are given access to local parks, their symptoms of psychological illness—such as depression and anxiety—improve, their self-reported stress levels drop, and their social cohesiveness increases (James et al., 2015). It has been reported that vulnerable groups, such as low-income individuals, senior citizens, and kids, benefit most from green space (Mitchell and Popham, 2008).

Particularly, it has been established that incorporating well-maintained parks and playgrounds nearby has a favourable impact on the health of children (Potwarka, 2008). It has been proven that even with a relatively modest rise in the density of green local space, vulnerable communities can gain health benefits from green places (Mitchell et al., 2015). However, several factors affect the advantages that urban green spaces have on local communities. These include accessibility and availability, measured by location and distance from a residence; aesthetics, such as landscaping and quality perception; amenities/equipment; infrastructure and services with the regularity of maintenance; and garbage removal (de Vries et al. 2013; Maas et al. 2009). The greatest health benefits are found in green spaces that are close to homes, accessible to a variety of groups, and seen as being well-maintained (Toronto Public Health, 2015).

To conclude, urban green spaces have long been used as a location for residents to unwind and experience a little bit of nature amidst a vast hardscape environment. Any green park in the globe will have people reading, joking with companions, or simply feeding pigeons if you take a quick stroll around it. However, they have gained a new function in the 21st century, to diminish the effects of climate change as they are naturally adapted to absorb carbon dioxide emissions through their abundance of trees and grass (Mitchell et al., 2015). Although it may seem that parks are too little of a project to have much of an influence, that isn't always the

case. While adding parks won't necessarily stop climate change, they can certainly lessen its effects, especially for urban residents.

2.5. Urban parks in South Africa and climate change adaptation

As noted previously in the literature review, urban parks have a major climate change adaptation role in light of being located within city centres, central Tshwane, in this case, is part of those rapidly urbanising regions and as such, the urban park is partly responsible for managing the local climate that is witnessing the urban heat island effect through its abundance of green elements. However, due to historical legacy difficulties as well as municipal resource and budget restrictions, urban parks in South Africa are prone to deteriorate and lack sufficient provisioning (McConnachie & Shackleton, 2010). When there are insufficient park gates (minimising access), secluded sections, and amenities in disrepair, this might raise crime levels, especially when located in a poor neighbourhood (Blobaum & Hunecke, 2005; Baran et al., 2014). This is one of the challenges with park administration and design. In particular, urban open space challenges such as societal and environmental sustainability have given urban park management a significant role (CAY, 2016). Safety in South African parks is an important issue because of the possibility that people would link them with feelings of fear, anxiety, and vulnerability (Chiesura, 2004).

An investigation into the environment and public space usage of various areas of South Africa's capital city, Tshwane, was conducted as part of ongoing efforts to alter public space in the country. Users' perspectives and experiences in these locations were also studied. Although many reasons were cited as to what made using different public areas undesirable, there was a recurrent pattern in which crime and the fear of crime were indicated as a top concern by city participants in public spaces (Landman, 2017). These characteristics may pose a risk to climate adaptation strategies within public spaces that are already undergoing deterioration.

The importance of urban parks is clear yet they are among the most susceptible to climatic hazards. However, they also possess potential qualities that are important for efforts to adapt to climate change (Silva & Costa, 2018). By taking into account public space as a shared space system that creates spatial amenities as an integrated system of shared concerns,

public space may also function as a social space for change where people and communities are involved agents in the management of the vulnerability of public spaces (Pelling, 1997).

The security of assets, and conservation of ecosystem products, functions, and services for the present and the future can all be benefited by adaptation. No single strategy for lowering hazards is suitable across all settings, as adaptation is context-specific (Santos Nouri & Costa 2017). According to Santos Nouri and Costa (2017), successful risk reduction and adaptation methods take into account vulnerability, exposure, and its relationships with socioeconomic processes, sustainable development, and climate change.

Even though place-based climate change adaptation has not gotten much attention, it is important to take into account how public space development and upgrades relate to climate change adaptation strategies (Groulx et al. 2014). Since the UN charter for public space (Instituto Nazionale di Urbanistica, 2013) depicts public space as diversified and broad-ranging, it is vital to expand the potential of public space for climate change adaptation beyond the supply of green infrastructure, which applies to urban parks.

2.6. Research gaps in relation to urban parks in South Africa and climate change adaptation

Currently, a significant geographic bias exists in studies of how urbanisation and climate change affect public spaces. North America, China, and Europe form part of the three primary research regions of study focus (Chapman, 2017). In regions like Africa that are at an increased vulnerability and risk to climate change, there has not been much research done (Chapman, 2017). The climate change and migration induced by climate concerns will be concentrated in Africa's fast-growing cities, which will exacerbate existing strains associated with exclusion, governance, poverty, and informality (IPCC, 2022).

Since the current rate of urbanisation presents a limited timeframe for the opportunity to progress toward climate change adaptation advancement in the setting of international climate change, study efforts need to concentrate more heavily on the public spaces in urban environments for certain regions (IPCC, 2022). In the city of Tshwane efforts to realign unsustainable urban growth patterns have begun. One such effort has set tactical pillars and outcomes to guide the city on a new growth trajectory (City of Tshwane Integrated Development Plan, 2020) through implementing the Tshwane Regional Spatial Development Framework. However, a detailed analysis of urban public spaces from a micro-climate

perspective about the impacts of urbanisation on climate change and climate change adaptation is still lacking.

Therefore, the study is relevant in regards to approaching a site through a micro lens to not only understand its current unique characteristics and networks but to deduce the appropriate adaptation responses specific to that site. This study focuses on Tshwane's public spaces, with a particular focus on Burgers Park, and has studied the pertinent literature to measure the significance of urban public spaces, the potential effects of urbanisation, and climate change adaptation on their utilisation. This study intends to draw attention to significant unresolved research questions and knowledge gaps. The successive section will introduce the study area.

3. Burgers Park: The study area

3.1. Introduction

The public space under study is Burgers Park, the oldest park in Tshwane located in Pretoria Central. It is approximately (45779m^2) in size which is a typical size for a Pretoria city block making it the largest public park in the area. The park was established in 1874 and named after Thomas François Burgers who was the South African republic's fourth president. There is a statue of President Burgers in the park and it was declared a national monument (Engelbrecht, 1960). The park was initially intended to be Pretoria's first botanical garden (Hardijzer, 2018) but due to a multitude of factors, that vision did not come to fruition. This segment delivers a brief outline of the setting in which the study was conducted. It begins by summarising Tshwane before briefly describing Burgers Park in Pretoria Central (CBD).

3.2. Tshwane as the larger context

Pretoria is South Africa's capital city, established by the former Boer statesman's son, Marthinus Pretorius (Britannica, 2014). Before 1600, the Ndebele first settled in and inhabited the territory surrounding the city (Britannica, 2014). The Ndebele Khosi Musi, who ruled the region in the 1600s, did so from eMhlangeni, which he titled after his father Mhlanga and is now Mohlakeng (Randfontein) (Britannica, 2014). The era of Mfecane or Difeqane, also known as the 1820–1832 period, was marked by intense conflict between the black communities of Southern Africa and would lead to the Afrikaners settling the area about 1840 (Britannica, 2014).

It is situated in the northeast of Gauteng, the smallest province in the country yet the most urbanised region (Gotz et al. 2014). Pretoria continues into the western foothills of the Magaliesburg to the east, running along both banks of the Apies River. The Metropolitan Municipality that comprises Pretoria and neighbouring districts were given the name Tshwane after new municipal structures were established throughout South Africa in 2000 (Gotz et al. 2014).

The population of Tshwane grew by 2.92% annually from 2 478 557 in 2007 to 3 555 741 in 2017. This growth rate is twice as rapid as the growth rates of the province and the nation as a whole (The City of Tshwane Metropolitan Municipality, 2016) Ga-Rankuwa, Soshanguve, Mabopane, and Rosslyn make up the majority of Region 1 (with a population of 27%), followed by Region 3 (Hercules, Pretoria CBD, Danville, Laudium, Atteridgeville, Lotus, and Saulsville),

with populations of 22% and 18%, and Region 6 (Eersterust, Lethabong, Mamelodi, Silverlakes).

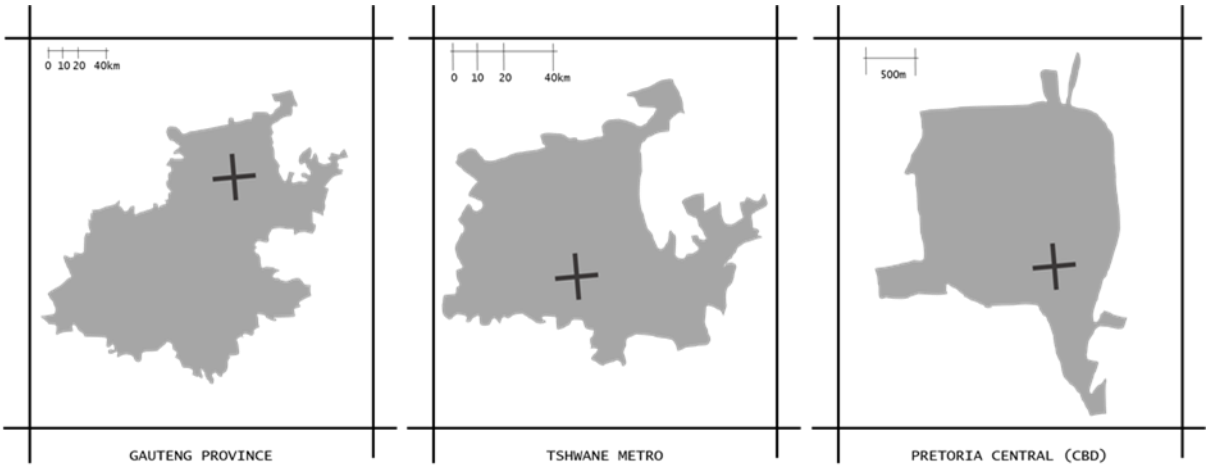


Figure 1: The study area within a larger context (Source: drafted from google maps, 2023)

The Priority Development Areas of importance in the City of Tshwane were divided into nodes and corridors according to the Spatial Structuring Matrix, each with a different priority (The City of Tshwane Metropolitan Municipality, 2016). About nodes: There are distinct node types regarded as areas where development should be prioritised (Horn, 2021). Urban Cores, also known as underserved township regions by the UNS (including Mabopane, Ekangala, Atteridgeville, Mamelodi, Ga-Rankuwa Hammanskraal, Olievenhoutbosch, Refilwe, Soshanguve, Temba, and Zithobeni) are located towards the outskirts of Tshwane. The majority of people live in the city's central business area where the conversion of office blocks into residential buildings resulted in more people being accommodated (The City of Tshwane Metropolitan Municipality, 2016).

The city is also coordinating its response to climate change with its global counterparts after joining the C40 Cities Climate Leadership Group (C40), an international alliance of megacities devoted to combating climate change, and signing the Compact of Mayors' Declaration in 2014 (currently termed the Covenant of Mayors for Climate and Energy) (The City of Tshwane Metropolitan Municipality, 2016). To successfully collaborate, share knowledge, and promote significant, quantifiable, and sustainable action on climate change, cities, and their mayors are supported by the C40 organisation (The City of Tshwane Metropolitan Municipality, 2016).

Important political, socioeconomic, and spatial developments have taken place in Tshwane. Different people's daily routines and everyday lives in the city, as well as public areas, changed (Landman and Nel, 2021). Others appreciate unlimited use of space in more historical parks and high-quality public spaces in once-marginalized neighbourhoods, while some people have

retreated into semi-privatised spaces (Landman and Nel, 2021). This raises concerns about how these modifications may affect urban resilience, particularly in light of the new Tshwane 2055 vision, which calls for a "liveable, inclusive, and resilient city."(Landman and Nel, 2021).

3.3. Burgers Park within the Pretoria Central context

Pretoria Central (Central Business District) is an active downtown area with modern high-rise buildings, a collection of colonial-era buildings, and landmarks such as the former parliament Ou Raadsaal, and the 19th-century Palace of Justice located in Church Square (central public park) (Greyling, 2000). Pretoria Central has experienced significant changes in scale and constitutes many high-density residential and commercial buildings, this is in stark contrast to the historic residential character of this neighbourhood (see Figure 3). While Pretoria Central has advanced and densified considerably, the provision of public space, in particular public parks, has unfortunately been neglected.

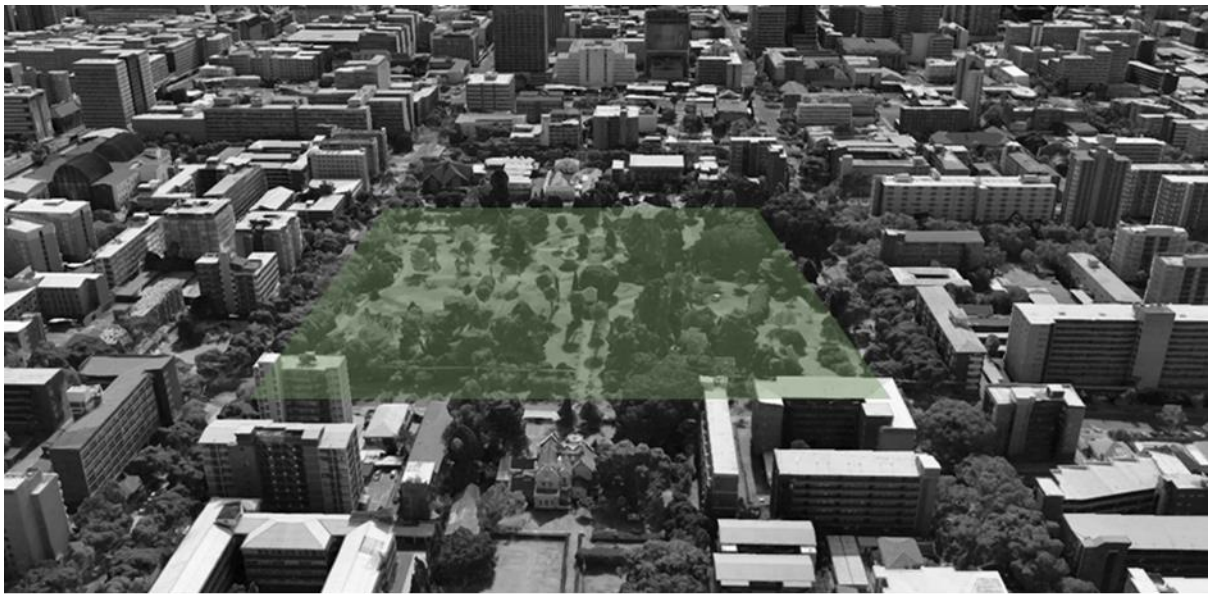


Figure 2: Burgers Park within the urban context of Pretoria Central (Source: google maps, 2023)

When the annexation of the Transvaal on the 12th of April 1877 occurred (Goodfellow, 1966), they declared that Burgers Park should be sold and that the remaining plants would deteriorate because the park's location was unfavourable and too rocky for a botanical garden. The plants were then moved to a new location close to Weskoppies Hospital (Engelbrecht et al. 1955). Pretoria Botanical Gardens were constructed east of Pretoria in 1946 after the project near Weskoppies was abandoned (Engelbrecht et al. 1955).

The park faced challenges in management and was under threat with evidence of neglect. This prompted many proposals regarding how the space could be repurposed: a space to be used for a church building, or a hotel (which the government approved) but a community complaint resulted in the place being approved for recreational use (Engelbrecht et al. 1955).

Heys was hired to develop the park in 1890, and shortly after, park laws were established (Engelbrecht, 1960) which led to the formalisation of the park.

Over the years, the park hosted numerous celebrations, fairs, banquets, and charitable events. When General Louis Botha and his wife returned from London in 1911, the park hosted a Mayoral Reception to welcome them (Engelbrecht et al. 1955). This welcoming celebration was attended by almost a thousand individuals. A second evening reception drew roughly 3,000 guests. Up to the 1960s, band performances were a common occurrence (Engelbrecht et al. 1955). It continues to be accessible to the public and is currently recognized as a national monument.

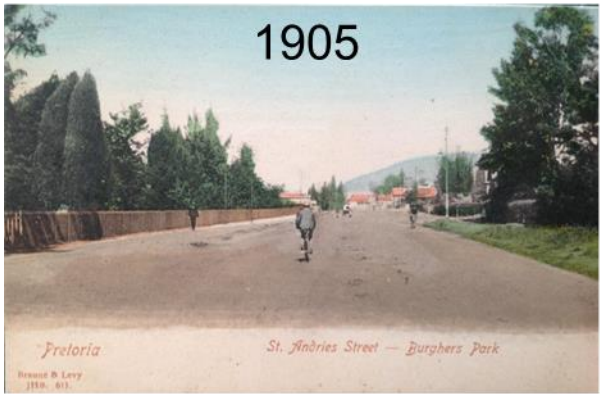


Figure 3: Burgers Park, left side, as viewed from then St. Andries Street card published by Braune & Levy (Source: Engelbrecht et al. 1955)

Figure 4: Burgers Park, left side, as viewed from now Lillian Ngoyi Street in 2023

Burgers Park still possesses historical significance, and natural beauty and continues to function as a public park in central Tshwane. However, it faces challenges that have resulted in signs of decay to both the natural environment and the built infrastructure, this is highlighted in detail in the findings section, and it is also worth noting that it is an old park and therefore requires constant maintenance. When observing it within its context, one can recognise the significant role it plays for urban dwellers who have little to no public spaces within their residential complexes, and yet the park is not as well kept as it used to be. The study recognises the significance of the public space and seeks to understand its current state, the existing user patterns, and its potential to adapt to climate change because as highlighted in depth in the literature review, it serves an important local social (as a public space) and climate role within central Tshwane (as an urban green park).

Figure 5: The study area boundaries

The study area (Burgers Park) sits within the context of Pretoria Central, see Figure 5. The study considers the surrounding context of Burgers Park and subsequently moves closer to studying the park through on-site observational analysis. A series of maps highlighting the contextual study area and Burgers Park will be analysed.

Local susceptibility is frequently increased by the urban structure itself, which is regularly exposed to both inner and outer pulse and stress disturbances (Landman 2016). One of the first stages towards a better understanding of such vulnerability drivers might be through a method that makes use of local, context-specific knowledge which is the premise of this study.

City of Tshwane Ward 80 Demographics Census 2011

Ward Number	Total Population	Median Age	Percentage of Females	Percentage of Males	Total No. of Households	Highest Percentage of Dwelling Type (Apartment)	Highest Percentage of Household ownership (Rented)	Median Annual Income	Percentage of employed people	Percentage of unemployed people	Percentage of Highest Education Level (Grade 12- Matric
(North) 58	33617	25	52%	48%	12088	45%	67%	R117000	46.8%	11%	44%
(West) 60	27099	27	44%	56%	9885	40%	66%	R57300	46.2%	11%	39%
(Location) 80	15482	25	52%	48%	7292	70%	66%	R57500	46.2%	18%	55%
(East) 81	23661	25	51%	49%	10902	92%	90%	R57500	48.2%	16%	55%

Table 1: City of Tshwane Census 2011- Demographics of the study area context (Source: Census, 2011)

According to the census 2011, Burgers Park is located in Ward 80, and contextually surrounded by Wards 58, 60, and 81. The data shows that the female population is predominant and the median age is 25. Households predominantly live in apartments and the predominant type of ownership is renting. 18% of the people are unemployed, which is higher than the surrounding wards with a R57, 500 median annual income (of about R4,700 a month) this already shows that when renting and having a constrained budget (Statistics South Africa census,2011), there is barely any room to financially donate or invest in this case, towards the park. These statistics will later be linked to the findings mapped by the author. The next section breaks down the method used to undertake the study.

4. Research methodology

This study takes into account public spaces as contributors to the general potential of our cities to adapt to climate change as a companion project to the Regenerative Public Spaces project, an interdisciplinary project at the University of Pretoria. The three Tshwane public spaces and neighbourhoods where the research locations are situated are Moja Gabedi in Hatfield towards the east of central Pretoria, the Muckleneuk Commons located in Muckleneuk a neighbourhood close to central Pretoria, and Burgers Park which is centrally located in Pretoria. This particular study will focus on the historic urban green park known as Burgers Park.

4.1 Research objectives

This project intends to comprehend Burgers Park's potential for adaptation to climate change, both in the present and the future, and whether there is any connection to park usage. The study aims to evaluate how the utilisation of Burgers Park is affected by its ability to adapt to climate change. This study goal was significant in that it highlighted several risks that were pertinent to the context and user patterns within the space. Sub-questions to the main research issue were translated as three study objectives**.**

The results of the three research objectives influenced the answering of the main research question. The following are brief discussions of the three study objectives that the research methods will address:

- Determine the current, and future, climate change adaptation potential of Burgers Park and whether that affects the climate change risk of Burgers Park itself and its immediate context
- Determine how the establishment and development of Burgers Park affects its current climate change adaptation potential within its immediate neighbourhood
- Determine how the spatial and material characteristics and climate change adaptation potential affect the use of Burgers Park

4.2 Research paradigm

The pragmatism paradigm serves as the basis for this research project. Pragmatism tries to build techniques to direct practice in response to particular difficulties that arise in actual life (Weaver, 2018). Early pragmatists rejected the idea that social inquiry using a single scientific approach could access truths about the real world. This applies to the study approach as many forms of data collection are undertaken (Onwuegbuzie and Johnson, 2006). These include but are not limited to interviews, desktop studies, and on-site mapping. The pragmatic paradigm

is a form of thinking that places more emphasis on "what works" than on elements that are undeniably real and true (Teddlie and Tashakkori, 2009). The truth, according to these pragmatists, may be evaluated based on its results. The findings ultimately answer the research questions instead of the researcher approaching the study with preconceived theories.

While combining various methods might result in a theoretically unreliable research method, the pragmatic paradigm is advantageous (Weaver, 2018). Research conducted under the pragmatism paradigm frequently employs mixed or hybrid methods, such as the case study method (du Toit, 2015) which was employed in this study. Multiple approaches must be combined in mixed-method research (Yin, 2006) to highlight commonalities in findings through triangulation. To provide the analysis additional depth and rigour, the researcher must take the time to integrate and employ complementary approaches that are contextually appropriate.

4.3 Research procedure

The research method used in the study is a case study approach, which enables one to comprehend a specific phenomenon in its context and as it manifests in reality (Yin 2014). It is frequently used in working professions as exploratory case studies or causal explanatory case studies (which might disclose the causality of specific events) (Yin 2014). In this study, a mixed-methods approach is used, which normally has neither a qualitative nor a quantitative bias but tries to apply the research technique best suited to the issue at hand (Denscombe 2008). A mixed method study strategy is employed: Both qualitative and quantitative research methodologies were used in various data collection procedures, such as contextual desktop studies and on-site mapping. This approach also permits the triangulation of data and the validation of the results (Yin 2014). To inform the final qualitative analysis, the research design used elements of a convergent parallel design (collecting and analysing qualitative and quantitative data, comparing or linking the two, and then interpreting the results) that started the study with a mix of qualitative and qualitative data collection which was then compared and interpreted (Edmonds & Kennedy, 2017). The subsequent section will highlight how the study applied the methodology in collecting and analysing data.

4.3.1 Data collection procedure

Qualitative and quantitative data collection was conducted by following systematic observational studies of the park, photographs, site maps, sketches, and reflections were used to fully capture the essence of the public space. In this process, there was an observation of activities, site movement, and the park's spatial-material quality as proposed by Gehl and Svarre (2013) and Kabir (2016). Due to the size and nature of Burgers Park (45779m^2), the site had to be divided into four parts (quadrant system, see figure 5), spending a minimum of ten minutes per quadrant per visit to a minimum total of 40 minutes per day visit.

4.3.2 On-site mapping

The sites were visited on the following dates and times: Friday 17/03/2023 07:15-08:30, Saturday 18/03/2023 07:45-08:45, Wednesday 22/03/2023 12:15-13:00, Friday 24/03/2023 13:05-13:31, Saturday 25/03/2023 13:08-13:47, Wednesday 29/03/2023 16:17-16:47. The days were consistent in line with the course programme but the times varied to deduce a holistic perception of the park. For each day four maps were manually produced (based on the quadrant system) which came to a total of twenty-four maps which were consolidated into six and then through a process of overlapping one final map was produced. Spatial orientation can be comprehended through spatial organisation and relationships such as symmetry, circulation, geometry, and repetition (Clark and Pause, 2012). The quadrant system was developed bearing in mind these principles to tackle a large space that was designed with the mentioned spatial organisations in mind. A CAD application was used to consolidate the in-situ mapping. Maps were produced to show the location of activities while the graphs produced

show in detail how many users (gender and age-specific) performed the indicated activities on a specific day.

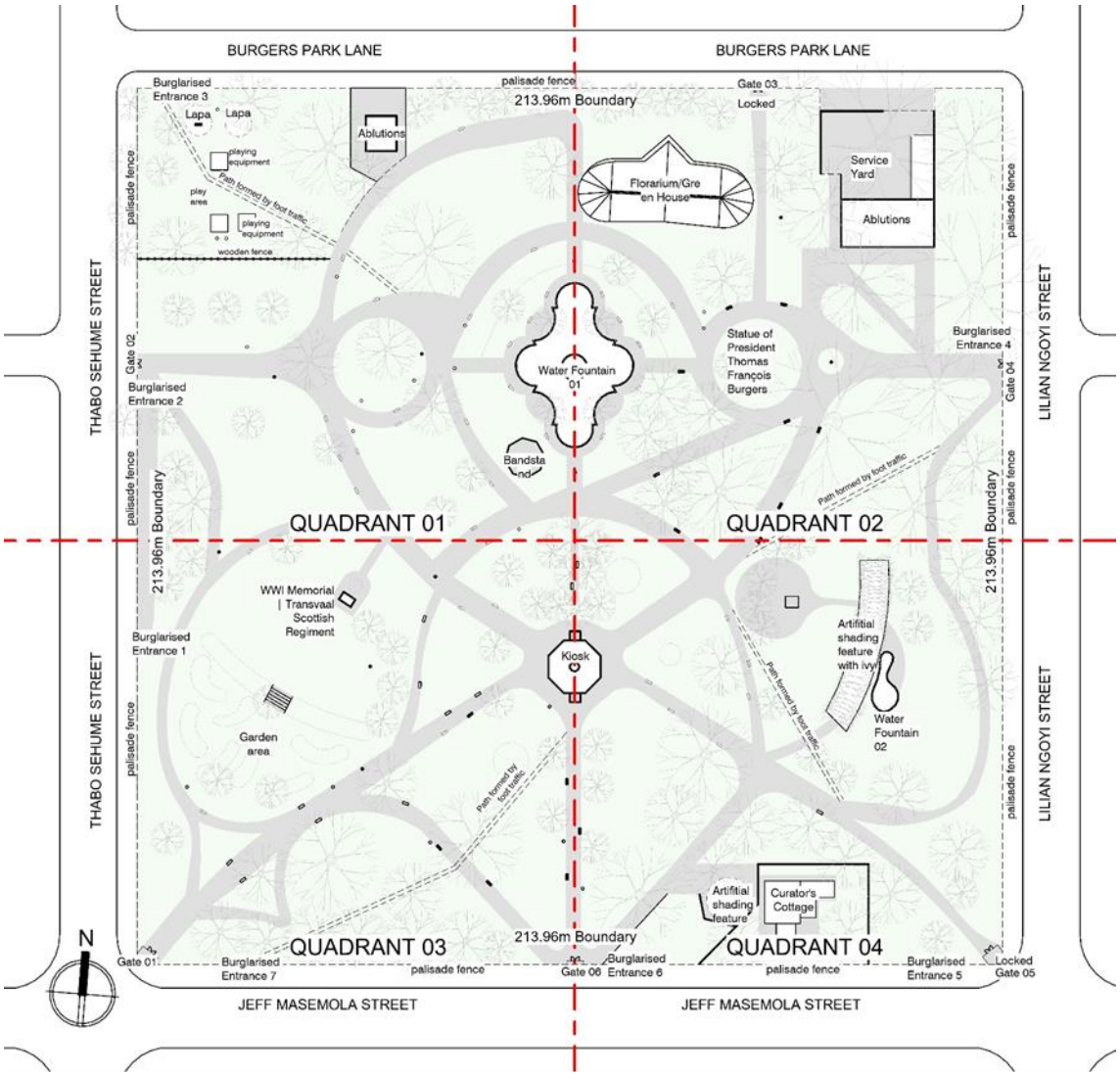


Figure 6: The park quadrant system for observational studies

4.3.3 Climate change risk assessment

Under a qualitative mapping of climate change risk to identify the potential for climate change adaptation of the park, the following reports were consulted: CSIR (2021), Tshwane Vulnerability Report (2020), and the Department of Environment, Forestry and Fisheries (2020). This made it possible to identify associated climate change hazards, risks, vulnerabilities, exposures, and potential for adaptation within the three main areas of the park: the built environment, the human environment, and the green infrastructure. The framework to assess climate risk was adapted from the frameworks established by Polsky et al. (2007)

and Simpson et al. (2021). The following dimensions adapted from Shuyan Han et al. (2022) were taken into account during mapping:

- The built environment which included the structures, components, spatial technology, and amenities
- The human environment includes the neighbourhood inhabitants and people using the park
- The park's green infrastructure, natural elements, open space, or constructed green spaces all have the potential to promote human health as well as the mitigation and adaptation to climate change

4.3.4 Contextual Mapping

To understand how Burgers Park functions within its surrounding location, a desk-based contextual mapping process was used to map current and historic conditions, demographics, nearby zoning and building functions, public transport routes, pedestrian movement and density, green infrastructure, water bodies, and landmarks (Bassot, 2022). The above themes were adapted from the key components of urban form (boundary conditions, transport routes, nodes, landmarks, and monuments) by referencing the study which reported that people understand their urban environment by creating mental maps. As a result, place legibility in the city affects the way people understand elements within the city (Lynch, 1960) and ultimately understand the use of the park.

4.3.5 Interviews

To understand people using Burgers Park purposive sampling was utilised to choose participants for a focus group of concerned citizens who participated in the continual maintenance and upkeep of the park. This focus group session was conducted in a semi-structured manner to find information about Burgers Park's founding, changes over time, and progress toward long-term sustainability. This is important to understand those who created the particular public area or are essential to its management (Punch & Oancea, 2014).

Secondly, semi-structured on-site interviews of 5 people who use the park were conducted (Wednesday 29/03/2023 between 13:30-14:39) utilising randomised sampling to gain additional insight into their use, perception of the space's quality and safety, and activities that happened when the researcher was not there. Semi-structured interviews were conducted on purpose to gather unreported information on the subject of the study. In-depth data is typically obtained through unstructured or semi-structured interviews (Gill et al. 2008). Semi-structured

interviews provide you the chance to be led during the interview by overarching themes while also drilling down and elaborating on particular elements or assertions (Qu & Dumay 2011).

4.4 Analysis of collected data

The study used a qualitative data analysis approach, which allowed for familiarisation with the material gathered and the finding of correlations and differences in data. To discover correlations in findings and conclude accordingly, the collected data was analysed (Kawulich, 2005). Triangulation was used for each sub-question to produce accurate and trustworthy study results. Subsequently, each data type was analysed using appropriate analysis methods.

- In terms of the interviews thematic coding was used. Thematic coding was created in-vivo to analyse the interview data. The analysis was carried out manually using transcribed digital copies of the interviews.
- The observational analysis used pre-existing assessment criteria and an in-vivo technique; visual coding was established for the observation analysis of the place occupied. While mapping and reflective journals shed light on the causality of certain occupancy patterns, the quantitative and qualitative documentation of the occupancy and use of the spaces were analysed using descriptive statistics to discover and confirm trends.
- The spatial material analysis of the public space in question employed photography to document the composition and quality of the built environment with a focus on built structures and the floor area. These were then labelled based on type and location on site in terms of the quadrant system.
- A CAD-based application was used to consolidate and present the desktop and in-situ mapping. This enabled the data to be shown and overlapped, allowing for a qualitative analysis of the data. The results ultimately aided in understanding the public role of the park and the local risk of climate change.

The process of triangulating the data started with consolidating the data for interpretation and analysis to be feasible. The overarching themes were the establishment, use, and climate adaptation potential of the park. Images were coded according to public space aspects they conveyed, in understanding what makes a successful public place, adapted from Gehl and Svarre (2013) such as use (activities, users, and movement), amenities, natural features, accessibility and boundary condition, spatial materials (floor, seating, and bins), perception of quality of space which led to the classification: signs of degradation. In interviews, the main reoccurring themes were highlighted which spoke about the state of the park, its use, and

perception of the park and its context. An example of how some of the findings came together to make sense of the patterns observed in the park can be seen in Figure 7.

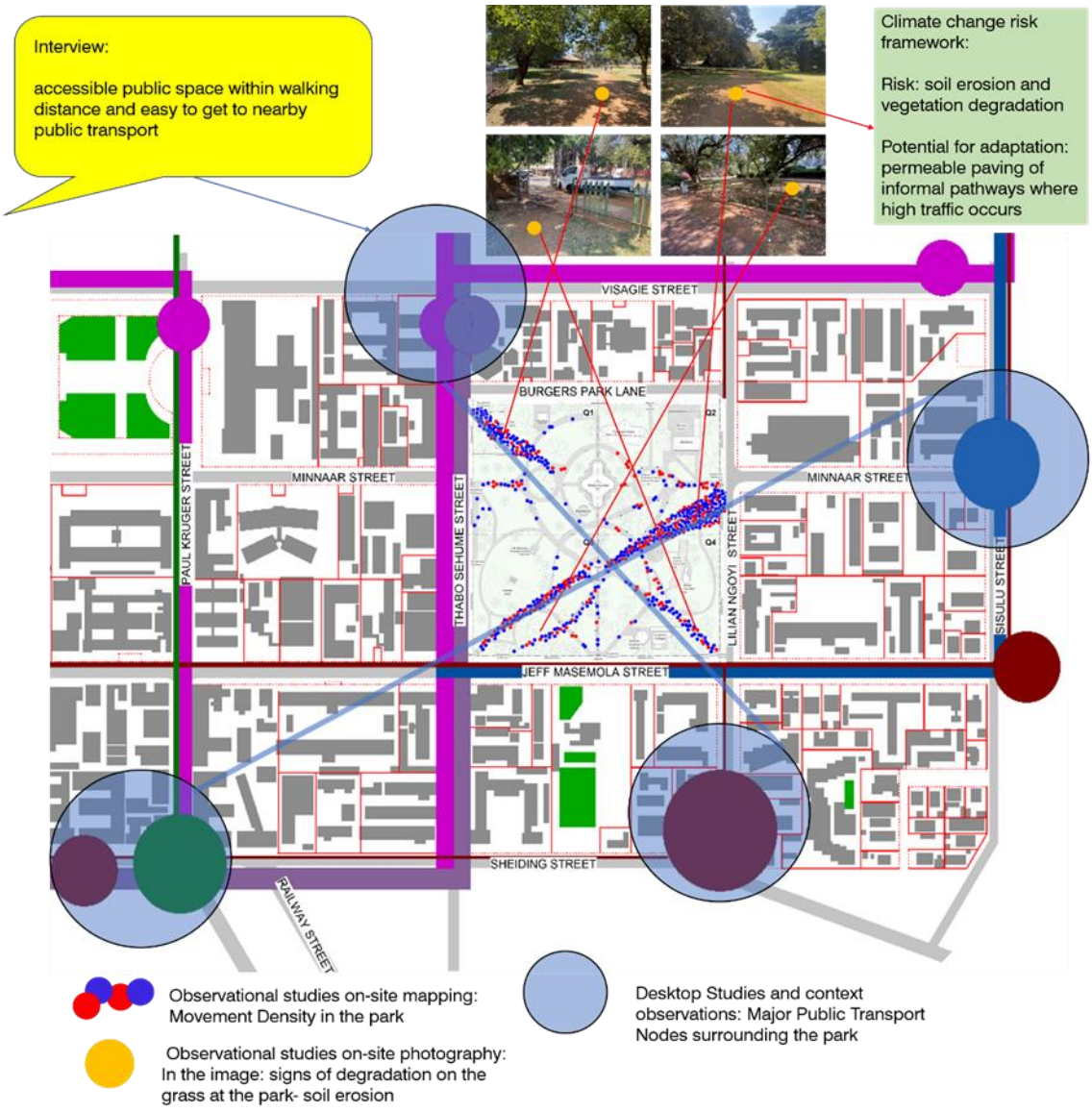


Figure 7: The triangulation system example for data analysis

In conclusion, the analysis revealed that findings, although coming from different methods of inquiry, had some correlations that further confirmed answering the research questions (see Figure 7). For instance, through observational studies such as photographing the park's infrastructure, one could see that there was a level of degradation occurring not only to the natural elements but also to the built infrastructure and through asking interviewees about their perception of the park, most mention how much the park is degrading and what contributed to the degradation. This reveals one of many correlations in findings that answer some of the research sub-questions related to use and climate adaptation potential.

5 Findings

"I feel like they shouldn't remove it, just to maintain it, because it's a beautiful park, we need it" ~Interviewee (04)

"The park is used, it's great, it has challenges, but people use it" ~ Friends of the Park Forum

This chapter mapped and analysed Burgers Park in the context of Pretoria Central to understand Burgers Park's potential for adaptation to climate change, both in the present and the future, and whether that affects the park's utilisation. The section was divided into four subsections, where there was a breakdown of findings through contextual mapping, interviews, observational studies (images and on-site mapping), and finally climate risk assessment. Each of the stipulated sections highlight the main findings in achieving the stipulated research objectives.

5.1 Contextual mapping findings

When studying aerial photographs (see Figure 8), there is evidence that the neighbourhood has seen developments over the years with hotels being established on Jeff Masemola Street, construction of apartment blocks towards the north of the park, and shopping centres on Bosman Street which all contribute to the city's urbanisation. The park's grass presents a drastic change from 2009 to 2022 (summer aerial views), it used to be greener and more abundant, but now parts are degrading, evidenced by the fading colour of vegetation. This observation highlights that the park is affected by the changing climate and lack of maintenance as evidenced by vegetation degradation.

Figure 8: An aerial view of the park in context showing changes overtime

The park has a relatively gentle slope and is surrounded by high-rise buildings, with some single and double-storey buildings present on site. Adjacent streets comprise major transport routes that provide points of entry and exit into the city. Another observed element was access. The majority of the context is privatised and therefore public access is limited. The park is surrounded by a fence that has been broken in certain parts, gates on the north and southern edge remain locked. Subsequently, parts of the fence ended up being broken into, especially right next to where the gates are located, a detailed view of these elements can be referenced in Figure 6. As mentioned earlier, the park is a national monument and is surrounded by other monuments and landmarks which increases public interest in the context.

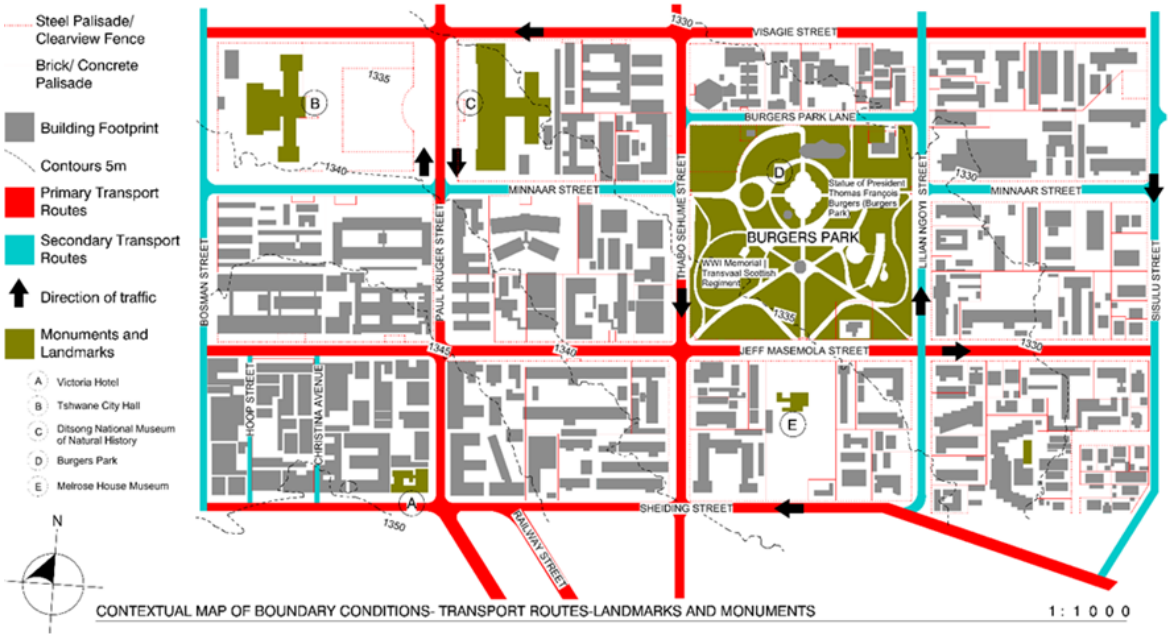


Figure 9: Context: Boundaries, Landmarks, transport routes and contours

As mentioned earlier, the park is a national monument and is surrounded by other monuments and landmarks which increases public interest in the context. The predominant surrounding zoning is residential high-rise buildings with little to no green public spaces. This contributes to the urban heat island within the context and the site's major climate adaptation role is mitigating its effects, this will be further discussed in the climate change risk assessment section. Furthermore, this emphasises the social role the park plays as these residential buildings consist of not only young students but family units with children (Statistics South Africa Census, 2011).

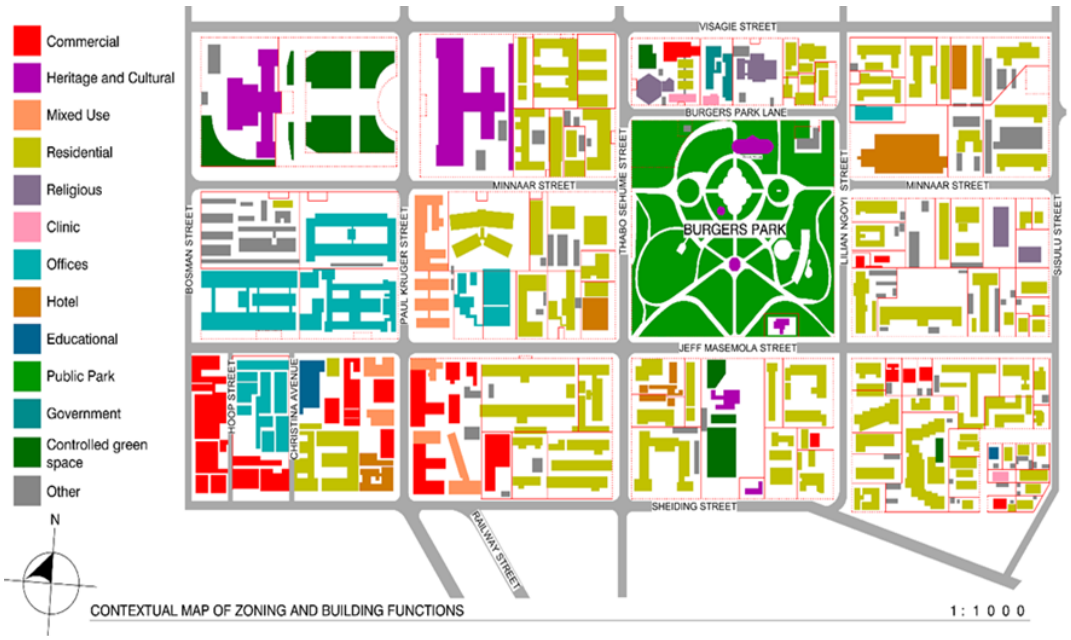


Figure 10: Context: Building Functions

Burgers Park is the central area with majority green coverage, streets generally have trees on walkways, and city hall (which is located 200 metres from the park, see Figure 9) also has a green outdoor lawn, however, it is no longer accessible to the public, and the apartment blocks seem to have little to no lawn provision. Therefore, the park provides an important green space for the inhabitants.

The context has a generally limited number of water bodies, see Figure 11, most of which are pools for private use. The park has two ponds that are not functional, the central one has not been cleaned in years and has accumulated algae (looks green on the map) and an unhygienic smell. The other one is located on the south-eastern part of the site and was drained years ago, see Figures 6 and 19 for a detailed look. The Egyptian geese no longer seasonally visit the park where they would occupy the ponds while migrating, affecting the park's biodiversity.

Figure 11: Context: Vegetation and Water bodies

The park is located close to major public transport stops and routes see Figure 12, (taxis, Tshwane, A re yeng, and Gautrain Buses) which contributes to its ease of access and diversity of users but also highlights the vehicular-centric aspect of the city which contributes to carbon dioxide emissions.

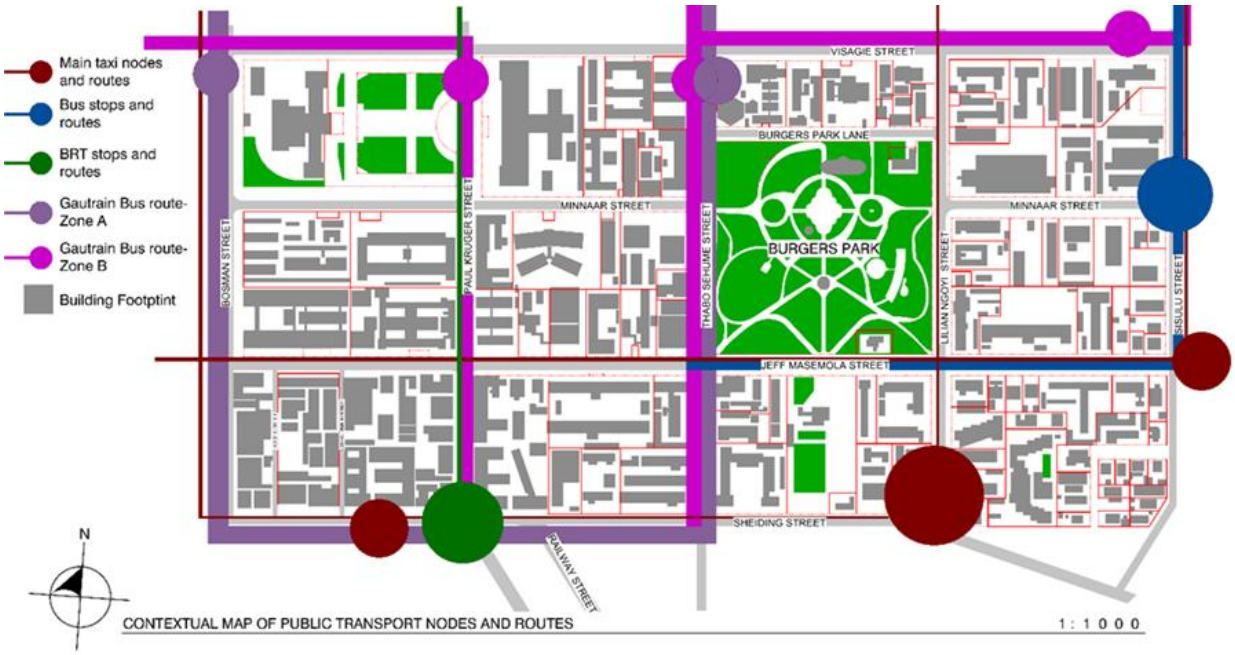


Figure 12: Context: Public transport routes, nodes and stops

In conclusion, the context affects what occurs within the park, informing routes and movements within the park. The role of the park, both socially and climate-related, is further emphasised due to the lack of provisioning of accessible green public spaces within the context, being surrounded by mostly high-rise buildings, the large city blocks that make walkability difficult, nearby developments resulting in more people moving to the city and the lack of natural features such as water bodies within the context. The development of the context thus inevitably affects both the use and the climate change adaption potential.

5.2 Interview Findings

Through the thematic coding of a group interview relating to the establishment of the park and its developments with the contribution of Friends of the Park and TLF (Tshwane Leadership Foundation) as well as on-site users, findings were made. This provided a historical and current perception of the park and its use:

5.2.1 What the park used to be:

In the 90s the park was a fancy and very smart touristy place, there were many events such as *Christmas in the park* that were well attended and very attractive at night. Safety was not a concern as security guards/marshals were patrolling during the day and night and enforced

an accountability system within people using the park. There used to be a beautiful and very vibrant restaurant in the centre of the park (in the historic pavilion) with a catering company. This restaurant also accommodated the homeless, it was a place where the homeless could find their dignity and purpose and often had organised meetings in the park. In 2010 Virtual Village, a month-long festival focused on the soccer World Cup was hosted in the park and it was packed every day. Beyond activities, the park's physical attributes were plenty of flower beds, ablutions were working, access was easy and the fence was fully intact. The bandstand still had electricity and the lighting was functional. The park was overall well-tended with the two fish ponds functioning well. It was a place for nearby families who live in flats and have no access to private green spaces and a safe space for meeting fellow parents, forming supportive engagements, and having picnics.

5.2.2 Challenges facing the park:

Between 2011 to now, there was a change in context leading to the misuse of the park, and the city's change in ownership. A decline in management from the City of Tshwane Metropolitan Municipality, a decline in budgets, a lack of ownership from the civil society, the social conditions in the park, and the increase of 'nyaope' and drug addiction contributed to its gradual degradation. The City of Tshwane Metropolitan Municipality withdrew the lease agreement of the kiosk and declared it 'structurally unsound' and sometimes simply rejected any requests to use the park, even for the greater good. Break-ins to the kiosk occurred, due to there being no security personnel at the park.

Figure 13: The Park's palisade fence in 2013 versus 2023 (Source: Google Maps,2023)

Tourists from Burgers Park Hotel, which sits across the park, started to feel afraid and they demanded that the park be locked at night. Locks were put everywhere and they only opened some entrances. This very quickly led to people breaking down little entrances around the park as seen in Figure 13. Site maintenance gradually became limited to certain aspects, with most of the built infrastructure remaining neglected. The park's greenhouse is not functional and the city closed it down which means plants are no longer grown on site. The grass is no

longer as green as it used to be and littering increased. Another aspect that was mentioned is that there used to be more people using the park in the past.

The park experienced dilapidation to property in these areas: some of the bins were broken and removed, the play area AstroTurf deteriorated, and with no one guarding the play areas, adults began to occupy it which made it unsafe for children and prone to facilities easily breaking. The ponds became neglected, one being drained out and the other not getting cleaned. The feeling of insecurity grew with the park being dark at night because of broken lights and people getting robbed, trees forming hiding spots for criminals which made it difficult for women to go alone because it felt unsafe. It also negatively affected the social work progress of healing and helping. Currently, there is no plan or vision to look after it.

5.2.3 The positive side of the space despite the awareness of its deterioration:

Some people go to the park and have a lot of social issues and they end up getting aid from social workers. People get to sit, pause, and connect with other people. It remains an accessible public space within walking distance and easy to get to by public transport. It is a place used to host the annual Feast of the Clowns Festival to celebrate the city's diversity and address social issues. It is considered peaceful, unique, quiet, beautiful, and therapeutic. It is seen as a place that brings people together with historical significance, and tranquil, beautiful plants, and to some, it is considered a need.

In conclusion, the findings stated above from interview data reveal a sense of conflict in the perception of the park. On one hand, users see its significance and enjoy all that it offers, on the other there is a level of dissatisfaction directly linked to its physical degradation and lack of safety. There seems to be a longing for how it used to be as some users communicated that it was in a much better state in the past. Lastly, the findings reveal the opposite of progression occurring in the park which inevitably impacts elements within the park that have prevented it from being optimally utilised. However, there is still an abundance of trees and grass which has since taken on a climate change mitigating role, and through maintenance can continue to thrive.

5.3 Observational analysis findings

The goal of the study was to find out how the material and spatial characteristics and climate change adaptation potential affect the use of Burgers Park. The results ultimately aid in understanding the use of the park, local risk, and climate change adaptation potential.

5.3.1 The spatial material quality of Burgers Park

As discussed in the literature review, factors of what makes a good place provide guidelines on what to map when studying a public place. The starting point was visiting the site to take inventory of the elements that influence a successful public place adapted from Gehl and Svarre (2013) as shown in Table 2. The initial visit entailed documenting the current condition of the site and from Table 2, one can deduce that the park has elements of dysfunction such as neglect but also offers positive elements such as public seating and landmarks.

Date Visited	15/03/2023- WEDNESDAY MORNING	
Accessibility	Inclusive Design	YES
	Signage / Wayfinding	NOT ON SITE (PARK LAYOUT ON SOUTHERN EAST EDGE)
	Number of Entrances	6 FORMAL (2 PERMANENTLY LOCKED) 7 INFORMAL (BY WAY OF BURGLARY)
	Fenced-off or Open	FENCED OFF WITH BURGLARISED OPENINGS
Security	Security Office	NO
	Passive surveillance	LIMITED
	Cameras	NO
Amenities	Dustbins	YES-SOME ARE BROKEN
	Lighting	YES- ALL BROKEN
	Wi-Fi	NO
	Drinking Fountain	NO
	Water Feature	YES- BUT NOT FUNCTIONING, ONE DRY, ONE LITTERED AND FULL OF ALGAE
	Artificial Shading	YES (6 FEATURES)
	Public Art	YES (STATUES)
	Public Furniture (excl. seating)	NO
	Seating	YES (60 MADE OF IRON/METAL)
	Parking	ON STREET
	Playing Equipment	YES-DELAPIDATING
	Ablutions	YES-BUT LOCKED DUE TO DISFUNCTIONALITY
Perception	Comfort	Relatively comfortable
	Air quality and smell	Foggy, open fires, BAD SMELL AS ONE GETS CLOSER TO THE WATER FEATURE
	Cleanliness and Maintenance	Signs of grass cutting, littering
	Neglect and quality	Neglect
Natural Features	Trees, Grass, Flowers	YES

Table 2: Site Inventory based on aspects that constitute a successful public place

5.3.2 Floor Materials

The park is abundant in grass and trees which cover most of the site, see Figure 14. However, there is a variety of floor materials that can be attributed to the different parts of the park. Some of the grass in Quadrant 2 differs where there is an abundance of old trees that have dried up the surface, making the grass there uncomfortable for sitting, see Figures 14 and 15. The main walkways that make wayfinding easier on site are made up of red brick pavers. Most of the floor materials are in generally good condition except the Astroturf on the play area which is deteriorating and some of the paving lifting due to tree roots. Overall, the construction of these surfaces does not allow water drainage and this means that most of the water drainage is managed by the grassed area.

Figure 14: Aerial view depicting tree coverage within the park's quadrant system

Figure 15: Burgers Park Floor Materials

Figure 16: Burgers Park natural elements

5.3.3 Natural Features

The one undeniable aspect of the park is the abundance of natural elements. It is full of different kinds of trees, young and old, as well as ample lawn coverage which provides

opportunities for different activities such as sleeping or playing sports. It is surrounded by diverse flora and fauna which add to its biodiversity and is key in defence against climate change hazards especially in an environment largely densified by high-rise buildings. This means that not only is the park adapted to climate change concerning its natural environment but it plays a mitigation role as well.

Figure 17: Burgers Park Amenities

5.3.4 Amenities

Part of its ecosystem services is the provision of amenities. The park offers six artificial shading elements but due to the nature of its size, could accommodate more, especially in the face of climate change. It has a total of sixty benches, which is a small number for a park that experiences an influx of over 140 on-site users (as noted later from the graphs), however, some people opt for the choice of sitting on the grass as it is abundant. The park offers points of attraction due to its historical significance and has a memorial and the statue of former president Francois Burgers. The dual nature of the site again reveals that while some aspects of the park are considered successful, other elements are in disrepair such as the ablutions building see Figure 17, particularly the image next to the statue of former president Francois Burgers and the one on the top left corner.

5.3.5 Access and Boundary Conditions

The boundary of the park is marked by the palisade fence which is covered with blooming flowers. As noted from the thematic coding, the images show its state of dilapidation with parts completely broken down because out of the six gates in the park, two remain permanently locked (sparked by safety concerns in the past) which led to the breaking down of the fence and the formation of six informal entrances. Looking at the fence alone shows a sense of neglect in the park and raises safety concerns.

Figure 18: Access and Boundary Condition

5.3.6 Perception of Neglect

From observations, there is evidence of neglect in the park. Some of the neglect is caused by people who misuse the park, while on the other hand a breakdown in the management of the site, and those appointed to look after it has significantly made the conditions worse. From the images one can see that the two ponds no longer serve the purpose of the pond which is by creating stepping-stone habitats that allow a variety of species to disperse over the landscape, it is possible to promote connection across freshwater habitats (Juraka et al., 2019; Hyseni et al., 2021). Ponds and (networks of ponds) are essential for the preservation of biodiversity, and their numerous advantageous ecosystem services give them the ability to be instrumental in mitigating and adapting to climate change.

Figure 19: Burgers Park evidence of neglect

Ponds are frequently ignored in water and environmental policy, and there is a lack of information on how to manage and restore ponds to maximize their potential as artificial solutions. The second pond located in the park has been entirely dried out see Figure 19, devoid of its drainage system, and filled with litter. The first pond has not been cleaned since 2014 and has gathered litter, algae, and a foul odour.

Littering in the park is a problem because, in addition to being unsightly, if improperly disposed of, it can serve as a haven for bacteria and illnesses (Hill, 1997). The problem is made worse by the fact that some of the bins are damaged, see Figure 19 bottom right corner. Finally, open fires were observed mainly occurring in quadrant 1, and as evidenced in Figure 19, if uncontrolled, open burning could potentially put the ecosystem and people at risk.

5.3.7 Signs of degradation on the grass leading to path erosion of the soil

Although the park has official gates and walkways, one can see from the subsequent maps in connection to the above pictures that there is evidence of soil degradation caused by vandalised access points and partly by the formation of informal routes. The grass area is becoming less fertile and nutritious, degrading it and rendering it unusable. Over time, erosion may reduce the soil's capacity to absorb water, which could lead to flooding and the formation of huge amounts of standing water. When people's feet damage the soil structure and vegetation (in this case, the grass), over time, if unresolved, rainwater and wind could move the soil away leading to further degradation.

Figure 20: Evidence of grass degradation leading to soil erosion

5.3.8 The use: users, activities, and movement in Burgers Park

By referring to the subsequent images, graphs, and maps, the following can be deduced regarding users, activities, and movement:

5.3.8.1 Users of the park

- First, it is worth noting that the majority of users of the park were male, particularly adult males even though the census reveals that Ward 80 has a predominance of females, see Table 1. Due to the predominance of females in the area, there should be a larger number of them using the park and yet that is not the case. This finding is surprising especially because the park is located at the centre of residential buildings with households and children yet even the number of children and the elderly is drastically low. This can point to the safety factor of the park and could question its social role as a public space because it should function as a place that can be used by all and not exclude others.
- Another interesting observation was the presence of homeless people at the park. Most of whom could be observed sleeping and recycling. During a rainy Saturday visit to the park, they were observed taking shelter in the kiosk, underneath the bandstand and a shading structure next to the curator's cottage, see Figure 22. This is another

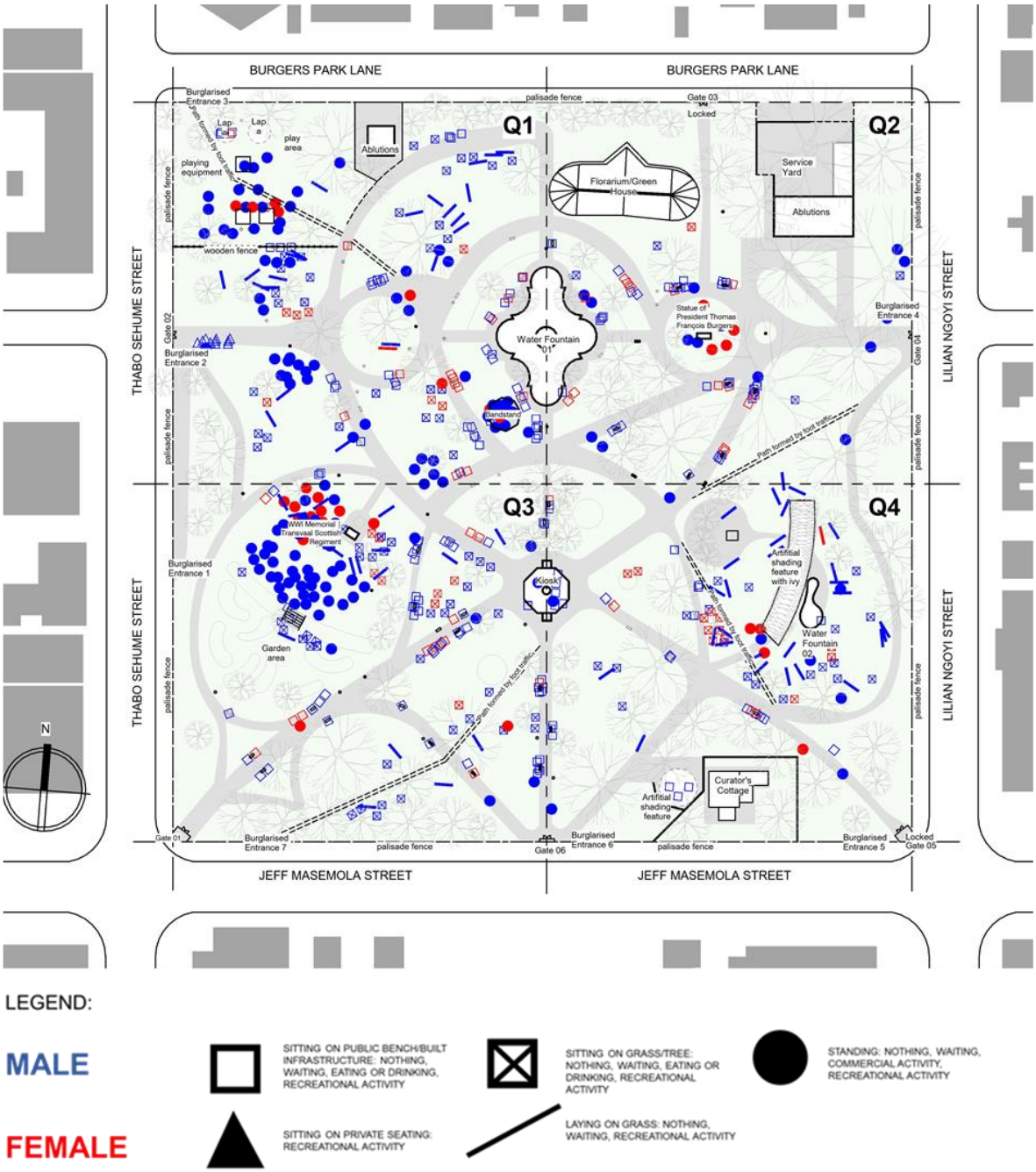
result of urbanisation (Mlambo, 2018), where people move to the city due to developments and unfortunately, they are vulnerable as they have no means to safely shelter themselves against the effects of climate change.

5.3.8.2 Activities in the park

- The most frequent activity was sitting on the bench or built infrastructure performing a recreational activity, mostly conversing. A mix of activities was concentrated on the quadrants with fewer trees (quadrants 1 and 3) whereas quadrant 1 with many trees had people sitting on benches and none sat on grass due to the majority of the grass there being dry, see Figure 15. Most activities occur where the site is most visually permeable with less tree coverage which is quadrants 1 and 3, see Figures 14 and 22.

Figure 21: Types of observed activities in the park

- The above findings can be linked to findings from on-site interviews where users expressed: that they came to relax, meet people, meet up with friends, read a book, see beautiful views, and have peace of mind while watching birds and trees (which are all recreational activities). Some had planned on spending an hour or more at the park while some had no set time, just seeing how their day would go, and they come to the park often. They have observed rare activities such as events with celebrities and dancing, marches, soccer matches, and aerobics groups.



LEGEND:

MALE

FEMALE

SITTING ON PUBLIC BENCH/BUILT INFRASTRUCTURE: NOTHING, WAITING, EATING OR DRINKING, RECREATIONAL ACTIVITY

SITTING ON PRIVATE SEATING: RECREATIONAL ACTIVITY

SITTING ON GRASS/TREE: NOTHING, WAITING, EATING OR DRINKING, RECREATIONAL ACTIVITY

LAYING ON GRASS: NOTHING, WAITING, RECREATIONAL ACTIVITY

STANDING: NOTHING, WAITING, COMMERCIAL ACTIVITY, RECREATIONAL ACTIVITY

Figure 22: On-site mapping of activities within the Park

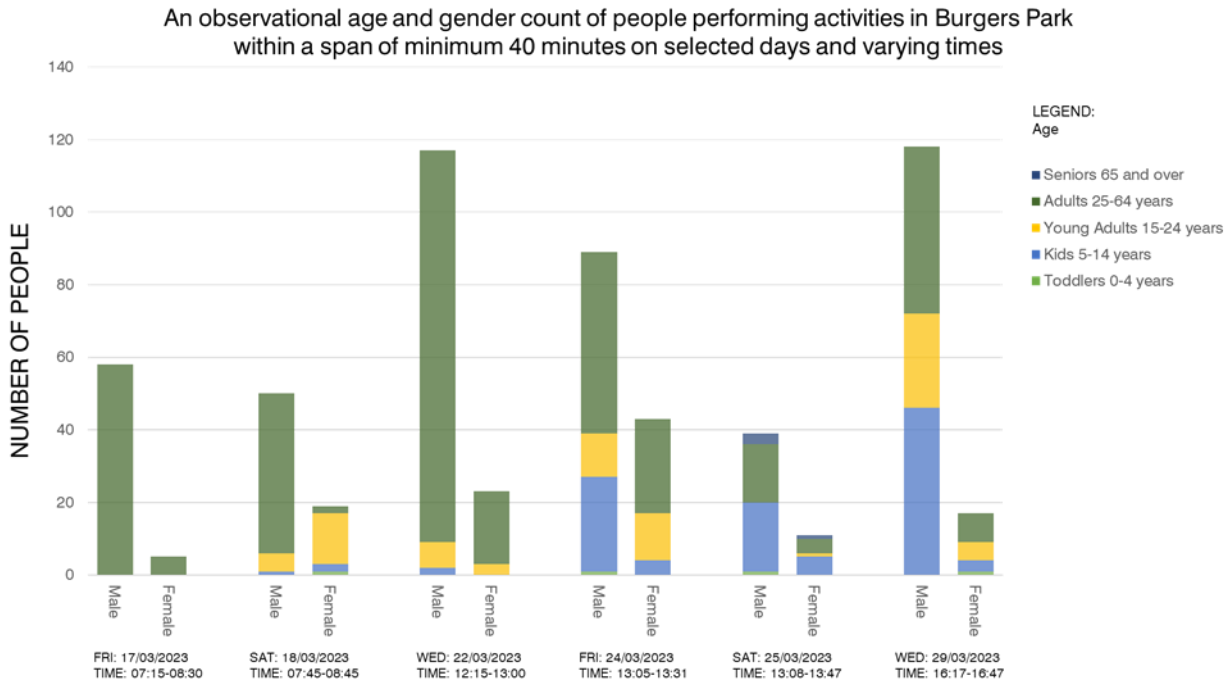


Figure 23: Graph showing the age and gender count of people using the park

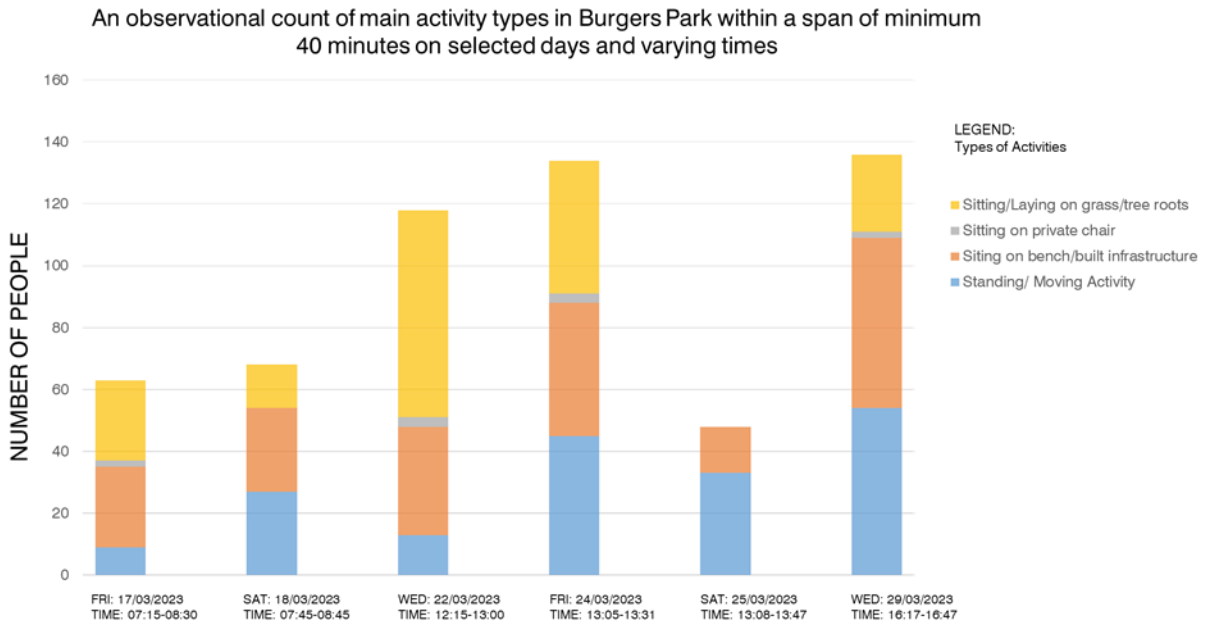


Figure 24: Graph showing main activity types within Burgers Park

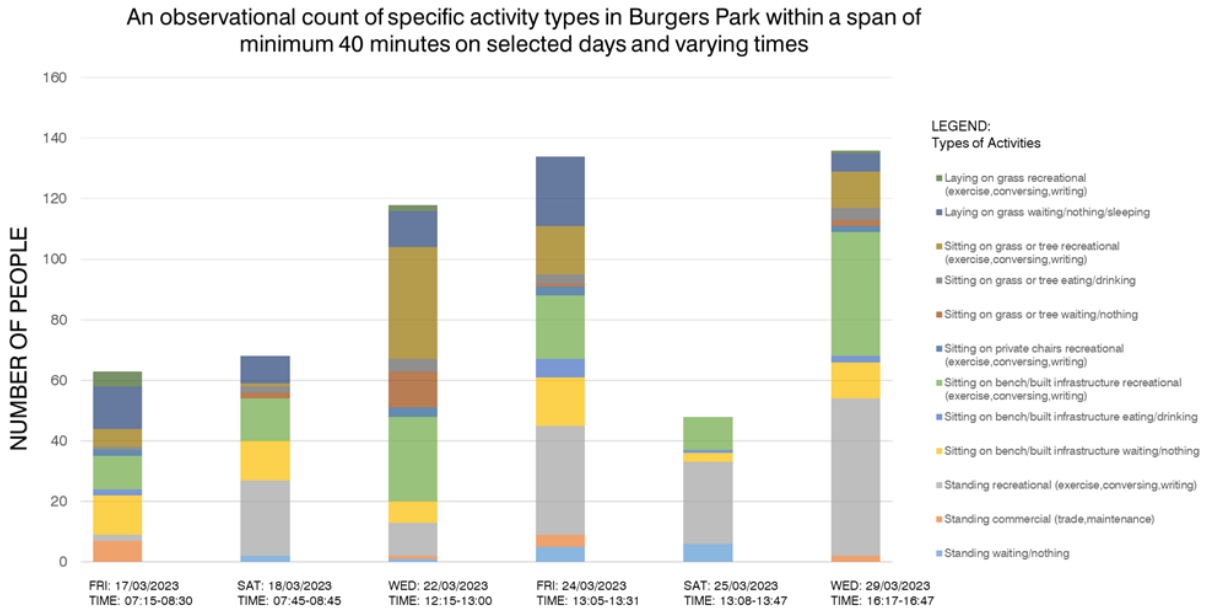


Figure 25: Graph depicting sub-activities observed within Burgers Park

5.3.8.3 Movement within the park

From interviewing users, the findings revealed that the majority either walked or used public transport to get to the site. A lot of people use the park to get to the other side of the city where some of these transport nodes are located. The park seems to offer ease of movement in a city that is developed as large inaccessible blocks that require people to walk longer distances.

Using the same approach of the quadrant system, users were mapped entering the site through main formal and informal entrances and pathways. The majority of the users were adult males, again the number of females remains low with kids and the elderly rarely seen in the park. However, it is worth noting that the number of females moving through the site is more than the number of females who stayed and performed an activity in the park. This again links to the safety factor of the park, while staying in the park might feel unsafe, moving through the main visible routes seems to be preferred.

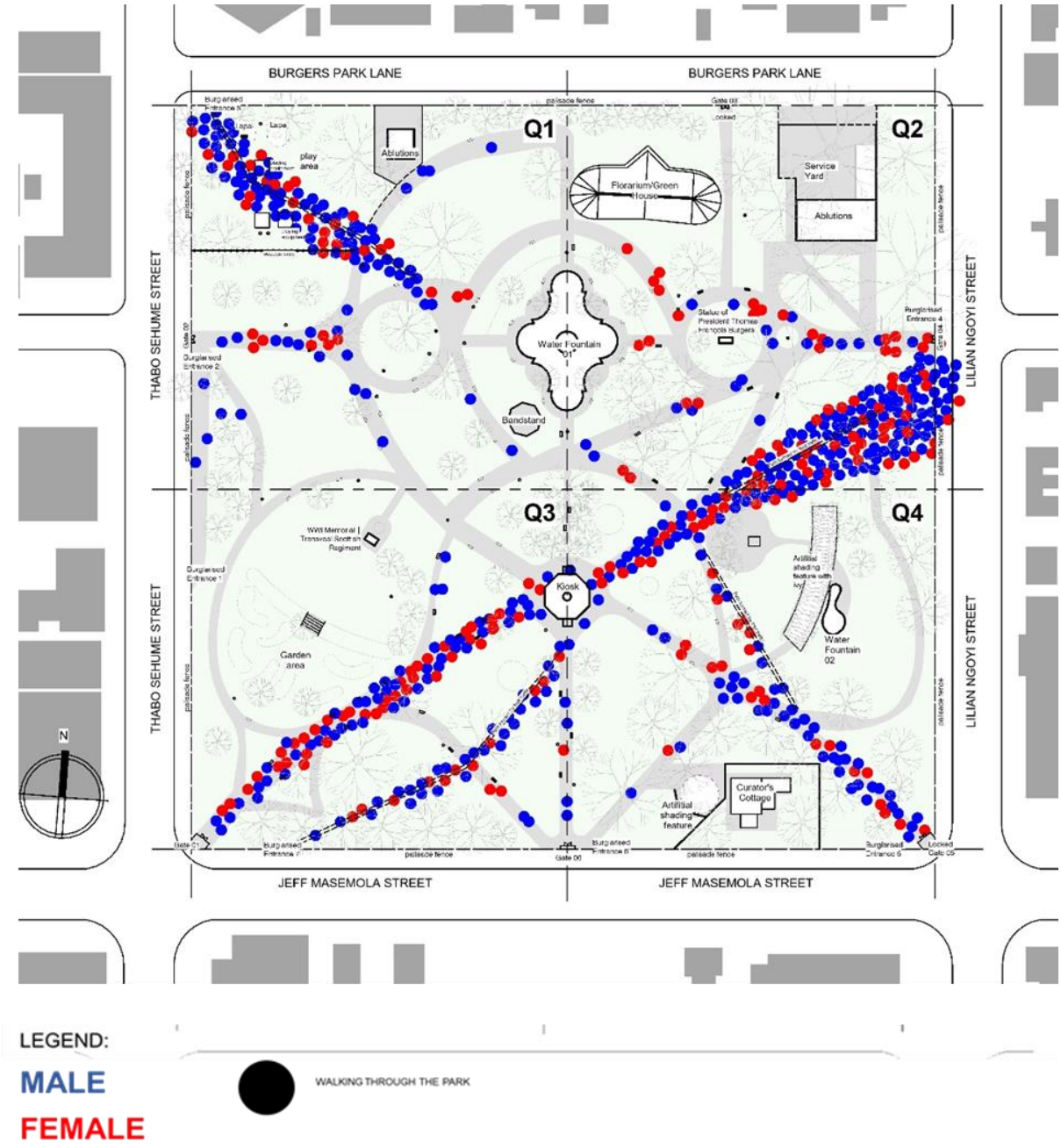


Figure 26: On-site map showing people moving through Burges Park by gender

The highest foot traffic can be seen in Quadrant 02, through the informal entrance and Quadrant 01. These patterns can be evidenced by the spatial material quality images, see Figures 15 and 20, where grass degradation is apparent and is expanding in width creating a larger eroded area. Through triangulation, the desktop contextual maps indicate a correlation between these informal routes and the location of major public transport nodes see Figures 7 and 12.

These informal routes, as one can note from the map, align with pre-existing formalised routes that are paved and accommodate walkability. However, people walk on these informal routes

which are mainly soil and surrounded by grass, and ultimately continue on formalised pathways of the park that are appropriate for walkability.

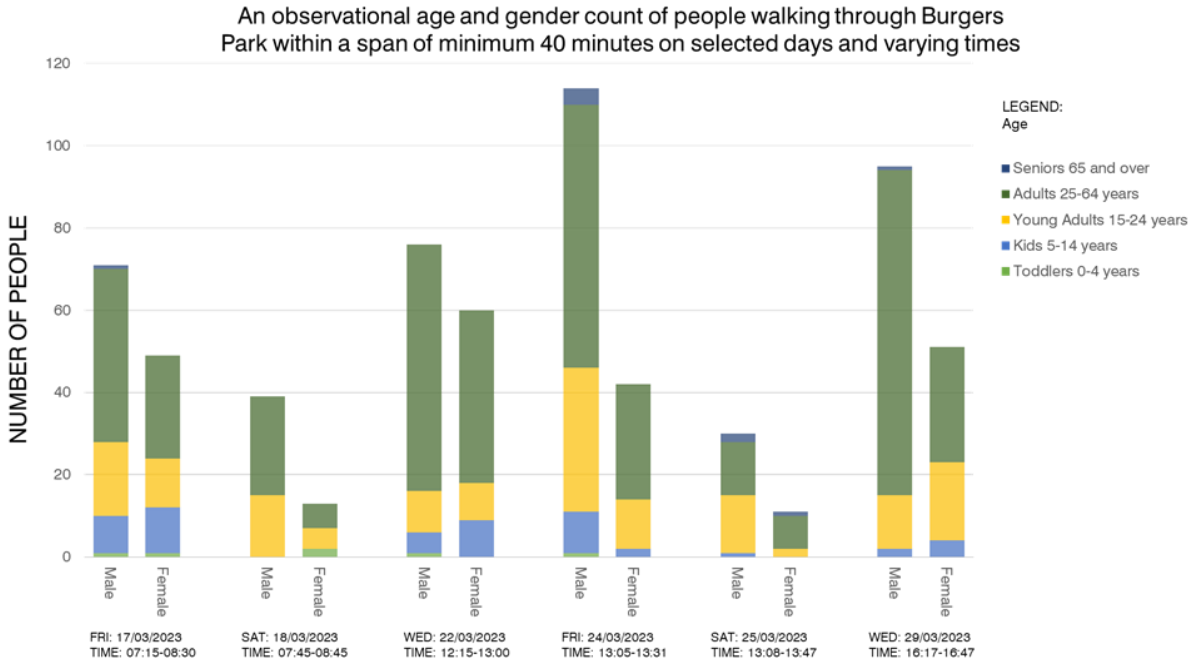


Figure 27: Age and gender count of people moving through Burgers Park

In conclusion, the park has features that constitute what makes a successful public place, however, most of these features are in disrepair and require maintenance as some of them not only affect how the park is used but make them vulnerable to the impacts of climate change. In addition, activities are versatile, however, some of them require the park to adapt to accommodate them such as large groups playing soccer. The disparity in male and female numbers is astonishing and reveals how the park might not be as accommodating as it seems.

5.4 Climate Risk Assessment Findings

5.4.1 Introduction

The goal of the study was to research the current, and future, climate change adaptation potential of Burgers Park and how it affects the climate change risk of Burgers Park itself and its immediate context

The mixed method mapping procedure of systematic observational studies of the park, photographs, site maps, and diagrams are used to fully capture the park's natural environment, built infrastructure, and users (Gehl, J., & Svarre, 2013, Kabir, 2016).

According to research conducted by the Council for Scientific and Industrial Research (CSIR) (2016) on cities in South Africa, Tshwane being one of them, the urban heat island effect can cause temperatures to rise by 3 to 10 degrees Celsius in comparison to the city's outskirts. From the desktop observational studies, Burgers Park, is generally the most adequate green space, in the face of rising urbanisation in central Tshwane. It contributes to mitigating the impacts of climate change and the urban heat island effect, which contributes to local climate change in the studied context. The urban heat island effect creates primarily negative effects on temperature, wind, precipitation, and air quality patterns; therefore, Burgers Park's green infrastructure contributes to moderating these changes. Findings will be grouped into the following themes adopted from the objective factors influencing public open spaces by Shuyan Han et al., (2022):

- The built environment refers to the structures, components, spatial technology, and amenities that can be used to satisfy the preferences associated with the climate.
- The human environment includes the neighbourhood inhabitants and park users' impact on the park and general ability to partake in public life.
- The park's green infrastructure, natural areas, open space, or constructed green spaces all have the potential to promote human health as well as the mitigation and adaptation to climate change.

As outlined in the methodology section, qualitative risk mapping was informed by the stipulated South African reports on climate change. The framework to undertake the assessment was adapted from frameworks by Simpson et al. (2021) and Polsky et al. (2007). The subsequent section will outline how the author adapted a framework to establish what risks impact the site and the potential for adaptation thereof.

Figure 28: Summary of climate change risk assessment within Burgers Park

The first diagram shows, in summary, all the findings from a qualitative observational analysis point of view. The specified general hazards (CSIR, 2021) that will or can pose a threat to Burgers Park are:

- Temperature expected to rise- heat waves with longer hot days
- Projected less rain
- Drought
- Floods (extreme rainfall events, hailstorms)

The subsequent section highlights the park's associated risks and vulnerabilities as well as the potential for adaptation within the three encompassing environments:

5.4.2 The Green Infrastructure associated risks and vulnerabilities are the urban heat island effect, the loss of biodiversity, soil erosion, fallen trees and limb drop, and littering. These can be addressed through:

- Maintenance of the existing trees and green infrastructure already mitigating and managing the effects of the Urban Heat Island through absorbing carbon dioxide emissions, reducing heat stress, and controlling wind patterns.
- Maintenance of healthy grass that inherently aids in temperature reduction, soil improvement, carbon dioxide capture, stormwater runoff erosion reduction, and air cleaning.
- Other measures include permeable paving of informal pathways where high traffic occurs.

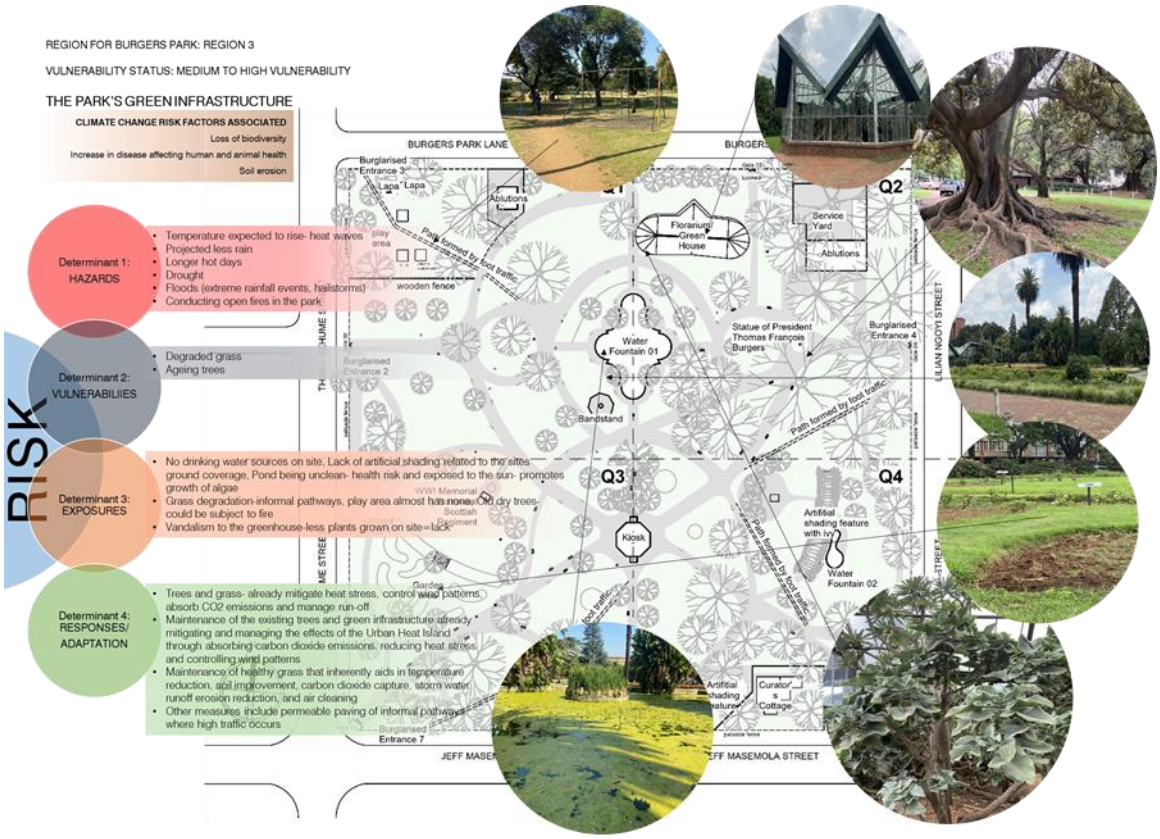


Figure 29: Climate Change Risk Assessment of the Green Infrastructure

5.4.3 The Built Environment- the associated risks and vulnerabilities in Burgers Park are: Loss of biodiversity (the dilapidated pond), damage to infrastructure, water insecurity due to lack of provision of drinking fountains, decline in maintenance of the park's infrastructure, and increase in surface run-off. These can be addressed through:

- Stable management of the park where maintenance and improvement of the park's infrastructure can take place i.e., fix and clean damaged ponds.
- Provide drinking water sources.
- Providing more permeable surface materials.
- Provision of seating made from comfortable materials.

- Due to expected rising temperatures, seating is currently made of steel which is uncomfortable to sit on when temperatures are extremely hot or cold, therefore exploring alternative materials would be advantageous.

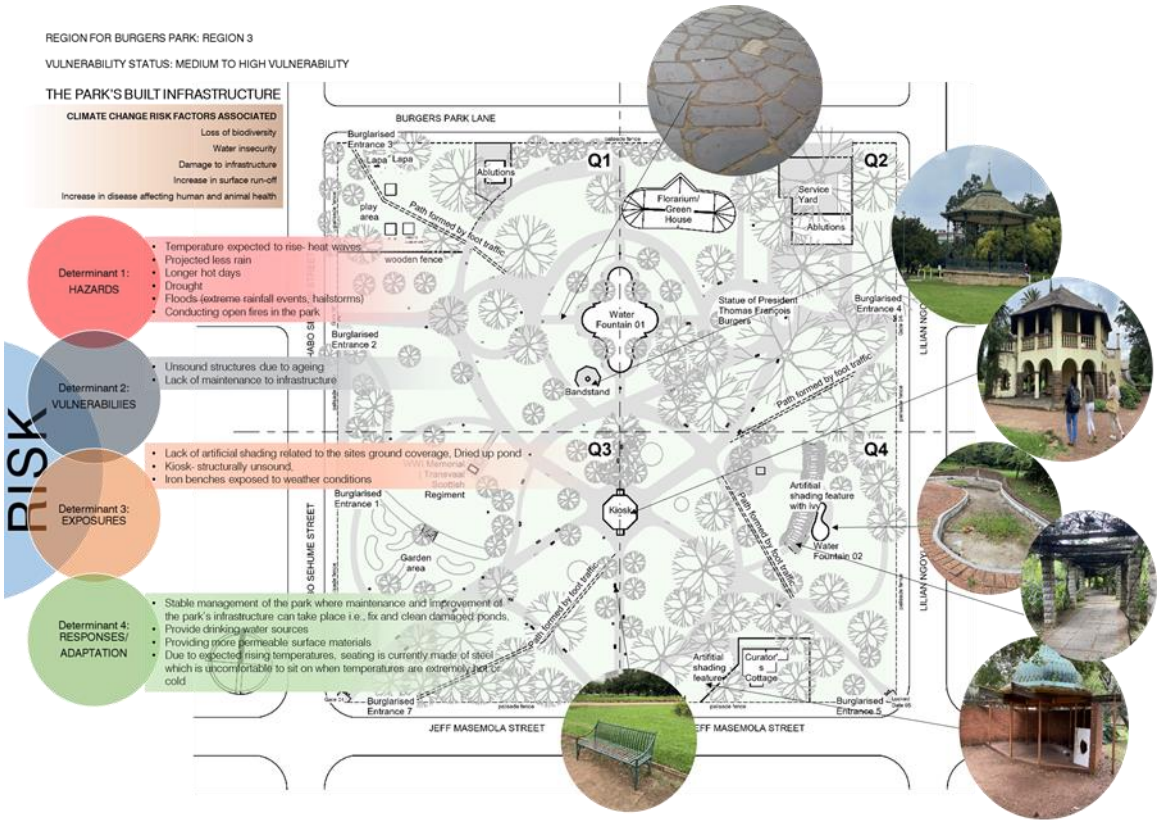


Figure 30: Climate Change Risk Assessment of the Human Environment

5.4.4 The Human Environment associated risks and vulnerabilities are lack of management or ownership, high density of people and increased pressure on the environment and misuse, and homeless people using the park. These can be addressed through:

- Collaboration efforts among managers, investors, users, residents, etc. to maintain and improve the park by spreading awareness about the importance of urban green spaces.
- Climate change drives urbanisation and lots of the people moving to the city are poor and ultimately become homeless. Accommodating them through park infrastructure improvements could limit their vulnerability.

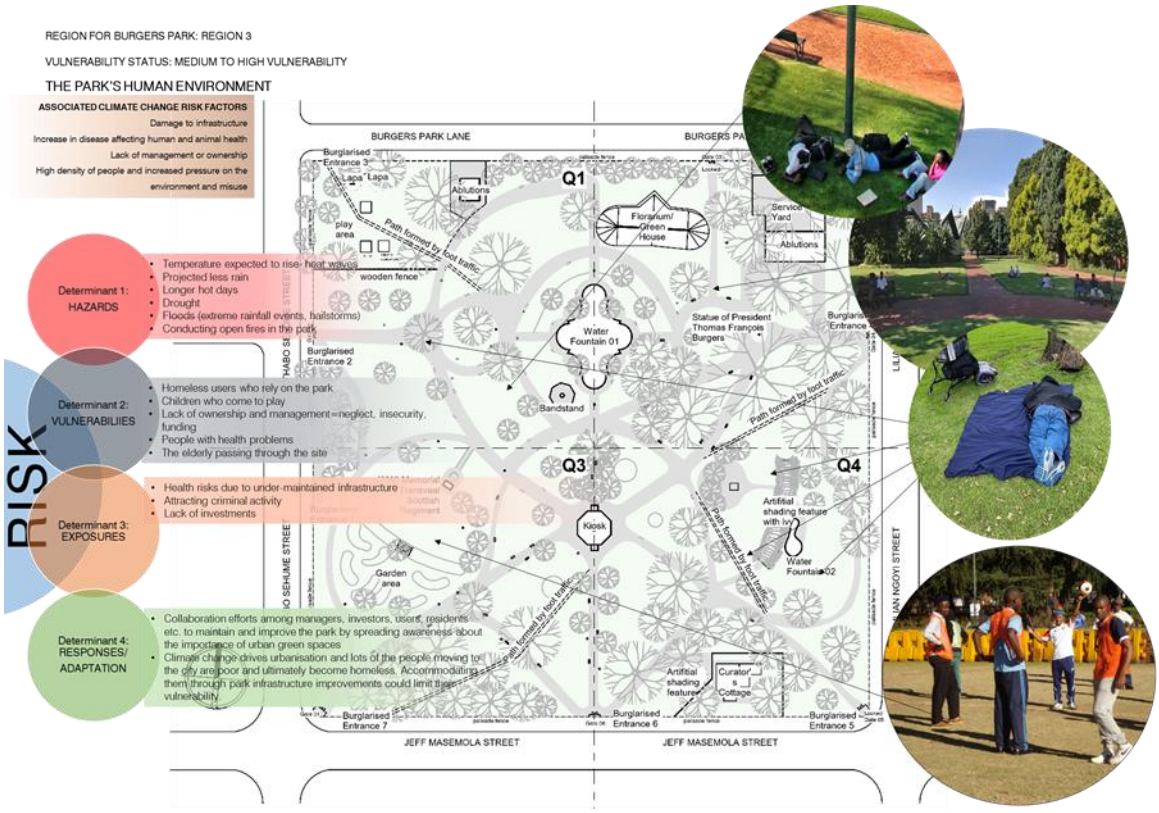


Figure 31: Climate Change Risk Assessment of the Built Infrastructure

In conclusion, the findings section revealed that associations from the different methods of inquiry can be formed to respond to the research question. Pertaining to the use of the park, the data revealed that the park is being used, with diverse activities, however, some are more predominant than others. There is a clear predominance of male users over female users which can elaborate on the safety aspect of the park. Observational analysis shows a general sense of degradation in both natural and built infrastructure which makes them vulnerable to climate change hazards. However, the potential for climate change adaptation is possible as seen from the climate risk framework. The discussion section will go into detail in making the relevant associations in data to ultimately answer the research question.

6 Discussion

6.1 Introduction

This chapter aims to identify connections between data obtained using multiple approaches, and the interconnected approach to the analysis of the findings is applied. Subsequently, the outcomes of the three research goals are summarized in this chapter to determine how Burgers Park's establishment and development will have an impact on the area's current potential to adapt to climate change. It also examines the effects of Burgers Park's physical spatial attributes or the perception thereof, materiality, and potential for climate change adaptation impact on use and to finally find out how Burgers Park can adapt to climate change now and in the future and how that can affect the risk of climate change in the particular public space and its surroundings. A mixed-method research design that required a final synthesis of the study findings from the various research parts was necessary due to the exploratory nature of the research question (Creswell & Clark 2011). This led to the three research objectives' findings influencing one another. The research is summarized in this last chapter.

6.2 The development and establishment of Burgers Park within its context

Green spaces frequently suffer as a result of urban growth. Here, the stresses posed on green infrastructure include rapid development, declining management, and initial poor planning of public space provision. To manage and maintain the city's green infrastructure, many departments and stakeholders must collaborate more effectively.

Cities must strike a balance between meeting citizens' basic needs and protecting green areas for biodiversity, climate change adaptation, and environmental health, especially in light of the desktop mapping that highlighted Burgers Park's contextually and revealed how important it is, in its location. According to interview findings, the city should engage in collaborative procedures to generate an enabling atmosphere and work toward practical principles for the coexistence of people and green spaces.

Urban parks and urban green spaces in general provide residents with a doorway to the outdoors, human history and culture, biodiversity, and the environment. Additionally, they give locals a place to interact with one another and engage in both energetic and passive outdoor leisure activities. These kinds of physical and social activities are crucial for city people's quality of life and well-being (City Parks Forum, 2007). The park was noted as a crucial space in the context and a resource for the city in the urban contextual research.

We may therefore conclude that changes in the park have been influenced by how the urban surroundings have evolved in terms of both physical and socioeconomic elements. The context is expanding while the park is deteriorating; they need to be improved simultaneously. Collaboration would be necessary to make any climate adaptation programs feasible, and the park is now being slowly destroyed due to a lack of ownership and management, which puts it in danger from climate threats.

6.3 The material and spatial characteristics and climate change adaptation potential's effects on the use of Burgers Park

Floor surfaces are impermeable and their construction does not allow water drainage and this means that most of the water drainage is managed by the grassed area. However, this does not necessarily affect the use of the space and the surface is in an acceptable condition while the majority of the park is covered in grass. It can however be adapted to climate change through the exploration of permeable surfaces meaning there is potential.

The green vegetation cover's climate change adaptation role is undeniable as green elements naturally contribute to mitigating climate change. Maintenance of these features is key to sustaining their role even from the user perspective. The parks' green infrastructure is enjoyed by diverse users and its degradation can potentially prevent certain activities from happening, i.e., people have been observed to prefer seating on green grass as opposed to dry grass as observed in quadrant 2. However, quadrant 1 and 2 have witnessed a mix of uses and a predominance of users and offers plenty of open space, which attests to the park's importance within its context

The park offers amenities that promote attraction to the park and possibilities for activity, such as the choice to sit under the bandstand, the pergolas, and public benches. These make using the park favourable, however, if not maintained, structural degradation like the one declared in the kiosk will begin to make these amenities unsuitable for use. Furthermore, if not maintained this can increase their vulnerability to climate change hazards.

Access to the park is marked by the palisade fence which influences the movement patterns within the site and we can triangulate that with the soil erosion patterns because some of the gates remain locked. When the safety concern of park users grew, the implementation of the palisade fence and locking of main gates limited access to the park. When main gates were subsequently locked, it prompted people to break down informal entrances that were not part of the initial establishment of the park and layout.

The closure of the gates has impacted the use of the park. This led to informal pathways created on grassed areas that are now gradually eroding. Grass around those paths will become unsuitable for use with the growth of those paths. Adapting those paths to climate change by making them permeable and formalising them will be an added advantage in protecting the surfaces of the park. From the outside looking in, the vandalised park presents a negative perception of the safety of the park which could potentially affect the desirability to use or invest in the park which is key in implementing adaptation measures.

The safety and comfort of any social environment can be measured by who chooses to use the space. Women and children relaxing in and enjoying a place is often a key indicator of how safe and pleasant the space is. This is why gender and age were considered when analysing user activities within the park. The results from interviews pointed to a general perception of unsafety and observational people counting showed a huge disparity in the number of males and females in the park, in what is deemed a predominately female area, with males being the predominant gender and children as well as the elderly having the lowest count. In effect, the space is not conducive for use for all people and genders and is consequently inaccessible for a large portion of the population. Yet it serves an important role in the urban context.

The perceived lack of comfort and safety directly impacts use and could potentially affect investment into the space affecting climate adaptation measures which require collaboration and investments. This also affects the equity of the city due to the park gradually posing as a liability instead of the asset it should be.

The site revealed a mix of activities, which shows that there are opportunities to perform a multitude of activities within the space instead of a limited programme. However, from the maps shown, these activities constantly occurring in the same area i.e., constant playing of soccer in quadrant 3 and the high traffic of people walking on the same path on grass is slowly leading to the degradation of the grass area and the lack of maintenance or climate adaptation measures on those areas further puts them at risk. Quadrant 3 in comparison to the other quadrant is visually permeable and offers vast open green spaces that are conducive for sitting and sleeping. If these areas continue to degrade, opportunities to carry out specific activities such as sleeping on grass will diminish. These call for surface adaptation measures to accommodate uses such as playing soccer.

Another vital aspect that can be observed is that some of the activities on site are sleeping on grass and some of the people observed are homeless people who also took shelter on the kiosk and other shading structures in the park during a rainy day. The park serves an important

role in accommodating them and the maintenance of both the built and green environment subsequently benefits them in light of their vulnerability.

6.4 The future, and current, climate change adaptation potential of Burgers Park and how it affects the climate change risk of Burgers Park itself and its immediate context

Through an analysis of the park's diversity, including the built environment, human environment, and green infrastructure, a risk assessment for climate change was conducted. The park's current role is climate change mitigation and through this quality, it is adapted to climate change and plays a big role in mitigating threats such as the Urban Heat Island due to its location within an urban setting that is predominantly high-rise residential and mixed-use buildings which contribute to an unstable micro-climate. Other risks are loss of ecosystem goods and services ("*ecosystem goods and services" is used by ecologists to describe gifts humans receive, which are frequently gratis such as clean air and water, fertile soil for plant production, pollination, and flood management, are just a few of the numerous life-sustaining benefits received from nature thanks to ecosystems*) (EPA, 2022). Other threats are biodiversity loss, harm to public infrastructure, water insecurity, soil erosion, and vegetation degradation, a lack of management or ownership, high population density, increased environmental pressure, and littering. Through the above findings, it is apparent that due to the predominance of natural elements of the park, the adaptation potential lies in how well it can be maintained and pre-existing degradation reversed, for it to continue to serve in mitigating the impacts of climate change.

In conclusion, there is a relationship between the climate change adaptation potential of the park and its use. However, it is worth noting that the park has a predominance of natural elements which according to studies already play a significant role in mitigating the effects of climate change (unintentional in its establishment as a public place). The park is used by different people for different reasons and part of them is the abundance of green infrastructure such as grass and trees. This inherent climate adaptation is what makes it possible to perform certain activities but it also inhibits other social activities due to the majority of the space being grass. People generally come to the park to relax and the green infrastructure supports that predominant activity. The park is important and with climate change hazards being an inevitable factor, its role will become increasingly important, however, due to the current state of deterioration, if it continues, its abilities to adapt to climate change might become diminished

7 Conclusion

The final section of the report sets out to sum up a holistic perspective of Burgers Park in answering the research question and provide some reflection on the study's relevance within the public space and climate change adaptation spheres.

The establishment of Burgers Park did not necessarily intentionally design the park with climate change adaptation in mind but rather to serve the public realm as it was established 150 years ago. However, due to the urban development of Tshwane's Pretoria Central and the way cities have become a key contributor to climate change, the park's role now goes beyond its initial intentions. The park is not only a place for the people but now touches on an environmental role and as such it needs to adapt and evolve with these new changes and contributing stressors. As noted in the literature review, urban green parks are a key ingredient against climate change's effects (City Parks Forum, 2007). Due to rising urbanization, urban green parks are generally the predominant green areas. Urban green parks improve local wind patterns, moderate artificially higher temperatures caused by the urban heat island effect, control soil erosion, and lessen some of the main public health issues that are made worse by climate change, like heat stress (City Parks Forum, 2007).

Although urban green parks help to combat the effects of climate change, they are still vulnerable to climate change itself, just like other parts of our landscape and society. Although adaptation measures such as regular maintenance might come at a cost, ensuring healthy green spaces in the long run and the present delivers benefits to people and the environment. It is worth remembering that as vegetation dies, its ability to balance temperatures and fight the urban heat effects diminishes. It is therefore important that land managers consider these issues in management plans to reduce risks and vulnerabilities that can affect climate change adaptation.

The role parks play in the urban public environment was noted, and user patterns in correlation to the park environment were also studied. The conclusion is that while the park is at risk due to contextual developments, the use of the space is affected by factors beyond climate change adaptation potential (lack of green spaces in the cities, movement patterns, and public transport stops to name a few) however, should the quality and management of the park continue to degrade, the park may reach an unstable state that might make climate change adaptation measures challenging to implement. Yet this does not speak of the park's potential, which is currently possible and to a large degree, because of its abundance of green infrastructure. This aspect, among other factors, makes using the park easier because in light of climate change, "comfort" is becoming a more crucial consideration for designers and decision-makers and the green infrastructure of the park provides that aspect. However,

intentional adaptation can help with the asset security of the park for the present and the future (Santos Nouri & Costa 2017, Vukmirovic, Gavrilovic, and Stojanovic, 2019).

In conclusion, the research is relevant in today's society, especially in a climate where the masses are not aware of the importance of urban green parks beyond their social role. This consequently means that people continue to use public spaces unaware of the impact they leave in those spaces. Burgers Park is a testimony to the above statement because who knew that using an informal entrance and subsequently forming informal routes would result in grass degradation which consequently impedes its ability to serve its climate role aiding in temperature reduction, soil improvement, carbon dioxide capture, stormwater runoff erosion reduction, and air cleaning. People simply use public spaces for the enjoyment and convenience they offer. This would have not been deduced if a case study was not conducted and it is therefore important that other public spaces are also studied and understood to a detailed degree to understand their current state and what it is they require to optimally serve within their context.

This study has the potential to contribute to the sustainability of cities because one of the key approaches to creating climate change-adapted cities is to examine the existing urban fabric, identify opportunities, and re-design urban spaces as multifaceted environments capable of adapting to a changing climate while preserving the uninterrupted continuity of city services. The study represents a possible step toward undertaking this kind of inquiry. Furthermore, it has the potential to form a method procedure or blueprint for understanding how urban green parks are used within their context, the role they currently play in combating the effects of climate change, and their adaptation potential. With more data collection time, the quantitative aspect of the study can be further developed to understand the study area's micro-climate.

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Appendix A- Ethics Clearance

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

19 February 2023

Reference number: EBIT/267/2022

Dr JM Hugo
Department: Architecture
University of Pretoria
Pretoria
0083

Dear Dr JM Hugo,

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your recent application to the EBIT Research Ethics Committee refers.

Conditional approval is granted.

This means that the research project entitled "The climate change adaptation role of regenerative public spaces" is approved under the strict conditions indicated below. If these conditions are not met, approval is withdrawn automatically.

Conditions for approval:

Photographs taken at the public space should exclude people otherwise consents (to be included in the photos) need to be obtained. No minors are to be photographed.

All field workers (students) need to sign the researcher's declaration forms and the principal investigator needs to keep these forms for the next 5 years.

This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Code of Ethics for Scholarly Activities of the University of Pretoria, or the Policy and Procedures for Responsible Research of the University of Pretoria. These documents are available on the website of the EBIT Ethics Committee.

If action is taken beyond the approved application, approval is withdrawn automatically.

According to the regulations, any relevant problem arising from the study or research methodology as well as any amendments or changes, must be brought to the attention of the EBIT Research Ethics Office.

The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.

Prof K.-Y. Chan
Chair: Faculty Committee for Research Ethics and Integrity
FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

Appendix B- Interview Questionnaire

Location: _____

Date: _____

Time: _____

Level of education and employment status_____

Gender: _____

Age: _____

A. What brings you to this park today?
    A. Just passing through, anywhere in particular?
    B. Shopping/Market
    C. Spending time with my family
    D. Meeting up with friends
    E. Spending time by myself
    F. Sightseeing
    G. Recreation/Sports/Exercise
    H. Walking my pet
    I. Cultural event/Performance
    J. Political event/Protest

B. How often do you visit or use the park?
    A. Daily
    B. Weekly
    C. Monthly
    D. Rarely (once per year or less)
    E. First time here

C. How did you get here today? (Select option travelled for longest distance)
    A. Walk
    B. Bike
    C. Bus
    D. Train
    E. Private car
    F. Taxi/Rideshare
    G. Private bus/Shuttle
    H. Other. Please describe
    I. _____

D. What best describes your relationship to this area? (Check all that apply)
    A. Neighbour/Resident
    B. Employee (of nearby institution/business)
    C. Student (of nearby school)
    D. Tourist
    E. Attendee (cultural event or institution)
    F. Other. Please describe

G. _____

E. How much time do you plan on spending here today?
   A. Less than 10 min.
   B. 10 min.
   C. 20 min.
   D. 30 min.
   E. 1 hour or more
F. How do you feel about this neighbourhood?
G. How would you rate your feeling of personal safety in this space right now out of 10?
H. What would make you feel safer in this place?
I. How do you feel about this particular park?
J. What three words would you use to describe this park?
K. What two things would you like to do in the public spaces of this area that you can't do now?
L. Why do you come to this park?
M. What do you like to do here? If it's a group activity, will you be joined by others? Will they be doing the same activity?
N. What works well in this park and makes it possible to use this park?
O. What doesn't work well in this park and makes it difficult to use or visit?
P. Are there times you prefer not to visit the park? Why?
Q. Are there any built elements in the park that negatively impact the park?
R. What changes have you noticed in the park over time from the time you started coming here?
S. What activities or events take place in the park that we don't usually see? Are they negatively or positively contributing to the quality of the park?

Appendix C- List of Interviewees

INTERVIEW 01

Location: Burgers Park- Quadrant 3
Date:29/03/2023
Time: 13:39 PM
Level of education/ employment status: Student at nearby college
Gender: Female
Age: 21

INTERVIEW 02

Location: Burgers Park- Quadrant 3
Date:29/03/2023
Time: 13:52 PM
Level of education/ employment status: Student at nearby college
Gender: Male
Age: 22

INTERVIEW 03

Location: Burgers Park- Quadrant 1
Date:29/03/2023
Time: 14:14 PM
Level of education/ employment status: Employed
Gender: Male
Age: 38

INTERVIEW 04

Location: Burgers Park- Quadrant 4
Date:29/03/2023
Time: 14:27 PM
Level of education/ employment status: Employed
Gender: Male
Age: 49

INTERVIEW 05

Location: Burgers Park- Quadrant 4
Date:29/03/2023
Time: 14:39 PM
Level of education/ employment status: Employed
Gender: Female
Age: 40

Appendix D- Tabled Data from people counting observational studies

NB: The tables below communicate the summarised findings as documented in the graphs (which show a qualitative perspective of the findings) and can be read in conjunction with the graphs

An observational age and gender count of people performing activities in Burgers Park within a span of minimum 40 minutes on selected days and varying times

Date and Time	Gender	Toddlers 0-4 years	Kids 5-14 years	Young Adults 15-24 years	Adults 25-64 years2	Seniors 65 and over
FRI: 17/03/2023 TIME: 07:15-08:30	Male	0	0	0	58	0
	Female	0	0	0	5	0
SAT: 18/03/2023 TIME: 07:45-08:45	Male	0	1	5	44	0
	Female	1	2	14	2	0
SAT: 18/03/2023 TIME: 07:45-08:45	Male	0	2	7	108	0
	Female	0	0	3	20	0
WED: 22/03/2023 TIME: 12:15-13:00	Male	1	26	12	50	0
	Female	0	4	13	26	0
SAT: 25/03/2023 TIME: 13:08-13:47	Male	1	19	0	16	3
	Female	0	5	1	4	1
WED: 29/03/2023 TIME: 16:17-16:47	Male	0	46	26	46	0
	Female	1	3	5	8	0

An observational count of main activity types in Burgers Park within a span of minimum 40 minutes on selected days and varying times

	MAIN ACTIVITY TYPES			
Date and Time	Standing/ Moving Activity	Siting on bench/built infrastructure	Sitting on private chair	Sitting/Lying on grass/tree roots
FRI: 17/03/2023 TIME: 07:15-08:30	9	26	2	26
SAT: 18/03/2023 TIME: 07:45-08:45	27	27	0	14
SAT: 18/03/2023 TIME: 07:45-08:45	13	35	3	67
WED: 22/03/2023 TIME: 12:15-13:00	45	43	3	43
SAT: 25/03/2023 TIME: 13:08-13:47	33	15	0	0
WED: 29/03/2023 TIME: 16:17-16:47	54	55	2	25

An observational count of specific activity types in Burgers Park within a span of minimum 40 minutes on selected days and varying times

	ACTIVITY TYPES											
Date and time	Standing waiting/nothing	Standing commercial (trade,maintenance)	Standing recreational (exercise,conversing,writing)	Sitting on bench/built infrastructure waiting/nothing	Sitting on bench/built infrastructure eating/drinking	Sitting on bench/built infrastructure recreational (exercise,conversing,writing)	Sitting on private chairs recreational (exercise,conversing,writing)	Sitting on grass or tree waiting/nothing	Sitting on grass or tree eating/drinking	Sitting on grass or tree recreational (exercise,conversing,writing)	Lying down waiting/nothing/sleeping	Lying down recreational (exercise,conversing,writing)
FRI: 17/03/2023 TIME: 07:15-08:30	0	7	2	13	2	11	2	0	1	6	14	5
SAT: 18/03/2023 TIME: 07:45-08:45	2	0	25	13	0	14	0	2	2	1	9	0
WED: 22/03/2023 TIME: 12:15-13:00	1	1	11	7	0	28	3	12	4	37	12	2
FRI: 24/03/2023 TIME: 13:05-13:31	5	4	36	16	6	21	3	1	3	16	23	0
SAT: 25/03/2023 TIME: 13:08-13:47	6	0	27	3	1	11	0	0	0	0	0	0
WED: 29/03/2023 TIME: 16:17-16:47	0	2	52	12	2	41	2	2	4	12	6	1

An observational age and gender count of people walking through Burgers Park within a span of minimum 40 minutes on selected days and varying times

		AGES				
Date and time	Gender	Toddlers 0-4 years	Kids 5-14 years	Young Adults 15-24 years	Adults 25-64 years2	Seniors 65 and over
FRI: 17/03/2023 TIME: 07:15-08:30	Male	1	9	18	42	1
	Female	1	11	12	25	0
SAT: 18/03/2023 TIME: 07:45-08:45	Male	0	0	15	24	0
	Female	2	0	5	6	0
WED: 22/03/2023 TIME: 12:15-13:00	Male	1	5	10	60	0
	Female	0	9	9	42	0
FRI: 24/03/2023 TIME: 13:05-13:31	Male	1	10	35	64	4
	Female	0	2	12	28	0
SAT: 25/03/2023 TIME: 13:08-13:47	Male	0	1	14	13	2
	Female	0	0	2	8	1
29/03/2023	Male	0	2	13	79	1
	Female	0	4	19	28	0

Appendix E- Template sample of people counting and activities observations per quadrant system

FREQUENT: USERS ON SITE

Location: _____

Date: _____

Time: _____

Temperature and weather condition: _____

Noise Level: _____

Air Quality: _____

Cleanliness/ Maintenance Status: _____

Q1

MAP BELOW USING INDICATED CODES FROM TABLE: Quadrant 1

AGE			
0-4-Todlers Code (T)	Total:		
	MALE	FEMALE	OTHER
5-14- Kids	Total:	Total:	Total:
	Code (KM)	Code (KM)	Code (KO)
15-24-Young Adults	Total:	Total:	Total:
	Code (YM)	Code (YF)	Code (YO)
25-64- Adults	Total:	Total:	Total:
	Code (AM)	Code (AF)	Code (AO)
65 and over- Seniors	Total:	Total:	Total:
	Code (KM)	Code (KM)	Code (KM)

POSTURE	CODE AND TOTAL	ACTIVITIES				
		NO MOVING/ WALKING/ TRANSPORT	EATING/DRINKING/ FOOD/REFRESHMENT	RECREATIONAL ACTIVITY	CULTURAL ACTIVITY	EXERCISING/ RECREATION/ PLAY/SPORTS
STANDING/MOVING	●					
SITTING ON PUBLIC FURNITURE/BUILT STRUCTURES	□					
SITTING PRIVATE	△					
SITTING COMMERCIAL	○					
SITTING ON NATURAL STRUCTURES: GRASS, TREES	⊠					
LYING DOWN	▬					
MULTIPLE MOVEMENT	X					

Appendix F- Summary of Climate Risk Assessment Framework Approach