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Green infrastructure planning principles for improved decision-making at the site development design stage at the City of Tshwane

Supervisor:

Doctor Christina A. Breed, University of Pretoria

Examiners:

Doctor Solène Guenat, Swiss Federal Institute for Forest, Snow & Landscape Research, WSL.

Doctor Lise Herslund, University of Copenhagen

by Tania du Plessis

85463559

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Student:	Tania du Plessis
Supervisor:	Dr CA Breed
Department:	Department of Architecture
Faculty:	Faculty of Engineering, Built Environment and Information Technology
Institute:	University of Pretoria
Degree:	Master of Landscape Architecture (by research)

Declaration

I declare that the thesis, Green infrastructure planning principles for improved decision-making at the site development design stage at the City of Tshwane, which has been submitted in partial fulfilment of the requirements for the degree of Master of Landscape Architecture (by research), 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 thesis.

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

Tania du Plessis
August 2023

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Thank you for your mercy and grace, Heavenly Father!
You are my Shepherd. Your word is a lamp to my feet and a light to my path.
Psalm 23 and Psalm 119: 105.

Abstract

Globally, researchers advocate the potential of green infrastructure applications to contribute to inclusive, safe and sustainable cities as captured by the United Nations Sustainable Development Goal number 11. Socio-economic urgencies and political agendas often overshadow green infrastructure opportunities in Sub-Saharan Africa. The development and incorporation of implementable, context-based green infrastructure planning principles in spatial planning policies and frameworks are scant in many Sub-Saharan African cities, and so is research on green infrastructure. This study considers the challenges and opportunities that city officials face with green infrastructure planning when enforcing minimum public open space requirements in the City of Tshwane, South Africa.

A literature review that focused mainly on green infrastructure guidelines in Sub-Saharan Africa was conducted. The researcher considered the alignment of the green infrastructure guidelines identified in the literature with a policy document review of spatial and environmental development principles in South African national, provincial and local spatial policy documents. In parallel with the literature and policy review process, 16 semi-structured interviews were conducted with 18 interviewees involved in green infrastructure planning at the City of Tshwane. The researcher followed a co-development process that commenced with the interviews and continued through a participatory workshop with 23 participants, including a pre-workshop online survey and five post-workshop feedback and clarification discussions. Participants included city officials, property developers, and built-environment practitioners, all with many years of experience in the city's land development application process.

The findings illustrate that city officials face many complex challenges with the application of green infrastructure, such as poor intergovernmental collaboration; conflicting policies, regulations and frameworks; scarce resources; urbanisation resulting in land invasions due to a housing shortage; and a lack of appreciation of the value and benefits that green infrastructure can provide. The findings further illustrate that local spatial policies have many national, provincial and city planning principles but are not carried through to the site development planning stage. Many opportunities were identified for improved green infrastructure planning, such as streamlining the land development application process,

incentivising developers, enabling cross-sectoral partnerships to open up new resource pools to fund green infrastructure applications, and promoting the long-term benefits of green infrastructure. Based on the findings, 20 planning principles are proposed for the city's site development planning phase that overlap with 18 principles in the literature but emphasise aspects of access, safety, quality and cross-sectoral partnerships to co-develop and co-manage green space. These are unique requirements in a Sub-Saharan African context that can assist with the increased sustainability, protection and local benefits that green infrastructure offers and represents in the city. The study demonstrates the value of local cross-sectoral input in green infrastructure planning by following co-design, co-development, co-management, and co-ownership approaches that enable residents to benefit from civic resources and contribute to environmental justice whilst ascertaining the contextual application of research outcomes.

Keywords: City of Tshwane, landscape design, guidelines, co-development, South Africa, green space

List of Acronyms

CoT	City of Tshwane
CSIR	Council for Scientific and Industrial Research
D'MOSS	Durban Metropolitan Open Space System
GDARD	Gauteng Department of Agriculture and Rural Development
GI/ UGI	Green Infrastructure/Urban Green Infrastructure
GRIP	Integrative Green Infrastructure Planning research project
IDP	Integrated Development Plan
LDP	Landscape Development Plan
LOSP	Local Open Space Plan
MFMA	Municipal Finance Management Act (53 of 2003)
MSDF	Metropolitan Spatial Development Framework
NEMA	National Environmental Management Act (107 of 1998)
NEMBA	National Biodiversity Act (10 of 2004)
NFA	National Forests Act (84 of 1998)
NHRA	National Heritage Resources Act (25 of 1994)
NWA	National Water Act (36 of 1998)
POS	Public Open Space
RSDF	Regionalised Spatial Development Framework
SANBI	South African National Biodiversity Institute
SDP	Site Development Plan
SPLUMA	Spatial Planning and Land Use Management Act (16 of 2013)
SSA	Sub-Saharan Africa
TOSF	City of Tshwane Open Space Framework (2005)

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Chapter 1 Introducing the Study

1.1 Background and Problem Statement

Africa is undergoing a significant demographic and economic growth phase (Cilliers et al., 2021; United Nations, 2019; Gulati and Scholtz, 2020). The United Nations World Population Prospects 2019 (United Nations, 2019) predicts that by the end of this century, Africa's global population will increase from its current share of 16.7% (1,3 billion) to about 39.5% (4,3 billion) of approximately 11 billion people on the planet. Conversely, Global North cities have seen a steady decline in growth, with cities in Europe growing the least (UN-Habitat, 2016). The UN-Habitat (2016) study reports that the African urban growth rate is 11 times faster than Europe's. Rapid urbanisation can also result in a significant loss of vegetation cover due to changes in land cover to make place for built-up areas (Guenat et al., 2019; Yao et al., 2019). Benefits derived from vegetation cover for humans and the environment, such as absorbing atmospheric CO_2 and alleviating the urban heat island effect, are diminished (Yao et al., 2019). Simultaneously, climate change adds to the continent's risks and challenges (Du Toit et al., 2018; Cilliers et al., 2021; Pasquini and Enqvist, 2019) by causing life-threatening weather conditions such as severe flooding, extended droughts, and extreme fluctuations in temperature. The region is reportedly warming up 1.5 times faster than the global average (Gulati and Scholtz, 2020).

The above trends place additional stress on the already over-capacitated, often poorly-maintained urban infrastructure services (Du Toit et al., 2018). Gulati and Scholtz (2020) emphasise that to make cities more resilient and sustainable, authorities should integrate urban ecosystems' support and regeneration in urban infrastructure development.

Several studies focus on the benefits that green spaces could provide for cities and the environmental risks they may be able to mitigate (Benedict and McMahon, 2002; Güneralp et al., 2018; Titz and Chiotha, 2019; Dipeolu et al., 2021; Pauleit et al., 2017). This has brought about concepts such as ‘green infrastructure’ (GI) and ‘nature-based solutions’ (NbS) to capture these “green systems”. The integration of green (and blue) infrastructure with conventional grey infrastructure applications has the potential to reduce environmental risks such as flooding, heat waves and droughts and increase human health and well-being benefits by providing sport and recreation facilities, reducing the urban heat island effect, sequestrating carbon and increasing urban biodiversity (Cilliers 2019; Gulati and Scholtz, 2020; Monteiro et al., 2020).

Benedict and McMahon (2002) refer to GI as a “natural life support system” and “an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations.” The European Union (2013) describes GI as “a strategically planned network of natural and semi-natural areas designed and managed to deliver a

wide range of ecosystem services." Monteiro et al. (2020) add that "besides ecological functions, GI can also contribute to social, cultural, and economic benefits, which support the establishment of sustainable, resilient, inclusive and competitive urban areas." These ecosystem services align with the UN Sustainable Development Goal 11 to "make cities inclusive, safe, resilient and sustainable" (United Nations, 2015).

Many proponents argue that greater advocacy of GI must be supported by scientific data, information, and insights across a range of benefits, scales and settings (Cilliers et al., 2021; Shackleton and Shackleton, 2016; Cilliers, 2019). However, there is still little consensus among researchers and practitioners regarding the concept of GI or its implementation approaches (Cilliers, 2019; Monteiro et al., 2020; Sussams et al., 2015; Washbourne, 2022). This lack of agreement makes it difficult for urban planners and other professionals to design, plan and implement robust GI, particularly in the Global South and Sub-Saharan Africa (SSA) (Cilliers et al., 2021; Cilliers, 2019). Pauleit et al. (2021) argue that the first step is to develop a shared meaning and vision for urban GI and advocate that this would enable the sharing and dissemination of knowledge by key stakeholders. Furthermore, policymakers need to change the typical fragmented silo management style, which leads to unsynchronised planning approaches (Cilliers and Rohr 2019).

The importance of "local identity and adapting models and metaphors to local circumstances have become recognised in Global South research, design and planning" (Cilliers et al., 2021:393). Therefore, the direct transfer of knowledge, instruments and tools developed in the Global North to cities in SSA is not workable (Pauleit et al., 2017) as the contextual challenges and considerations differ dramatically (Cilliers, 2019). Some examples of SSA contextual challenges are the lack of accountability at all levels of government, poor urban policies, lack of resources and wise allocation of revenue, and, specifically, poor investment in public infrastructure (Du Toit et al., 2018). Local role players must develop context-specific alternatives (Cilliers et al., 2021; Du Toit et al., 2018; Cilliers, 2019), some examples of which exist in the cities of Cape Town, eThekwini (Durban) and Johannesburg, South Africa.

The development and incorporation of implementable, context-applicable GI planning guiding principles at the site development design stage are lacking in SSA. Although there has been some research on GI in South Africa, there has been little emphasis thereon in the City of Tshwane. Such guiding principles may assist city officials, practitioners and developers in forming sustainable, resilient, inclusive and competitive urban areas (Cilliers, 2019; Gulati and Scholtz, 2020; Monteiro et al., 2020).

1.2 Research Focus

While the benefits of GI in cities have been well documented in the Global North, there is a lack of studies on GI in SSA (Pauleit et al., 2017; Du Toit et al., 2018; Cilliers et al., 2021). The lack of research leads to a shortage of practical tools and guidelines (Cilliers et al., 2021; Gulati and Scholtz, 2020) for decision-making and implementing GI at a local site development scale.

This study forms part of the Integrative Green Infrastructure Planning (GRIP) research project funded by the Ministry of Foreign Affairs of Denmark (DANIDA Fellowship). It is a joint research project between the University of Aarhus, Denmark and the University of Pretoria, South Africa.

> "Through a city-to-city collaboration, the long-term objective of GRIP is to facilitate a strategic transformation of the inherited social and urban landscape in CoT [City of Tshwane] through improved GI management, multifunctionality, and planning. We test the hypothesis that improved GI can increase quality of life in the city's urban communities by moving towards a more liveable, health promoting, equitable, biodiverse, and climate resilient city" (Aarhus University, 2023).

This study focuses on the lack of clear planning principles guiding the inclusion of GI in urban development projects proposed for the City of Tshwane. This has been confirmed in various scoping interviews that formed part of the initiation of this study. The absence of guiding principles is challenging for officials who evaluate and approve urban development projects. The absence further results in poor guidance to developers and built environment practitioners when planning and designing urban development projects.

The public and private sectors develop urban property in the City of Tshwane. These public and private developments occur at the individual site scale, where decisions affect the quality of the urban environment. This study focuses on private development applications at the individual site scale. However, cognisance of the functioning of ecological systems at all scales must be kept in mind by those involved in urban development (McFarland et al., 2019; Frischenbruder and Pellegrino, 2006; Aggestam, 2017).

Decision-making at the site development approval stage is challenging as planning policies are often developed autonomously by different departments within the city, such as Housing and Economic Development and Spatial Planning. Therefore, policies are not always aligned with the mandate and priorities of the Environment and Agriculture Management Department to ensure a cohesive outcome between the different departments and sectors in the city. Isolated decision-making occurs

where spatial planning at a city-wide level is not coordinated with infrastructure planning conducted at a line function level (Cilliers and Rohr, 2019). Although some policy directives exist to implement GI in the City of Tshwane at a high level (Metropolitan Spatial Development Framework stage) and on the ground (Site Development Plan stage), many development decisions and approvals occur on an ad hoc basis (Director of Environmental Planning and Open Space Management, City of Tshwane, pers.comm., 18 December 2021). See section 1.6 for a full explanation of the site development process and plans.

1.3 Research Questions

The primary research question that guides this study is:

> *What guidelines can improve decision-making for the application of GI in the City of Tshwane at the site development planning (SDP) stage?*

The study poses five research sub-questions to address the study's primary research question.

Research sub-question 1

What are the institutional challenges, and what opportunities exist regarding the incorporation of GI as part of the SDP process in the City of Tshwane?

Research sub-question 2

What is a contextually appropriate definition for urban GI for SSA and South African cities, particularly the City of Tshwane?

Research sub-question 3

What contextually appropriate GI planning principles will enhance decision-making at the SDP stage in the City of Tshwane's land development application approval process?

Research sub-question 4

Where are the gaps in the city's policy documents that weaken the inclusion and evaluation of GI at the SDP stage? Where are possible entry points for including GI guiding principles in the policy documents? Which entity in the city should take ownership of GI application across the City of Tshwane?

Research sub-question 5

Based on the findings from sub-questions 1 to 4, what recommendations can be made for improved decision-making regarding the application of GI in the City of Tshwane at the SDP stage?

1.4 Research Aims and Objectives

The study aims to explore the institutional challenges and opportunities of incorporating GI during the SDP process for the City of Tshwane and co-develop planning principles to guide GI application at the SDP stage. Figure 1-1 below illustrates the research objectives for each sub-question.

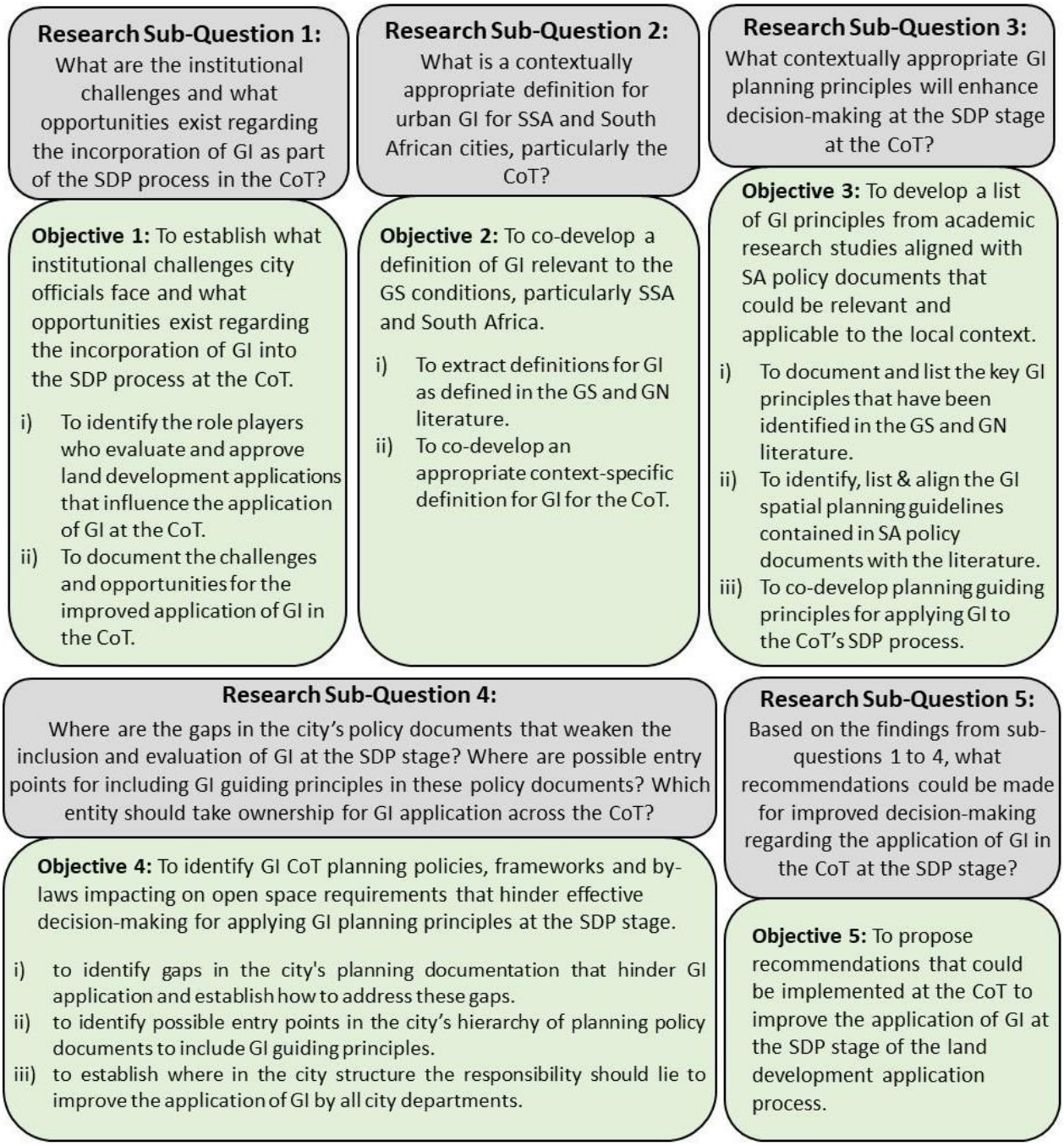


Figure 1-1. Research objectives related to the research sub-questions

Based on the research questions, the research objectives of the study are:

Objective 1: To establish what institutional challenges city officials face and what opportunities exist regarding the incorporation of GI into the SDP process in the City of Tshwane.

i) To identify the role players who evaluate and approve land development applications that influence the application of GI at the City of Tshwane and,
ii) To document the challenges and opportunities for the improved application of GI in the City of Tshwane.

Objective 2: To co-develop a definition of GI relevant to the Global South conditions, particularly SSA and South Africa.

i) To extract definitions for GI as defined in the Global South and Global North literature; and,
ii) To co-develop an appropriate context-specific definition for GI for the City of Tshwane.

Objective 3: To define a list of GI principles from previous academic research studies aligned with guidelines in South African policy documents that could be relevant and applicable to the local context.

i) To document and list the key GI principles that have been identified in the Global South and Global North literature;
ii) To identify, list and align the GI planning guidelines contained in South African policy documents with the literature; and,
iii) To co-develop planning guiding principles for applying GI to the City of Tshwane's SDP process.

Objective 4: To identify GI planning gaps in existing City of Tshwane planning policies, frameworks and by-laws impacting open space requirements that hinder effective decision-making for applying GI planning principles at the SDP process.

i) To identify gaps in the city's planning documentation that hinder GI application and establish how to address these gaps.
ii) To identify possible entry points in the city’s hierarchy of planning policy documents to include GI guiding principles.
iii) To establish where in the city structure the responsibility should lie to improve the application of GI by all city departments.

Objective 5: To propose recommendations that could be implemented in the City of Tshwane to improve the application of GI at the SDP stage of the land development application process.

1.5 Delineations, assumptions and limitations

1.5.1 Delineations

This dissertation has several delineations, as listed below.

i. The study will focus on the City of Tshwane as a case study.

ii. The focus will be on the SDP stage of the land development application process (see Section 1.6) at the City of Tshwane because this is where daily decisions occur regarding GI's inclusion and application in new development projects.

iii. This study will focus only on private-sector land development applications as the public-sector process has different challenges.[1]

iv. The study focuses mainly on city officials (public sector) and private practice built-environment practitioners, and property developers (private sector) engaged in urban spatial planning and development in the City of Tshwane.

v. Although the study acknowledges the importance and value of citizen input, the public participation field falls outside the core focus of this research. However, as mentioned before, this study forms part of the Integrative Green Infrastructure Planning (GRIP) research project. GRIP Work Package 3 (WP3) deals explicitly with social justice, engaging with the community and gaining their perceptions regarding GI. (Refer to Aarhus University, 2023, for more information on the GRIP Work Packages).

1.5.2 Assumptions

The dissertation makes the following assumptions:

i. The researcher assumes that the current draft spatial planning documents referred to in the study will be adopted and ratified by the Council of the City of Tshwane, namely:
   a. The draft Revised City of Tshwane Open Space Framework, 2015, Volumes 1-3 (City of Tshwane, unpublished a);
   b. The draft Review of the Open Space Framework 2020, Volumes1-5 (City of Tshwane, unpublished b);
   c. The draft Green Building Development and Net-zero Carbon Building By-law for the City of Tshwane, 2021 (City of Tshwane, unpublished c); and,
   d. The draft City of Tshwane Environment and Agriculture Management Department's Development Applications Requirements, 2022 (City of Tshwane, unpublished d).

[1] **Public land**: "Land owned by the national government, municipalities, provincial government, public entities, and public schools are classified as state, including land in the name of traditional trusts" (Republic of South Africa, 2017).
Private land: "Ownership by companies, trusts, individuals, and community-based organisations was classified as private" (Republic of South Africa, 2017).

ii. The study participants answered questions accurately and truthfully.

1.5.3 Limitations

The following limitations apply to this dissertation:

i. The study outcomes cannot be generalised and only apply to the City of Tshwane. However, the results could shed light on other municipalities nationwide and in SSA in terms of the method and focus of the study.

ii. The study cannot guarantee the uptake of any recommendations.

iii. Most public sector interviewees were at the senior management level, which might have resulted in some skewed opinions offered. Lower-management staff who work on the ground in the City of Tshwane may have different experiences and insights regarding the application of GI in the city.

iv. Although six city property developers were invited to participate in the study, only two accepted the invitation. A larger sample of developers may have brought other insights to the study.

v. Six Economic Development and Spatial Planning officials were invited to participate in the study. Only two accepted the invitation. A larger sample of city planners representing more city Regions may have brought other insights to the study.

vi. A final opportunity was presented to the study participants to comment on the proposed GI definition and 20 GI planning guiding principles after all the recommendations were considered, but none responded.

1.6 Research outcomes

The intended outcomes of the research are:

Outcome 1: A thick description of the institutional challenges experienced with applying GI in the City of Tshwane.

Outcome 2: A thick description of the institutional opportunities for applying GI in the City of Tshwane.

Outcome 3: An overview of institutional relationships between role players working with urban development in the City of Tshwane that impact GI.

Outcome 4: A proposed context-specific definition for GI for the City of Tshwane, located in South Africa, Sub-Saharan Africa.

Outcome 5: A co-developed descriptive list of context-based GI planning guiding principles for the City of Tshwane, which would:

i. Assist the City of Tshwane's municipal officials when evaluating GI applications at the SDP stage; and,
ii. Aid developers and private practice practitioners with the incorporation of GI in urban SDPs and projects.

Outcome 6: Identified gaps in the City of Tshwane's hierarchy of policy documents where GI guidelines are missing.

Outcome 7: Proposed entry points for including GI planning guiding principles into the City of Tshwane's hierarchy of planning policy documents.

Outcome 8: Identified responsible entity to promote and advocate for the application of GI across the City of Tshwane.

Outcome 9: Recommendations to improve the application of GI in the City of Tshwane at the site development stage.

Figure 1-2 illustrates the alignment of the study’s research questions, objectives and expected outcomes.

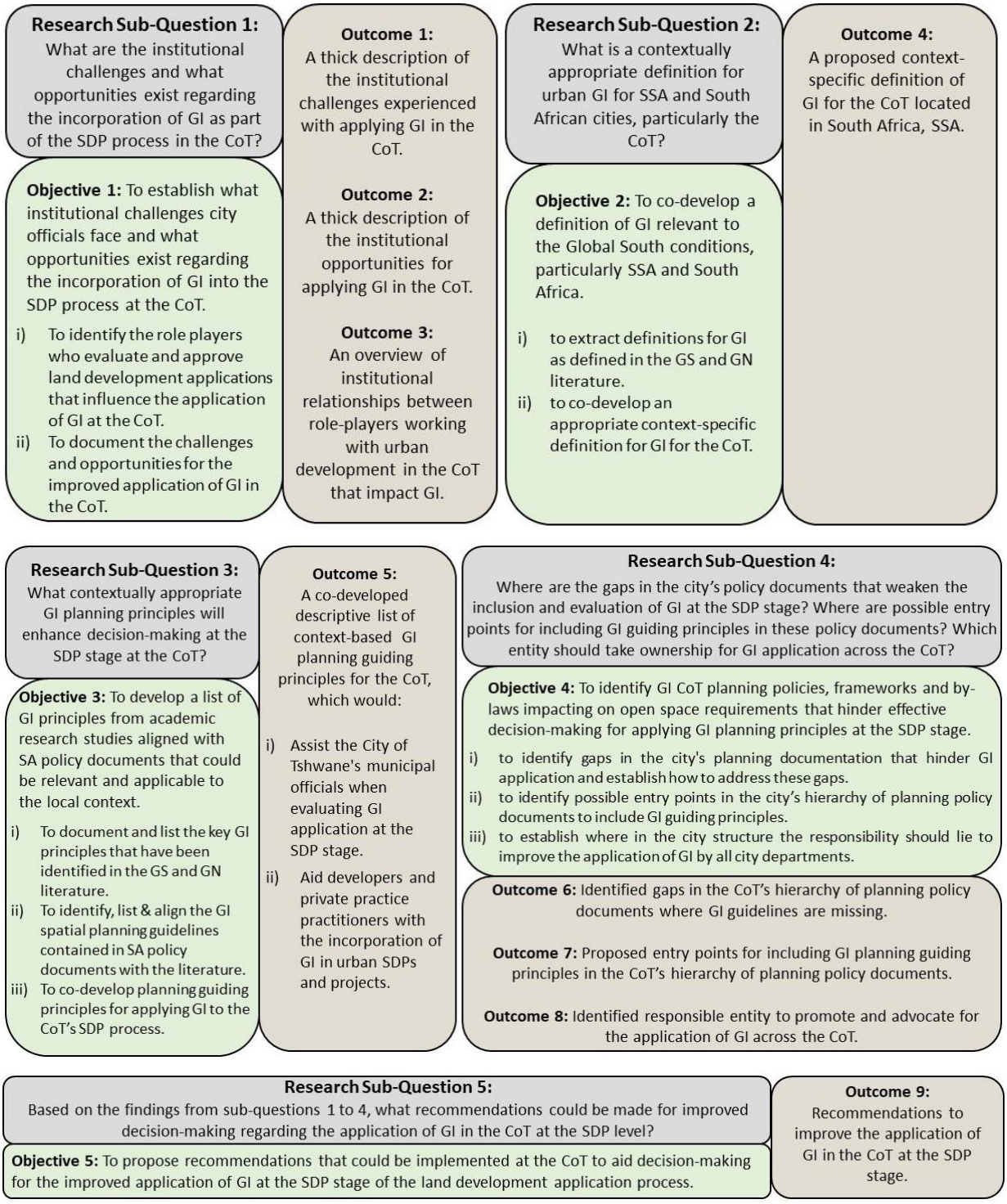


Figure 1-2. Alignment of the study's research questions, objectives and outcomes

1.7 Definitions of Key Terms and Concepts

Ecosystem services are goods and services society receives from ecological assets and ecosystems (Schäffler and Swilling, 2013). They can be arranged into four overarching categories, namely: *regulating services* (climate change adaption and mitigation such as temperature regulation,

risk reduction such as flooding and drainage mitigation, etc.), *provisioning services* (food provision employing urban agriculture and collecting of wild foods, building materials, firewood, medicinal plants etc.), *cultural services* (recreation, tourism etc.) and *supporting services* (habitat, shelter, biodiversity maintenance and protection etc.) (International Union Conservation of Nature, 2020).

Green Infrastructure (GI) is "the interconnected set of natural and constructed ecological systems, green spaces and other landscape features that together form a network providing services and strategic functions in the same way as traditional 'hard' infrastructure." (Gauteng City Region Observatory, 2019).

Grey infrastructure comprises manufactured or engineering systems such as roads, pipelines, railways, and utility servitudes that use traditional techniques and building materials such as concrete, bricks and impervious surfaces (Gauteng City Region Observatory, 2019).

The **Land Development Application Process** is the town planning process for approving property developments. In South Africa, the provincial and local municipal administrations review and approve land use management in their areas (iLead, 2016).

A **Site Development Plan[2] (SDP)** is a scaled and dimensioned plan that the Municipality may require the owner of a property to submit in addition to building plans "which shows the siting, elevations and exterior finish of the proposed buildings, parking areas and open spaces of the proposed development of a property and any salient natural features thereof", (City of Tshwane. 2014:25). No owner of any property shall commence the erection or structure before the … site development and building plans have been approved by the Municipality", (City of Tshwane, 2014:74-76).

GI planning principles are "underlying grounds that help guide and facilitate the planning procedures of GI, in order to ensure that it contributes to a network of quality and functional green spaces, capable of meeting the needs of a determined urban area, contributing in the best way to the sustainability of a given region or local area, depending on its scale" (Monteiro et al., 2020).

[2] "**Site development plans** are a crucial aspect of construction and development in South Africa… and are subject to review and approval by local municipalities. This process ensures that the proposed development is in line with local zoning regulations and building codes and will not negatively impact the surrounding area. Once a site development plan has been approved, it serves as a guide for the construction and development of the site" (Urban Arrow, 2023).

GI planning objectives aim to promote more effective and appropriate land use management practices (Mell, 2015) that provide public, private and community sectors with the enhanced capacity for environmental planning and management of urban green spaces (Ogu, 2000). This aims to promote the conservation of urban biodiversity; improve environmental quality; reduce the urban ecological footprint; assist with climate change adaptation; promote social cohesion; and start shifting toward a green economy (Pauleit et al., 2017).

1.8 Structure of the dissertation

Chapter 1 introduces the study by presenting the problem statement and focus of the research. The primary research question and five sub-questions are raised, followed by the research aim and objectives. Next, the delineations, assumptions and limitations of the research are disclosed. The expected outcomes of the study and the definitions of key terms and concepts follow. The chapter ends with an outline of the structure of the dissertation.

Chapter 2 firstly reviews GI literature to identify the challenges faced and opportunities for implementing GI at the local municipal level in SSA. Secondly, the definitions and planning guiding principles for GI that could apply to conditions in the City of Tshwane are explored. Lastly, the chapter introduces the South African planning policies (national, provincial, and local) which apply to GI application.

Chapter 3 discusses the selected interpretivist research design and case study methodology applied to the study. The research methods for data capturing, sample sizes, data analysis methods, and the limitations experienced in conducting the study are presented. Ethical considerations are also considered and documented.

Chapter 4 presents the findings of research sub-question 1. Firstly, results regarding the institutional challenges identified during the semi-structured interviews, workshop, and post-workshop clarification meetings are discussed. Next, the opportunities identified during the three data collection activities for implementing GI in the City of Tshwane are deliberated.

Chapter 5 presents the findings of research sub-questions 2 and 3. Firstly, the origin of the concept of GI is provided, and why the City of Tshwane requires its own definition is explained. Next, the process followed to develop a GI definition for the City of Tshwane is furnished. A definition is presented based on the results and a discussion of the co-development activities. The second section presents the findings on co-developing a set of contextual GI planning guiding principles for

the City of Tshwane. The methods follow, and the co-creation process is described. Finally, the main observations relating to sub-questions 2 and 3 are provided.

Chapter 6 presents the findings of research sub-question 4. Firstly, the results of the gaps identified and the proposed entry points for incorporating GI guiding principles into the city's policy documents are presented. The next section identifies where in the city structure the responsibility should lie to improve the performance of GI by all city departments. Then, a discussion of the findings follows together with some recommendations.

Chapter 7 presents a summary of answers to the research questions based on the study's findings, as per research sub-question five, based on the results of the former four questions presented in previous chapters. The chapter first considers all the research questions for the study and the related findings. The chapter then focuses on the study's contributions and the implications on current theory and practice and makes recommendations for future research.

Figure 1.3 illustrates the structure of the chapters in this dissertation.

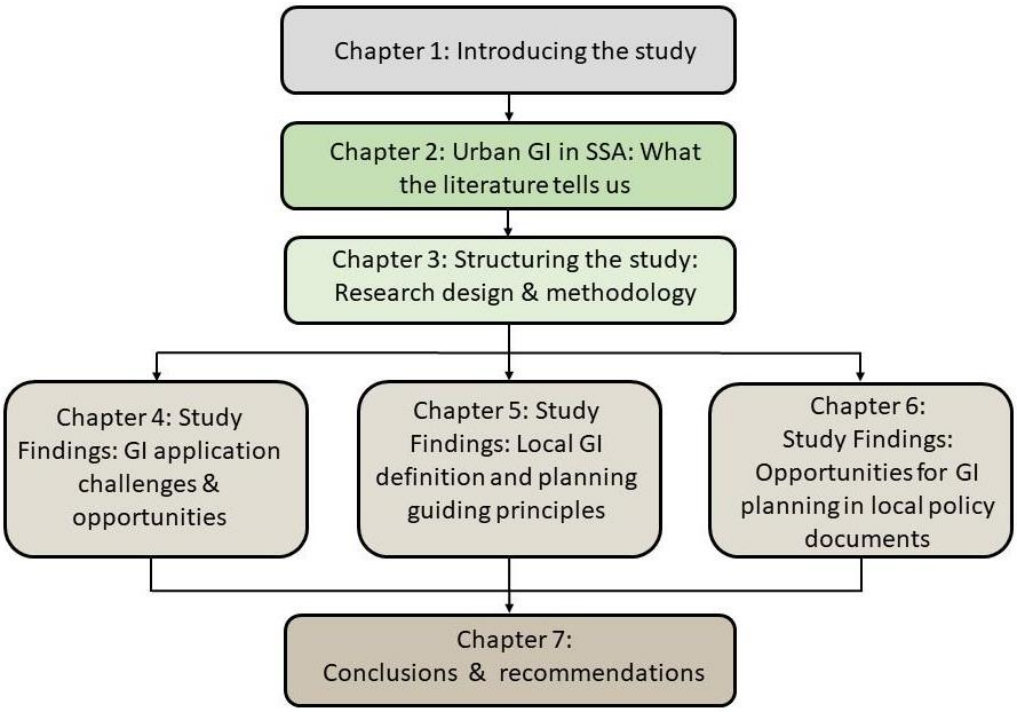


Figure 1-3. Structure of the dissertation

Chapter 2 Urban GI in SSA: What the literature tells us

2.1 Introduction

Studies on implementing GI to mitigate the effects of urbanisation and climate change on the environment are plentiful in the Global North (Benedict and McMahon, 2002; Hansen et al., 2017; Pauleit et al., 2017; Monteiro et al., 2018; Mell, 2019), where the concept of GI has become mainstream. Fewer studies exist in the Global South, particularly in SSA (Cilliers et al., 2021; Du Toit et al., 2018; Lindley et al., 2018), where socio-political imperatives take precedence over environmental imperatives (Lindley et al., 2018; Shin and Mabon, 2018). The predicted risks and challenges associated with the continued rapid population growth and urbanisation in Africa over the next 30 years are well-documented (Lamson-Hall et al., 2018; United Nations, 2019; Du Toit et al., 2018; Titz and Chiotha, 2019). The already visible effects of climate change on the continent (Titz and Chiotha, 2019) underscore the urgent need for evidence-based studies to elevate the concept of GI in the socio-political arena in SSA. Although most studies in SSA originate from South Africa (Guenat et al., 2019; Lindley et al., 2018; Du Toit et al., 2018), few studies focus on the City of Tshwane.

This chapter reviews studies on the planning and application of urban GI from the perspective of cities in SSA. A scoping review process was followed. The literature review included scientific literature concentrating on the past ten years. Keywords that were used to search for papers included: green infrastructure; guidelines; guiding principles, definition, challenges, barriers, opportunities, enablers, Sub-Saharan Africa, Global South, City of Tshwane, landscape design, co-development, green space. A snowball process was followed, accumulating papers referred to by other papers and recommended by the GRIP team. Some selected older yet still relevant published studies are also included to follow the development of the concept of GI.
The literature review of this dissertation has four focus areas related to the first three research sub-questions listed in Chapter 1 that aim to contextualise the problem and document information and knowledge gaps.

This chapter begins with a review of the institutional challenges and opportunities faced with implementing GI at the municipal level in SSA. The aim is to comprehensively understand the context of Global South challenges related to applying GI at the site development plan stage to answer research sub-question 1.

Secondly, definitions of GI that appear in global peer-reviewed research articles are extracted and assessed regarding their applicability to SSA countries. This focus area attempts to address research sub-question 2.

The third focus area entails the appraisal of existing Global North and Global South studies that discuss GI planning principles that can potentially be applied to the SSA urban context and respond to research sub-question 3.

Lastly, the fourth focus area introduces the spatial planning policy documents that regulate the City of Tshwane at the national, provincial, and local government levels. Figure 2.1 graphically illustrates the structure of the chapter.

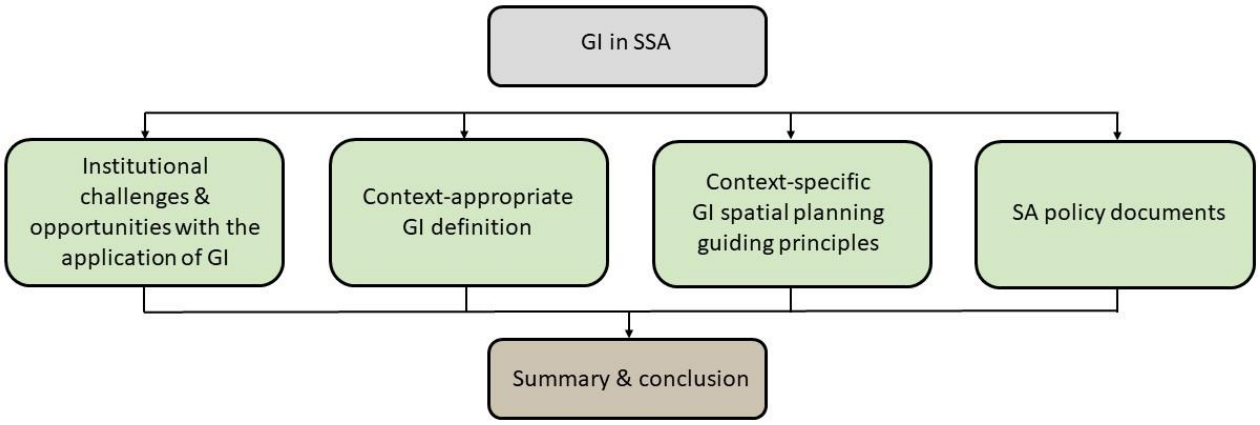


Figure 2-1. Structure of Chapter 2

2.2 GI research globally

Over the past 20 years, the term 'GI' has become accepted in the Global North. Numerous studies have been conducted, and many examples of GI application in the cities of the Global North exist (Hansen et al., 2017; Pauleit et al., 2017; McFarland et al., 2019; Monteiro et al., 2020; Pasquini and Enqvist, 2019). The systematic literature review conducted by Ying et al. (2022) supports the view that institutions in North America and European countries lead the study of GI. A well-known study is the European Union's 7th Framework Project, the Green Infrastructure and Urban Biodiversity for Sustainable Urban Development and the Green Economy (2013-2017) project (GREEN SURGE). GREEN SURGE[3] included 11 European countries and 20 cities over five years (University of Copenhagen, n.d.).

[3] "**GREEN SURGE** identified, developed and tested ways of linking green spaces, biodiversity, people and the green economy to meet the significant urban challenges related to land use conflicts, climate change adaptation, demographic changes, and human health and well-being. It provided a sound evidence base for urban green infrastructure planning and

Conversely, relatively few studies of GI have been conducted in the Global South. From the 2194 studies on GI collected from the World of Science database from 1995 to 2019, Ying et al. (2022) found that very few studies originate from Africa, South America or Asia (except for China). This is supported by other authors who found that the application of GI solutions for urban environmental problems in the Global South is limited (Ying et al., 2022; Pauleit et al., 2021; Du Toit et al., 2018; Cilliers et al., 2021; Pasquini and Enqvist, 2019). A study by Du Toit et al. (2018) reviewed 68 papers spanning 20 countries in SSA, including 74 urban areas (see Figure 2-2). The study revealed that only 38% of countries in SSA had conducted GI studies, with the majority originating from South Africa but none from the City of Tshwane. Therefore, the focus of this study on the City of Tshwane will aid in filling the current knowledge gap.

2.3 GI research in SSA

A Web of Science geographically focused search for papers published over the past ten years on GI and synonyms related to planning and design was conducted in August 2021 and updated in August 2022 to gain a holistic understanding of GI in SSA. The investigation revealed 164 articles. Forty papers focused more directly on urban spatial planning and design were selected for the literature review. Additional papers were added to provide background. Figure 2-2 indicates the location of the countries and urban regions represented in the studies reviewed.

implementation, exploring the potential for innovation in better linking environmental, social and economic ecosystem services with local communities" (University of Copenhagen, n.d.).

SSA COUNTRIES
South Africa (43)
Ghana (14)
Nigeria (10)
Tanzania (7)
Ethiopia (6)
Uganda (5)
Burkina Faso (4)
Kenya (4)
Zimbabwe (4)
Cameroon (3)
Senegal (2)
Central African Republic (1)
Chad (1)
Congo (1)
Cote d'Ivoire (1)
DR Congo (1
Eritrea (1)
Mauritania (1)
Niger (1)
Botswana (1)
Malawi (1)
Zambia (1)
Rwanda (1)

URBAN AREAS
Durban, Fort Beaufort, Bela-Bela, Grahamstown, Tzaneen, Cape Town, Port Alfred, Potchefstroom, Zeerust, Bathhurst, King William's Town, Johannesburg, Kumasi, Accra, Sunyani, Techiman, Kwabre East, Ibadan, Dakar, Harare, Bulawayo, Moshi, Dodoma, Dar es Salaam, Addis Ababa, Kampala, Nairobi, Lusaka, Gaborone, Bamenda, Lusaka, Lagos, Lilongwe.

Figure 2-2. SAA countries and urban areas represented in the literature reviewed

(Image source adapted from: https://www.nationsonline.org/oneworld/map/africa-political-map.htm)

2.4 Institutional challenges and opportunities

The institutional challenges and opportunities faced by planning regulators in SSA cities regarding urban GI planning and applications have been researched and documented. Still, there is only a scattering of studies for the whole continent; of the 40 papers selected for review, 31 related to institutional challenges. The studies were conducted between 2000 and 2022, covering the Global South and the SSA region. The 31 selected papers that covered institutional challenges were studied, and covered 23 SSA countries are listed in order of research interest (followed by the number of papers in brackets), namely: South Africa (43), Ghana (14), Nigeria (10), Tanzania (7), Ethiopia (6), Uganda (5), Burkina Faso (4), Kenya (4), Zimbabwe (4), Cameroon (3), Senegal (2), Central African Republic (1), Chad (1), Congo (1), Cote d'Ivoire (1), DR Congo (1), Eritrea (1), Mauritania (1), Niger (1), Botswana (1), Malawi (1), Zambia (1) and Rwanda (1). Thirty-three (33) urban areas feature in the studies reviewed, namely: Durban (by far the most reviewed), Fort Beaufort, Bela-Bela, Grahamstown, Tzaneen, Cape Town, Port Alfred, Potchefstroom, Zeerust, Bathhurst, King William's Town, Johannesburg, Kumasi, Accra, Sunyani, Techiman, Kwabre East, Ibadan, Dakar, Harare, Bulawayo, Moshi, Dodoma, Dar es Salaam, Addis Ababa, Kampala, Nairobi, Lusaka, Gaborone, Bamenda, Lusaka, Lagos and Lilongwe.

No known studies discuss the City of Tshwane's institutional challenges and opportunities. Still, the following challenges and opportunities feature in other cities in South Africa and SSA. The next section discusses this and comprises two parts regarding the application of GI concepts in urban spatial planning practices: Part 1: Institutional challenges and Part 2: Institutional opportunities.

2.4.1 Part 1: Institutional Challenges

Du Toit et al. (2018) identify seven overarching categories of challenges which limit the sustainable delivery of ecosystem services in SSA. They are:

i. socio-cultural values, traditions and perceptions;
ii. lack of capacity;
iii. governance, urban planning and social inequality;
iv. lack of data/ and or case studies;
v. ecosystem disservices;
vi. spatial trade-offs and conflicts; and
vii. climate change.

The above categories by Du Toit et al. (2018) have been compared and aligned to the literature reviewed to formulate a list comprising eight overarching institutional challenges faced in urban areas in cities in SSA (see Table 2.1). These challenges refer to the application of GI as part of the standard planning process.

Table 2-1. Comparison of categories of institutional challenges from Du Toit et al. (2018) and reviewed literature

8 Categories of challenges identified from the literature	**7 Categories of challenges identified by Du Toit et al. (2018)**
Rapid population growth and urbanisation	1. Spatial trade-offs and conflicts (due to development pressure and urbanisation)
Limited institutional ability/ capacity: (a) financial capacity; (b) institutional integration; (c) operational efficiency; (d) technical capacity; and, (e) political will.	2. Lack of capacity (including lack of financial resources) 3. Lack of data/ and or case studies
Urban land-use planning systems (Including customary land tenure influences and colonial and apartheid legacy effects)	4. Governance, urban planning and social inequality (including lack of political will and corruption)
Development pressures (Including customary land tenure influences)	1. Spatial trade-offs and conflicts (due to development pressure and urbanisation)

'Green-value' gap (Including ecosystem disservices and colonial and apartheid legacy effects)	5. Socio-cultural values, traditions, and perceptions 6. Ecosystem disservices
Heterogenous competing actors (Including customary land tenure influences)	1. Spatial trade-offs and conflicts (due to development pressure and urbanisation)
Lack of GI emphasis by role players (political will)	4. Governance, urban planning and social inequality (including lack of political will and corruption)
Climate change	7. Climate change

The following section discusses the eight identified categories of challenges that inhibit the incorporation of GI into broader land-use planning processes in SSA cities.

i. Rapid population growth and urbanisation

Government institutions in SSA countries are overwhelmed by the demands and effects of rapid population growth (Lamson-Hall et al., 2018) and urbanisation (Lindley et al., 2018; Titz and Chiotha, 2019; Du Toit et al., 2018; Amoako and Adom-Asamoah, 2019). According to Titz and Chiotha (2019), the rising urban population in African countries is due to natural population growth and rural-urban migration. The rapid pace of urban development gives rise to inadequate provision of housing (Pauleit et al., 2021), the inability of authorities to provide essential infrastructure services (Titz and Chiotha, 2019; Cilliers et al., 2014; Pauleit et al., 2021), high unemployment rates and growing poverty (Titz and Chiotha, 2019; Cilliers et al., 2014; Lindley et al., 2018). Again, this leads to high levels of informality and land invasion of natural areas (Cilliers et al., 2021; Titz and Chiotha, 2019; Arku et al., 2016). Expansive informal settlements encroach into sensitive environmental areas, placing pressure on fragile ecosystems due to their fragmentation and degradation (Pauleit et al., 2021; Lindley et al., 2018). The rapid population growth rate and urbanisation impact the ability of government planning agencies to properly plan and provide effectively for essential infrastructure service delivery and housing demands of the ever-increasing number of urban residents. In addition, the rapid loss of urban green space in African cities such as Nigeria (Zakka et al., 2017), Ghana (Cobbinah and Nyame, 2021; Arku et al., 2016), Harare (Matamanda et al., 2019) and South Africa (Shin and Mabon, 2018), is reported due to uncontrolled encroachment.

ii. Limited institutional ability

One of the principal barriers to effective governance and the application of urban GI in SSA cities is weak or limited institutional capacity and expertise (Du Toit et al., 2018; Lindley et al., 2018; Titz and Chiotha, 2019; Cilliers et al., 2014; Shih and Mabon, 2018). The United Nations Development Program (2016) defines institutional capacity as "the capability of an institution to set and achieve

social and economic goals through knowledge, skills, systems, and institutions". Furthermore, Du Plessis and Landman (2002), cited in Cilliers et al. (2014), explain that institutional ability comprises (a) financial capacity, (b) institutional integration, (c) operational efficiency, (d) technical capacity, and, (e) political will. These five aspects repeatedly emerge in the literature and are discussed in more detail below.

a. Financial capacity

Local governments of SSA cities are under increasing financial constraints due to an inability to effectively collect rates and taxes, corruption, tender fraud, political conflict, and the unwise allocation of revenue in infrastructure development (Ogu, 2000; Du Toit et al., 2018; Titz and Chiotha, 2019; Cobbinah and Nyame, 2021). Wasteful expenditure due to a lack of expertise and the inability to spend budgets within prescribed financial expenditure timeframes exacerbate the problem (Cilliers et al., 2014). Cilliers et al. (2014) further identify the tendency of government administrations to make uninformed decisions and allocate funds imprudently to meet treasury spending deadlines and deliver quotas as a daunting challenge. Specifically related to the provision of urban GI is the low resource base of institutions on green space (Mensah 2014 cited in Du Toit et al., 2018) and the lack of funding allocated to the planning and development of parks and green space (Arku et al., 2016; Guenat et al., 2020).

b. Institutional integration

Most government institutions in SSA work in silos, leading to poor collaboration and cooperation between key actors in managing urban land use and open space development (Cilliers et al., 2021; Cobbinah and Nyame, 2021; Amoako and Adom-Asamoah, 2019; Guenat et al., 2020). Arku et al. (2016) advocate that effective coordination between various planning agencies is urgently needed to improve institutional integration. In addition, Amoako and Adom-Asamoah (2019) believe that clearly defined and shared roles among the relevant stakeholders and institutions will promote cohesion in government sectors.

As mentioned previously, local administrations are generally considered weak and disorganised due to continued political conflict in many SSA countries (Cilliers et al., 2021; Titz and Chiotha, 2019; Cobbinah and Nyame, 2021; Matamanda et al., 2019; Du Toit et al., 2018). The City of Tshwane recently experienced such disruptive political conflict and had three different executive mayors from 11 February 2023 to 28 March 2023 (Harper, 2023; Mahlati, 2023; Mothiba, 2023).

c. Operational efficiency

Inadequate training of municipal officials results in a lack of expertise and knowledge (Titz and Chiotha, 2019; Du Toit et al., 2018) and adds to the overwhelming burden of new and complex tasks on officials (Shin and Mabon, 2018; Titz and Chiotha, 2019). The deficiency of qualified staff leads to ad-hoc planning, disorderly layouts, and haphazard development (Arku et al., 2016; Lamson-Hall et al., 2018). Operational inefficiency also occurs due to a lack of institutional integration, as mentioned in (b) above. The low level of accountability at all levels of government (Kessides, 2006; Lall, 2017; Ravallio, 2009 cited in Du Toit et al., 2018) has resulted in the absence of vigorous enforcement of plans, policies and regulations, which negatively affects operational efficiency.

d. Technical capacity

Du Toit et al. (2018) identify the lack of data and context-specific case studies to support and showcase the benefits of GI and its related ecosystem services as a significant barrier to its incorporation into the standard spatial planning process. Cilliers et al. (2014) contend that databases should be based on context-specific, socio-ecological research to inform environmental and spatial planning policies at all levels of government. There is a need for context-specific information on land-use patterns and future urban expansion to inform planning regulators on how to promote, educate, apply, manage and plan for GI (Cilliers et al., 2021; Pauleit et al., 2021). The current limited research, mapping, and monetary valuation of GI (Pauleit et al., 2021) applications in urban areas in SSA, plus the lack of practical, conceptual, scientific, and theoretical foundations for decision-makers (Shin and Mabon, 2018; Lindley et al., 2018), remains a challenge. This aspect is also linked to a lack of financial resources and adversely affects operational efficiency. Examples of African countries where mapping and monetary valuation have been conducted are Cape Town and eThekwini (Durban) (South Africa), Addis Ababa (Ethiopia), Dar es Salam (Tanzania) and Bobo-Dioulasso in Burkina Faso (Cilliers et al., 2014; Cilliers et al., 2021; Pauleit et al. 2021).

e. Political will

Du Toit et al. (2018) cite politicians' lack of political will as a significant stumbling block encumbering the application of GI in land use planning and development. Local politicians' political agendas, economic self-interests, and a general lack of awareness and knowledge of the benefits ecosystem services can supply directly cause the lack of support for GI application in urban areas (Cilliers et al., 2014).

iii. Urban land-use planning systems

Many authors state that SSA countries still struggle with inappropriate urban land-use planning models and frameworks ill-suited to urban African socio-political and environmental contexts (Lindley

et al., 2018; Titz and Chiotha, 2019; Güneralp et al., 2018; Ogu, 2000). The land-use planning modules are either a legacy inherited from colonial times or imported from elsewhere (Titz and Chiotha, 2019; Pauleit et al., 2021; Güneralp et al., 2018; Ogu, 2000; Zakka et al., 2017). The pre-independence or imported, top-down spatial planning models are poorly adapted to and have failed to incorporate the current institutional dynamics of African cities (Ogu, 2000; Titz and Chiotha, 2019; Guenat et al., 2020). Ogu (2000) argues that the formulated standards and regulations for the specifications and design of urban environmental infrastructure are based on Western standards and are often inappropriate and unaffordable for many African governments. Ogu (2000) further argues that there is a need for a change in strategy and advocates the adoption of flexible levels of environmental infrastructure standards supported by the effective participation of cross-sectoral stakeholders with a bottom-up approach to the "planning, choice of technology, implementation, operation and maintenance of projects" (Ogu, 2000:519).

GI is not embedded in the broader planning processes for land-use development in SSA countries (Cilliers and Rohr, 2019) and carries a low priority (see v. below) when weighed up against 'more pressing' socio-economic issues (Breed et al., 2015). Considering a scarcity of suitable, developable land in urban areas (Guenat et al., 2020; Matamanda et al., 2019), GI always comes second to the development pressures discussed in iv. below.

Cilliers et al. (2014) argue that the large body of complex policies, frameworks and guidelines regulating spatial planning in South Africa leads to confusion among stakeholders. At the same time, Cilliers et al. (2021) cite ineffective spatial planning policies, legislation and regulations that create poor transparency and silo effects as the root cause of the problem of addressing urban GI challenges in the Global South, as mentioned in the previous section. Contrary to the aforementioned, Cobbinah and Nyame (2021) find that the Local Governance Act of Ghana, 2016 is the only primary legislation at the city level that mandates Ghanaian city authorities to act as the principal authority for the planning and control of spatial development, including urban green space. Therefore, according to the authors of that paper, the lack of regulatory frameworks hampers enforcement and conflict resolution to protect urban green space from other land-use developments in Ghana.

Poor urban policies and weak enforcement of development control regimes (Cobbinah and Nyame, 2021; Du Toit et al., 2018) by state institutions make them seem helpless and overwhelmed by the fast rate of encroachments (Amoako and Adom-Asamoah, 2019). The weak enforcement of planning regulations, lack of institutional collaboration and poor technical resources mentioned before created the perfect breeding ground for unscrupulous developers and politicians to exploit the land

development process to promote their self-interests (Amoako and Adom-Asamoah, 2019). Furthermore, corruption and political interference result in unauthorised land deals and the sale of land to satisfy the economic and political gains of a few elite individuals rather than the overall welfare of citizens. (Lindley et al., 2018; Du Toit et al., 2018; Cobbinah and Nyame, 2021; Matamanda et al., 2019).

iv. Development pressures

African cities experience many pressing urban socio-economic challenges and socio-political demands (Washbourne, 2022; Lindley et al., 2018; Shin and Mabon, 2018). Some have been mentioned previously, such as rapid urbanisation leading to high demand for housing, high levels of unemployment, extreme poverty, expanding informal settlements encroaching into sensitive environmental areas, and a dire need for essential infrastructure services. There is a significant disparity between ecological concerns and the urban citizenry's basic needs, leading to spatial trade-offs and conflicts (Cilliers et al., 2014; Breed et al., 2015; Du Toit et al., 2018). Pressure from politicians, citizens, developers and traditional authorities to change the land use of green space or not include GI in new developments is fierce (Guenat et al., 2020; Matamanda et al., 2019; Cobbinah and Nyame, 2021; Amoako and Adom-Asamoah, 2019).

v. 'Green-value' gap

Du Toit et al. (2018:256) identify "socio-cultural values, traditions and perceptions" but also ecosystem disservices as leading reasons for the general misunderstanding and undervaluation of the benefits of GI by citizens (Arku et al., 2016; Cilliers, 2019; Guenat et al., 2019; Shackelton et al. et al., 2017; Shackelton et al., 2015) and as a consequence by politicians alike. Shackleton et al. (2016:588) remind us that "ecosystems also produce and deliver a variety of goods and services that undermine human wellbeing". Ecosystem disservices include unsafe green spaces and harbouring criminals (Guenat et al., 2020; Shackleton et al., 2015; Cilliers, 2019). The adverse effects of nature include plants that cause allergies, fire and drowning risks, poor maintenance and quality that encourages illegal dumping of waste and building rubble, polluted water, and harbouring dangerous wild animals (Guenat et al., 2020; Pasgaard et al., 2023).

Furthermore, negative perceptions of GI can also be influenced by colonial legacy effects, specifically in South Africa, the impact of apartheid planning (Shackleton et al., 2018). The colonial influence on urban planning cultures and standards can be seen in previous British and French colonies, particularly in Tanzania and South Africa, according to Titz and Chiotha (2019). Open green spaces or belts between different sections of colonial cities created spatial and racial

segregation of European and African residents in urban areas (Titz and Chiotha, 2019). Examples of this deliberate colonial segregation planning are still evident in SSA cities today.

The inability of local administrations to properly manage and maintain green spaces (Cobbinah and Nyame, 2021; Amoako and Adom-Asamoah, 2019) aggravates safety concerns held by residents that open spaces are the breeding ground for crime (Du Toit et al., 2018; Cobbinah and Nyame, 2021). Crime and the poor management of GI often make it impossible for many residents to access GI benefits (Shackleton et al., 2015; Titz and Chiotha, 2019; Pasgaard et al., 2023). Furthermore, as administrations have limited access to funding, the provision of basic infrastructure outweighs the importance of GI, which has an intangible value and is therefore perceived to be a low-end priority (Breed et al., 2015; Cilliers and Rohr, 2019).

The abstract perception of the concept of GI among government officials, politicians, practitioners, local communities, and other stakeholders adds to the misconceptions and lack of appreciation of the value of GI (Mngumi, 2020; Washbourne, 2022). Washbourne (2022) makes the case that GI lacks a shared meaning or definition between stakeholders and requires quantifiable and qualifiable guides to understand and communicate the multiple benefits of GI in urban settings.

As a result of this 'green-value gap' a low priority is assigned to the development of green space (Cobbinah and Nyame, 2021; Mensah, 2014, cited in Du Toit et al., 2018) and few opportunities for planning initiatives and incentives for GI and ecological design exist in the Global South (Cilliers et al., 2021). Yet, Cilliers (2019) and Breed (2022) put forward the additional view that GI is perceived as a luxury good within the broader African context and, therefore, not considered a priority compared to "more pressing needs".

vi. Heterogenous competing actors

The limited financial resources and scarcity of suitable, developable land in urban centres exacerbate the inability of state and city authorities to acquire land for GI development (Guenat et al., 2020). The competing need for developable land leads to conflicts internally between state institutions and also externally between the many competing stakeholders, including the state, customary landowners, private landowners and citizens (Titz and Chiotha, 2019). Concerning the City of Tshwane, the northern part of Region 2 has a strong presence of traditional leadership with vast portions of land under the management of the *Amandebele ba Lebelo* tribal authority (City of Tshwane, 2023c). (See Chapter 3, Section 3.3.1 for more detail regarding the seven administrative regions of the City of Tshwane).

As mentioned in item iii. above, unscrupulous developers, political actors and encroachers take advantage of this conflict and weak enforcement of planning policies, by-laws, and regulations to satisfy their political and economic self-interest and land-use needs (Cilliers et al., 2014; Amoako and Adom-Asamoah, 2019). At the same time, there is a lack of accountability, and the different actors blame each other for the loss of land due to land invasions and encroachments or the unauthorised sale or rezoning of land (Guenat et al., 2020; Amoako and Adom-Asamoah, 2019).

vii. Lack of GI emphasis by role players

The influence of state institutions, traditional authorities, and politicians on spatial planning processes and GI implementation is mentioned in item vi. above.

Breed et al. (2015) contend that landscape designers do not pay enough attention to the variety of functions (or services) that GI can provide in their planning and design proposals. Pauleit et al. (2021) support this view by stating that local planning professionals have inefficient skills and knowledge to incorporate GI into the spatial planning arena. Mngumi (2020) takes this argument further by adding that individual discipline-based approaches applied in the past have failed, and the successful implementation of GI relies on a transdisciplinary system. Such an approach must include the uptake of locally relevant practitioner knowledge to ensure contextually appropriate GI solutions (Guenat et al., 2020).

Breed et al. (2015) argue that the terms *"GI"* and *"ecosystem services"* feature increasingly in academia, policy documents and professional magazines but are seldom employed actively in practice in deliberations on urban land use decisions in South Africa. Therefore, they argue that trade-off choices are often enforced. Mngumi (2020) and Cobbinah and Nyame (2021) contend that the uncooperative attitudes of residents can be attributed to their misunderstanding of the abstract concept of GI and its intangible and long-term benefits. Pauleit et al. (2021) and Guenat et al. (2020) encourage consultation with customary and indigenous landowners and residents to include local knowledge.

The role of developers in exploiting conflict between government administrations and traditional landowners in SSA countries is mentioned in vi. above. However, the opposing interests of some developers and specific municipal departments must not be underestimated (Seeliger and Turok, 2015; Amoako and Adom-Asamoah, 2019). Seeliger and Turok (2015) contend that municipalities do not always appreciate all the factors influencing the feasibility of proposed developments and to what extent developers can contribute to public infrastructure. At the same time, developers do not

always care for the long-term goals of a city's spatial development plans, such as higher densities and mixed-use and inclusionary housing (Seeliger and Turok, 2015).

viii. Climate change

Due to the limited institutional capacity and an ineffective public sector, few measures are implemented for SSA cities to adapt effectively to climate change (Pauleit et al., 2021). Yet, Du Toit et al. (2018) state that climate change may be the most dominant challenge SSA cities face in delivering sustainable GI. The effects of climate change include extreme weather events, impacts on food and water supplies and rising temperatures (Titz and Chiotha, 2019; Du Toit et al., 2018; Mngumi, 2020; Zakka et al., 2020). Urban areas experience increasing heat waves, warm spells and heat island effects (Du Toit et al., 2018; Zakka et al., 2020; Titz and Chiotha, 2019). Poorer communities are the most vulnerable to natural disasters (Du Toit et al., 2018; Cilliers et al., 2021; Mngumi, 2020) and other effects of climate change, such as water scarcity (Titz and Chiotha, 2019; Cilliers et al., 2014). That may be why SSA cities focus on climate action plans instead of other aspects of GI (Pauleit et al., 2021), a viewpoint supported by the issuing of the City of Tshwane's Climate Action Plan in 2021 (City of Tshwane, 2021a).

2.4.2 Part 2: Institutional Opportunities

Eight (8) overarching categories of institutional opportunities that could enable the incorporation of GI as part of the standard planning process in urban areas in cities in SSA emerged from the literature reviewed, namely: (i) addressing the green-value gap, (ii) empowering institutions, (iii) integrating GI concepts into urban planning frameworks and functions, (iv) active citizen participation, (v) adopting a transdisciplinary planning approach, (vi) updating technical databases, and (vii) incentives and, (viii) conducting further research in the field.

i. Addressing the green-value gap

Many authors agree that it is vital to convey the concept of GI less abstractly and more tangibly so that all urban stakeholders understand and appreciate its value (Titz and Chiotha, 2019; Cilliers et al., 2014; Cilliers, 2019; Breed et al., 2015). The traditional view that the primary role of green space is aesthetic and recreational needs to change, according to Pauleit et al. (2021) and Lindley et al. (2018). Similarly, Cilliers et al. (2021) and Breed (2022) believe that the perception that GI is a luxury (nice-to-have) good as opposed to an essential component of urban planning and development that supports sustainable living in the city must be altered. Washbourne (2022) maintains that a shared definition and guidelines for understanding and communicating the multiple benefits of GI in the urban setting should take on a locally specific narrative.

Titz and Chiotha (2019) and Cilliers (2019) advocate that understanding users' different values of green space is essential. Dipeolu et al. (2021) add to the argument by recommending that a clear understanding of people's preferences for different types of GI and the factors influencing such preferences is essential to the adequate and effective provisioning of urban GI. At the same time, intensive education of urban stakeholders to appreciate the relationship between GI and mental well-being and economic, social and environmental conditions in urban areas is needed to change negative attitudes and evoke an appreciation of GI benefits (Arku et al., 2016).

Mngumi (2020) and Ogu (2000) contend that the negative attitudes of SSA communities towards urban GI, which result from the legacy effects of colonial urban planning (and apartheid in South Africa), can be altered by employing inclusive, bottom-up spatial planning approaches. Dipeolu et al. (2021) found that by improving the quality and increasing the number of preferred types of GI in urban neighbourhoods in Lagos, Ghana, more useable and accessible GI is provided to residents. Guenat et al. (2020) state that improved environmental education can alter actual and perceived negative perceptions of disservices associated with GI. The authors found that educational institutions such as schools and universities have some impact on changing negative perceptions and policies by combining academic and environmental activities and research.

ii. Empowering institutions

Institutional capacity building is required to empower regulating authorities to effectively deliver their mandates related to sustainable urban development (Lindley et al., 2018). Several mechanisms are identified in the literature to capacitate institutions. Arku et al. (2016) contend that government officials require professional development and training to advocate for the implementation of GI adequately. Amendments to legal and regulatory frameworks for local governance, including medium- and long-term GI implementation goals supported by the necessary budgetary allocations, are also essential (Amoako and Adom-Asamoah, 2019; Arku et al., 2016). This aspect is discussed further in iii. below.

Furthermore, Cilliers et al. (2014) argue that integrating the environmental and spatial planning functions, such as in the City of Cape Town, facilitates cooperative governance and integrated decision-making between planning and environmental management departments. The operations are in the same directorate and location (Cilliers et al., 2014). This is contrary to the City of Tshwane, where the Economic and Spatial Development and the Environment and Agriculture Management departments are situated in different directorates (see Chapter 3, Figure 3-6). Cobbinah et al. (2019) point out that improved collaboration is needed between the state and traditional leadership to overcome conflicts over the importance of retaining urban GI. Stakeholders' clearly defined and

shared roles will enhance the cooperation and coordination between various planning agencies (Arku et al., 2016; Amoako and Adom-Asamoah, 2019). Shin and Mabon (2018) find in their study of eThekwini's Durban Metropolitan Open Space System (D'MOSS) that the ultimate success of incorporating GI into a city's spatial planning process relies on strong and continuous advocacy (Washbourne, 2022). According to Cilliers (2019), managers and staff must carry out this advocacy in government agencies responsible for green space and GI to sensitise decision-makers (Cilliers, 2019) with evidence-based data (Arku et al., 2016). The successful implementation of GI elsewhere should be showcased (Arku et al., 2016). Although many studies make recommendations on *how* to build institutional capacity, the implementation thereof is complex and not as straightforward. The presiding political culture in African countries plays an immense role in the ability of city officials to advocate and successfully implement changes to policy aspects that are not seen to support political agendas (Arku et al., 2016).

iii. Integrating GI concepts into urban planning frameworks and functions

Many authors support integrating GI into mainstream spatial planning through a comprehensive planning package (Cilliers, 2019; Du Toit et al., 2018; Cilliers et al., 2014; Arku et al., 2016). Shin and Mabon (2018) maintain that the success of D'MOSS in eThekwini is because it is woven into all facets of the city's spatial planning systems. These systems include the Integrated Development Plan, Spatial Development Frameworks, the Municipal Town Planning Scheme and the SDP application process as a development control layer. Shin and Mabon (2018) point out that regulators must apply land-use management tools such as D'MOSS sensitively and reflexively. Doing so will prevent these tools from becoming a barrier to all development because of environmental needs. Arku et al. (2016) argue that a balancing mechanism is needed to ensure urban development reflects ecological sustainability. They concede that physical and economic growth is necessary but must not occur at the expense of GI facilities that promote social interaction and ecological biodiversity. In line with this, Breed et al. (2015) call for a balanced, adaptive management approach. Titz and Chiotha (2019) further recommend the annual updating and revision of planning policies as short review cycles enable such ongoing adaptive management.

iv. Active citizen participation

Harnessing and incorporating local urban citizenry resources (methods, knowledge and systems) by developing inclusive and participatory GI spatial planning, design and co-management approaches is widely cited as a critical enabler for successful future urban development (Titz and Chiotha, 2019; Cilliers et al., 2014; Lindley et al., 2018; Cilliers, 2019; Cilliers et al., 2021., Guenat et al., 2020). Cilliers et al. (2021) promote the inclusion of indigenous knowledge systems (IKS) linked to scientific knowledge (Cilliers et al., 2014; Cilliers et al., 2021). Washbourne (2022) argues

harnessing IKS will ensure a broad range of perspectives are included in the land development process. A bottom-up approach to reduce the conceptual differences among the various stakeholders and actors is endorsed by Mngumi (2020) and Ogu (2000). Mngumi (2020) and Cobbinah and Nyame (2021) believe this will yield both knowledge co-production and increase ownership of the concept of GI.

Examples of bottom-up approaches where communities organise themselves and establish and manage urban green spaces occur in Asia, Latin America and Africa (Pauleit et al., 2021). An example of a bottom-up participatory stakeholder partnership is Nigeria's Sustainable Ibadan Project (SIP) (Ogu 2000). The project forms part of the Sustainable City Programme (SCP) developed by the United Nations Centre for Human Settlements (UNCHS) in the 1990s. The basis of the SCP is that *all* stakeholders must be involved with *all* aspects of the development and improvement of urban environmental infrastructure to ensure sustainability. This includes all phases of the project cycle, from project identification to planning, implementation, operation, management and maintenance. Ogu (2000) contends that this approach fosters a sense of ownership and belonging of GI projects by communities. The top-down planning approach implemented in China is not the norm in the Asian region of the Global South (Pauleit et al., 2021; Cilliers et al., 2021). Ogu (2000) strongly argues that the conventional top-down approach to urban planning by town planners and managers with Western education does not work for low-income residents living in poor environmental conditions. A balanced management approach where the local government assumes a supportive role and takes hands with the private sector, local communities and other stakeholders seems to be more feasible (Pauleit et al., 2021).

The purpose of active citizenship is to facilitate the co-development and co-production of urban green planning solutions suited to the needs and requirements of the communities. Citizens should be allowed to participate in and benefit from civic resources using co-management methods and systems (Titz and Chiotha., 2019; Cilliers et al., 2014).

v. Transdisciplinary local expertise

The role of local built environment practitioners in the combined promotion of GI and its ecosystem services is critical as they are well-placed in the urban development arena to influence land-use practices (Breed et al., 2015). Shin and Mabon (2018) agree that the success of the D'MOSS can be attributed to local GI and conservation experts all working together to produce locally relevant solutions. These experts include officials in the city's environmental department, from the University of Kwa-Zulu Natal, local private-practice practitioners and local community actors.

Transdisciplinary planning approaches are just as crucial for implementing GI into urban planning strategies (Van Zyl et al., 2021) as developing cooperative and collaborative governance. These 'local experts' understand the socio-political and environmental contexts and are in the position to co-develop empirically sound, context-appropriate solutions for integrated, sustainable urban expansion (Shin and Mabon, 2018). The continuous professional development of planning practitioners and designers is essential to ensure that their knowledge remains current and appropriate (Cilliers, 2019; Cilliers et al., 2021).

vi. Technical databases

Cilliers et al. (2014:267) state that "the compilation of [technical] databases, driven by socio-ecological research in urban ecology [which also applies to GI], should be the point of departure to inform national, regional and municipal planning, captured in environmental policies." Up-to-date mapping and ecological data collection are needed to develop accurate, evidence-based geographic information system (GIS) data that will create the basis for context-specific solutions to promote, educate, apply and manage GI in SSA cities (Cilliers et al., 2021; Titz and Chiotha., 2019; Cilliers et al., 2014; Du Toit et al., 2018). Some examples of Global South and SSA cities where mapping and monetary valuation of GI have occurred are Cape Town and Durban in South Africa, Addis Ababa in Ethiopia, Dar-es-Salam in Tanzania and Bobo-Dioulasso in Burkina Faso (Pauleit et al., 2021). Baseline ecological and urban land-use data is vital to monitor GI projects' performance and safeguard sustainable future development (Du Toit et al., 2018; Cobbinah and Nyame, 2021). Furthermore, information on current land-use patterns and predicated future urban expansion is needed (Pauleit et al., 2021).

The value of developing more case study examples where urban GI has been successfully implemented, such as eThekwini (Durban) and the City of Cape Town in South Africa, cannot be underestimated (Pauleit et al., 2021). It is critical to monitor such case studies to document and show evidence of their benefits (Monteiro et al., 2020; Pauleit et al., 2021).

vii. Incentives

As mentioned previously under 2.4.1(vi) above, most property developers and landowners may not be willing to include GI as a standard component of their developments (Seeliger and Turok, 2015). A possible reason may be resistance from their potential buyers or, more likely, due to the additional development cost of such GI. An opportunity exists for local municipalities to encourage developers and citizens to incorporate sustainable urban practices in their developments by employing economic incentives (Selinger and Turok, 2015; Breed et al., 2015). The city of eThekwini has

successfully instituted two incentives[4]: environmental servitude and ecological compensation (Shin and Mabon, 2018).

Breed et al. (2015) further suggest awards and rating systems may incentivise landscape designers and other urban planning and design practitioners to "correct misconceptions about ecosystem services and biodiversity" and to influence the public and different built environment professionals to promote GI implementation. Awards are used for marketing professional practices to clients and, therefore, become directly beneficial to practitioners when placed on their web pages or office walls. The previous examples of incentives should be supported and included in legislation that capacitates enforcement by planning regulators (Breed et al., 2015).

viii. Further research

Shin and Mabon (2018) report on the decisive role that scientific knowledge plays in supporting and informing the conservation of biodiversity and ecosystem services in Durban, South Africa. They make the important point that the city of eThekwini justifies their science-based conservation strategies to support social justice.

Mngumi (2020) advocates that further context-based research is required in this field to develop locally appropriate evidence, methods and approaches to facilitate the implementation of GI as part of the regular urban planning and development process. This research must be situated in a typical local setting to demonstrate the concept and approaches to GI and its benefits to the city and its inhabitants (Cilliers, 2019).

2.4.3 Consolidating the challenges and opportunities

Table 2-2 lists the overarching challenges and opportunities extracted from the literature applicable to applying GI in the urban context in SSA. The challenges and opportunities listed in Table 2-2 are not aligned. They are presented as they emerged from the literature. The challenges are interrelated and impact one another, as do the opportunities. One opportunity can improve several challenges, while various opportunities may positively impact a single challenge. For example, empowering the institutions could enhance the limited institutional ability. Closing the green value gap, encouraging active citizenship, integrating GI concepts into urban planning and frameworks, adopting a

[4]**Environmental servitude**: "private landownership is allowed for passive recreation, with the municipality only having to provide rate relief as compensation for the landowner managing the area responsibly"; and,
Ecological compensation: "whereby off-site habitat creation or financial compensation (in both cases paid by the developer) is undertaken if land development becomes unavoidable" (eThekwini Municipality 2011, cited in Shin and Mabon 2018).

transdisciplinary planning approach, conducting further research and updating technical databases would all positively affect incapacitated institutions. Similarly, one opportunity may improve many challenges. Updating technical databases would impact limited institutional ability, an ineffective public sector, urban land-use planning systems, development pressure, and the green-value gap, and provide supporting data where it is lacking.

Table 2-2. List of challenges and opportunities with the application of GI in SSA from the literature

Challenges	**No.**	**Opportunities**
Rapid population growth and urbanisation	**1**	Closing the 'green-value' gap
Limited institutional ability/ capacity: (a) financial capacity; (b) institutional integration; (c) operational efficiency; (d) technical capacity; and, (e) political will.	**2**	Empowering institutions
Urban land-use planning systems (Including customary land tenure influences and colonial and apartheid legacy effects)	**3**	Integrating GI concepts into urban planning frameworks and functions
Development pressures (Including customary land tenure influences)	**4**	Active citizen participation
'Green-value' gap (Including ecosystem disservices and colonial and apartheid legacy effects)	**5**	Transdisciplinary local expertise
Heterogenous competing actors (Including customary land tenure influences)	**6**	Updating technical databases
Lack of GI emphasis by role players	**7**	Incentives
Climate change	**8**	Conducting further research in the field

This section provides clarity from the literature regarding the existing challenges and possible opportunities experienced with applying GI in urban centres in SAA and responds to research sub-question 1. The following section explores GI's meaning and responds to research sub-question 2.

2.5 Origin of the term GI

According to Monteiro et al. (2020), the idea of GI dates back to the late 19th century. The concept relates to philosophies such as green belts, parkways and the garden city movement, which the English town planner Ebenezer Howard promoted in his book "*Tomorrow: A Peaceful Path to Social Reform",* published in 1898 (Mell, 2016; Wilterdink et al., 2022). Monteiro et al. (2020) believe that the concept of GI began to emerge when the Greenway Movement started gaining attention in North America in the late 1980s. The authors highlight notable publications that promote the greenway

concept, such as *Greenways for America*, by Charles Little (1900), *Ecology of Greenways*, by D.S.P. Hellmund (1993), *A Guide to Planning, Design and Development*, by Flink and Searns (1993), and *The Beginnings of an International Movement,* by Fabos and Ahern (1995). Many research papers were published on the subject, and projects were implemented on the ground at the time. The first official use of the term "GI" was reportedly in a report, *Report to the Governor: Creating a Statewide Greenways System,* published by the Florida Greenways Commission in 1994 (Florida Greenways Commission, 1994). The definition of GI emerging from Europe evolved with an emphasis on ecological networks (Monteiro et al., 2020). In 2013, the European Union presented a definition for GI, 'to become an integral part of spatial planning and territorial development in all its member states" Monteiro et al., 2020:525).

As stated in the introduction of this dissertation, there is a shortage of research on GI in the Global South, particularly SSA. Many authors highlight the lack of shared meaning of the concept of GI (Washbourne, 2020; Sussams et al., 2015; Mell, 2019; Cilliers, 2019). SSA, South Africa and the City of Tshwane need a definition for GI that is contextually specific and geopolitically appropriate to local needs and conditions. According to Mell (2016:135), this is possible due to "the versatility of GI as an approach to [urban] landscape planning". Figure 2-3 illustrates the origin of the concept of GI.

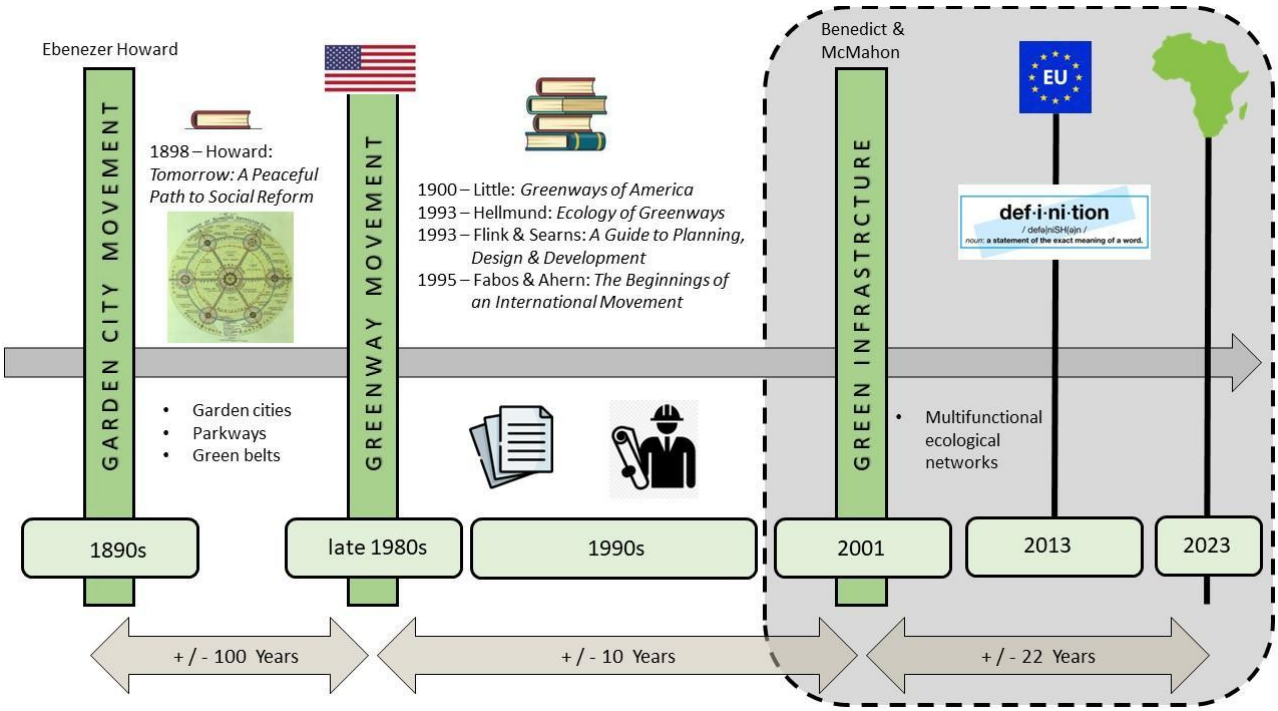


Figure 2-3. Origin of the concept of GI

2.6 Defining urban GI

According to Mell (2019), the ongoing engagement with the work by Benedict and McMahon grounds the debate on what GI is. In their paper titled "Green Infrastructure: Smart Conversation for the 21st Century", published in the Renewable Resources Journal in the Autumn of 2002, Benedict and McMahon (2002:12) define GI as 'an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations."

The concept of GI has developed to become "a strategically planned network of natural and semi-natural areas designed and managed to deliver a wide range of ecosystem services" (European Union 2013). GI benefits humans and is a "natural life support system" (Benedict and McMahon, 2002:12).

Different stakeholders and researchers use various terms when referring to GI (Pauleit et al., 2021; Washbourne, 2022), such as green space, gardens, ecological infrastructure and, recently, nature-based solutions (see Table 2-3). Similarly, numerous abstract and sometimes intangible definitions (Titz and Chiotha, 2019) for the concept of GI exist (Sussams et al., 2015), which creates confusion among politicians, academia, decision-makers, city officials and local communities (Mngumi, 2020).

Sussams et al. (2015:10) argue that the malleability of the term GI enables its manipulation to support specific "priorities and objectives of its user", while Washbourne (2022:103) asserts that "the broad scope and malleability of a term like GI can be a significant strength to ensure a broad range of knowledge and perspectives is captured". Matsler et al. (2021) maintain that the ambiguity of the term GI is both an advantage and a disadvantage. The authors contend that the flexibility of the term has allowed for alternative interpretations of its meaning, which has enabled cross-disciplinary and multi-partner efforts by academics and practitioners to address urban planning challenges. At the same time, Matsler et al. (2021) warn that ambiguity and flexibility can lead to frustration and greenwashing if not applied cautiously to address community interests.

2.6.1 Urban GI interchangeable terms

In her study of five cities, three in South Africa and two in the United Kingdom, Washbourne (2022) finds a lack of 'shared meaning' of the term 'GI'. GI is not considered a common terminology internally within the cities or between the five cities studied. Table 2-2 below lists some examples of the terms used for GI by researchers in the field.

Table 2-3. Examples of GI terminology

Sources	Terms used for GI
Pauleit et al., 2021; Matsler et al., 2021; Mell, 2019	Urban forests
Pauleit et al., 2021;	Public open spaces
Pauleit et al., 2021;	Private open spaces
Pauleit et al., 2021;	Gardens and yards
Pauleit et al., 2021;	Agricultural areas (farmland which includes field crops and vegetables, including floodplains and wetlands, utilised for planting food
Matsler et al., 2021; Washbourne, 2022	Ecosystem services
Matsler et al., 2021	Low impact development
Matsler et al., 2021	Best management practice
Matsler et al., 2021; Mell, 2019	Blue-GI
Matsler et al., 2021	Sponge city
Matsler et al., 2021	Garden city
Matsler et al., 2021; Mell, 2019	Water-sensitive urban design
Matsler et al., 2021; Mell, 2019	Green Belt
Matsler et al., 2021	Sustainable urban drainage system
Matsler et al., 2021; Cilliers, 2019; Mell 2019	Nature-based solutions
Matsler et al., 2021; Washbourne, 2022; Pauleit et al., 2021.	Ecological infrastructure
Breed et al., 2015; Pauleit et al., 2021; Amoako and Adom-Asamoah, 2019; Du Toit et al., 2018; Cobbinah and Nyame, 2021.	Urban green space
Washbourne, 2022; Pauleit et al., 2021	Metropolitan open space system
Washbourne, 2022	Natural capital
Pauleit et al., 2021	Urban green structures
Pauleit et al., 2021	Bio-infrastructure
Pauleit et al., 2021	Ecological main structure
Mell, 2019	Greenways

2.6.2 Benefits and components of Urban GI

The benefits provided by urban GI have been increasingly documented and generally grouped into four categories of ecosystem services: regulating, provisioning, supporting and cultural (Monteiro et al., 2020; Du Toit et al., 2018; Pauleit et al., 2021). These benefits are both biophysical and social and include, among others, flood attenuation, erosion control, reduced air and water pollution, mitigating the urban heat island effect, carbon sequestration, enhancement and conservation of biodiversity and strengthening of ecological resilience, promoting healthy living by encouraging active recreation, improving mental health and well-being (Washbourne, 2022; Du Toit et al., 2018; Cobbinah and Nyame, 2021; McFarland et al., 2019; Hansen et al., 2017; Sussams et al., 2015).

Components of GI include nature conservation reserves, parks, green servitude corridors, green public open spaces, river systems, water bodies, wetlands, green roofs, green walls, rain gardens, bioswales, urban farming, urban forests and street trees, pedestrian and cycle-friendly streets, permeable paving, rainwater harvesting systems and recycling opportunities (Cilliers, 2019; McFarland et al., 2019; Pauleit et al., 2017; Mell, 2019).

2.7 GI definition for SSA

Cilliers (2019) echoes the sentiment of others, such as Sussams et al. (2015) and Washbourne (2022), that no uniform understanding or definition of the term GI exists in the African context. Cilliers (2019) argues that deliberate efforts are required to define and capture the value of GI for African countries. “The lack of a static, universal definition is atypical and could result in a lack of consistency in its application and, in turn, a lack of clarity in its comprehension” (Sussams et al., 2015:10). Conversely, Mell (2016) agrees with Washbourne (2022) and argues that the strength of the concept lies in its versatility. Table 2-3 contains a selection of 15 definitions for GI, seven from the GN and eight from the GS.

Table 2-4. Selected definitions for the concept of GI

	Global North Source	**Definition**
1	Benedict and McMahon (2002)	“GI is an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations” Benedict and McMahon (2002:12).
2	Tzoulas et al., 2007:169 (Cited in Du Toit et al. 2018)	“All natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas, at all spatial scales” Tzoulas et al., 2007:169 (cited in Du Toit et al. 2018).

3	Ahern, 2007 and 2011 (Cited in Cilliers, 2019)	"…spatially and functionally integrated systems to aid sustainability; … society's natural life system".
4	European Union (2013)	"GI is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings" (European Union, 2013).
5	Monteiro et al. (2020)	"Apart from ecological functions, GI can also contribute to social, cultural, and economic benefits, which in turn support the establishment of sustainable, resilient, inclusive, and competitive urban areas" (Monteiro et al., 2020:525).
6	City of London official webpage	"GI is just as important to the city as its grey infrastructure of rail, roads, pipes and cables. It is a network of parks, green spaces, gardens, woodlands, rivers, and wetlands, as well as urban greening features such as street trees and green roofs, that is planned, designed and managed to: -**promote healthier living**, providing spaces for physical activity and relaxation -cool the city and absorb stormwater to **lessen the impacts of climate change** -filter pollutants to **improve air and water quality** -make streets clean, comfortable, and more attractive to **encourage walking and cycling** -**store carbon** in soils and woodlands -create better quality and better-connected habitats **to improve biodiversity and ecological resilience**" (City of London, 2023).
7	GREEN SURGE	"Urban GI planning is understood as a strategic planning approach that aims at developing networks of green and blue spaces in urban areas that are designed and managed to deliver a wide range of ecosystem services. Interlinked with GI planning on a landscape scale, urban GI planning aims at creating multifunctional networks on different spatial levels, from urban regional to city and neighborhood planning. Due to its integrative, multifunctional approach, urban GI planning is capable of considering and contributing to a broad range of policy objectives related to urban green spaces, such as conservation of biodiversity, adaptation to climate change, and supporting the green economy" (University of Copenhagen, n.d.).
	SSA Source	**Definition**
1	Titz and Chiotha (2019)	"The concept of GI is based on the principle that nature and natural processes and psychological benefits to human society are deliberately integrated into spatial planning and urban development to maintain and enhance the delivery of ecosystem services and, therefore, ecological, sociological, and psychological benefits to human society" (Titz and Chiotha, 2019:2).
2	Cobbinah and Nyame (2021)	"UGS has evolved in complexity, justified not only on civic, recreational, or environmental grounds but as a key component for urban sustainability and tackling climate-related vulnerabilities such as flooding" (Cobbinah and Nyame, 2021:415).
3	South African National Botanical Institute	"Ecological infrastructure (EI) refers to naturally functioning ecosystems that deliver valuable services to people, such as freshwater, climate regulation, soil formation and disaster risk reduction. It is the nature-based equivalent of built or hard infrastructure and is just as important for providing services and underpinning socio-economic development" (South African National Botanical Institute, 2013). "EI includes, for instance, healthy mountain catchments, rivers, wetlands, coastal dunes, and nodes and corridors of natural habitat, which together form a network of interconnected structural elements in the landscape" (South African National Botanical Institute, 2013).
4	World Wildlife Fund South Africa	"GI is a network of natural or man-made environmental features that deliver ecosystem services within the built environment through natural or ecological as well as man-made infrastructure" (Gulati and Scholtz, 2020:9).

5	City of Cape Town	GI is “a strategically planned, designed, and managed network of natural open spaces and ‘engineered’ ecological systems, with other environmental features, which provide ecological, community and infrastructure services” (City of Cape Town, 2022c:1).
6	eThekwini Municipality	“D’MOSS is a series of interconnected open spaces that incorporate areas of high biodiversity value and other supporting elements. These natural areas deliver a range of *ecosystem goods and services*…and includes a variety of aquatic and terrestrial environments, including thickets, grasslands, forests, wetlands, and rivers” (eThekwini Municipality, 2010:3).
7	Gauteng City-Region Observatory	“GI …refers to the interconnected set of natural and man-made ecological systems, green spaces, and other landscape features. It includes planted and indigenous trees, wetlands, parks, green open spaces and original grassland and woodlands, as well as possible building and street-level design interventions that incorporate vegetation, such as green roofs. Together these assets form an infrastructure network providing services and strategic functions in the same way as traditional ‘hard’ infrastructure” (Gauteng City-Region Observatory, 2013:3).
8	City of Tshwane	“GI refers to open spaces, with both social and ecological functions, that are seen as infrastructure equal to roads, water, electricity, and the other traditional municipal services that have long taken precedence over open space” (City of Tshwane, unpublished b, volume 1:19).

When analysing the main knowledge domains associated with GI, Ying et al. (2022) clustered the keywords of similar topics together. Their research found four core clusters: GI and stormwater management, GI and ecosystem services, GI and biodiversity and GI and climate change. The fifteen definitions for GI in Table 2-3 all include one or more of the core clusters. None have all four.

The following section investigates existing GI planning principles in response to research sub-question 3, which seeks to develop a descriptive list of GI guiding principles applicable and relevant to sub-Saharan Africa, South Africa, and the City of Tshwane.

2.8 Urban GI principles

Countless research papers published have produced ample evidence of the benefits that urban GI can provide, such as climate change adaption and mitigation, biodiversity conservation and protection, provision of multifunctional green spaces and flood water management (Mngumi, 2020; Pauleit et al., 2021; Van Zyl et al., 2021; Washbourne, 2022). Some authors doubt whether GI can achieve all these claimed benefits (Sussams et al., 2015). Pauleit et al., 2017 also clearly distinguish between GI objectives (or aims) and GI principles.

GI objectives identified by Pauleit et al. (2017) are conserving urban biodiversity, improving environmental quality, reducing the urban ecological footprint, promoting climate change adaptation, and promoting social cohesion and a greener economy. Other sources mention GI objectives rather casually, such as promoting healthier living, sustainable urban growth, and resilience (City of London, 2023.).

Monteiro et al. (2020:4) define GI planning principles as "underlying grounds that help guide and facilitate the planning procedures of GI to ensure that it contributes to a network of quality and functional green spaces, capable of meeting the needs of a determined urban area, contributing in the best way to the sustainability of a given region or local area, depending on its scale".

Despite scepticism by Sussams et al. (2015), several papers originating in both the Global North and the Global South have identified GI planning principles for urban contexts (Hansen et al., 2017; Pauleit et al., 2017; Monteiro et al., 2020; Pauleit et al., 2021). Pauleit et al. (2021) categorise the GI planning principles into those that relate to the planning *properties* of the GI and those that relate to the planning *process* of GI development. Table 2-5 below lists the eighteen GI principles extracted from the literature reviewed. Four GI principles relate to planning content or property characteristics, and four relate to their development process. The authors did not categorise the remaining ten principles. Descriptions of the principles extracted from the literature are included in the table below.

Table 2-5. GI planning principles extracted from the literature

GI PLANNING PROPERTY PRINCIPLES (as categorised by Pauleit et al., 2017 and Pauleit et al. 2021)			
No.	**GI Principle**	**Descriptions**	**Sources**
1	Urban ecological connectivity/networks (Systems thinking), (physical and functional)	"…connectivity within urban areas enables the migration of certain species, the dispersion of seeds, or even the repopulation of some patches in heterogeneous landscapes. Connectivity also serves as transit and recreation corridors for humans, contributing to the system stability and several ecosystem services, and to connect different landscapes. In this way, connectivity aims to create a well-connected green space network that can serve both humans and other species." (Monteiro et al., 2020:8). "…interlinking green spaces functionally and physically" (Pauleit et al., 2017:16).	Ahern, 2011; Cilliers et al., 2014; Breed et al., 2015; Mell, 2016; Pauleit et al., 2017; Hansen et al., 2017; Cilliers, 2019; Lindley et al., 2018; Titz and Chiotha, 2019; Monteiro et al., 2020; Pauleit et al., 2021.
2	Multi-scale (communities = neighbourhood scale) (cities = city-scale)	"… planning for different spatial levels ranging from city-regions to local projects [and]…linking different spatial scales within and above city-regions. (Pauleit et al., 2017:16) Planning "from a building perspective (e.g., green roofs), to a more regional and integrated perspective, which includes landscape interactions and larger natural areas. In this sense, GI planning should take into account all different scales, so that the interactions between and in these spaces can be enhanced" (Monteiro et al., 2020:8).	Ahern, 2011; Breed et al., 2015; Pauleit et al., 2017; Hansen et al., 2017; Lindley et al., 2018; Cilliers, 2019; MacFarland et al., 2019; Monteiro et al., 2020; Pauleit et al., 2021.
3	Multi-functionality (Across scales)	"Multifunctionality assumes significant importance because it directly connects GI with a wide number of ecosystem services, namely provision, regulation, support, and cultural. A multifunctional GI is capable to	Ahern, 2011; Cilliers et al., 2014; Breed et al., 2015; Pauleit et al., 2017;

		provide multiple social, ecological, and economic functions and possess a much higher resilience when compared with similar instruments that do not encompass this principle. Multifunctionality not only promotes multiple functions and increases synergies within green spaces, but also increases the effectiveness of this spaces, spatially in urban areas where space is limited and scarce" (Monteiro et al., 2020:8).	Mell, 2016; Hansen et al., 2017; Cilliers, 2019; Lindley et al., 2018; Titz and Chiotha, 2019; Cilliers and Rohr, 2019; Monteiro et al., 2020; Pauleit et al., 2021.
4	Integration of green and grey elements	"Integration is a principle that considers all connections and synergies between green and grey infrastructures and the landscape interactions with the building environment" (Monteiro et al., 2020:8).	Breed et al., 2015; Pauleit et al., 2017; Lindley et al., 2018; Monteiro et al. 2020; Pauleit et al. 2021.
GI PLANNING PROCESS PRINCIPLES (as categorised by Pauleit et al., 2017 and Pauleit et al. 2021)			
No.	**GI Principle**	**Descriptions**	**Sources**
5	Social inclusion/ stakeholder participation	"If the community does not feel integrated into the planning process, GI will not succeed which will not be appreciated and supported by the local population and its objectives and goals will not be accomplished" (Monteiro et al., 2020:9). …Social inclusion "aims for collaborative, socially inclusive processes (Pauleit et al., 2017:16) … "[that] are open to all and incorporate the knowledge and needs of diverse parties, emphasising those that are most in need of green space but may be less able to articulate themselves in the planning process" (Pauleit et al., 2021:109).	Cilliers et al., 2014; Pauleit et al., 2017; Hansen et al., 2017; Lindley et al., 2018; Cilliers, 2019; Monteiro et al., 2020; Pauleit et al., 2021.
6	Strategic spatial planning (focused on sustainability, integration, and developing contextually appropriate, affordable, and effective forms of land-use management)	"Urban GI planning is based on long-term spatial visions supplemented by actions and means for implementation, but it remains flexible over time. The process is usually led by the public sector, but that does not mean that nonstate actors are excluded" (Pauleit et al., 2017:16).	Cilliers et al., 2014; Mell, 2016; Pauleit et al., 2017; Pauleit et al., 2021.
7	Interdisciplinary and transdisciplinary	"… aims at linkages between disciplines, as well as between science, policy, and practice. It integrates knowledge and demands from different disciplines such as landscape ecology, urban and regional planning, and landscape architecture, and it is developed in partnership with different local authorities and stakeholders" (Pauleit et al., 2017:16).	Cilliers et al., 2014; Pauleit et al., 2017.
8	Reflexive	"… a continuous process of reflection, learning and adaption that contributes to community building and is able to cope with uncertainty" (Pauleit et al., 2021).	Pauleit et al., 2021.
UNCATEGORISED GI PLANNING PRINCIPLES			
9	Diversity/ Protection of Biodiversity	"Besides the type of structure (managed or natural) and their size (small or large), the diversity principle also enhances the role and importance of blue infrastructures in GI planning" (Monteiro et al., 2020:8).	Ahern, 2011; Cilliers et al., 2014; Cilliers, 2019; Monteiro et al., 2020.

10	Redundancy	Redundancy is about spreading risk and the ability to "contain" disturbance. It encompasses elements such as flexibility and adaptability…preparing and pre-planning for when (not if) a system fails" (Ahern, 2011:342).	Ahern, 2011; Ahern, 2013; Cilliers et al., 2014; Cilliers, 2019.
11	Evidence-based	"…GI planning must be based on robust scientific knowledge gained from a number of different fields" (Monteiro et al., 2020:11).	Monteiro et al., 2020
12	Adaptive and flexible design (temporal) recognise the heterogeneity in evidence produced for policy and practice	"Adaptive planning and design conceive the 'problem' of making decisions with imperfect knowledge about change and uncertain disturbances as an 'opportunity' to 'learn-by-doing'" (Holling, 1978 cited in Ahern, 2011:343).	Ahern, 2011; Cilliers et al., 2014; Du Toit et al., 2018; Lindley et al., 2018.
13	Context-based planning / Applicability	"…GI planning must consider the applicability, adaptability and implementation of the projects, which accounts if the plan (and the green projects) is realistic, can be implemented and developed, and if the solutions presented and adaptable to the considered area or not" (Monteiro et al., 2020:8).	Cilliers, 2019; Monteiro et al., 2020.
14	Accessibility	"The accessibility principle refers to the guarantee that all people can use, enjoy, and positively contribute to GI, and it is an important ground to be acknowledged in GI planning" (Monteiro et al., 2020:11).	Hansen et al., 2017; Cilliers, 2019.
15	Securing green space quality and quantity	"Providing access to green and public spaces for all strata of society; compensate for declining quantity by increasing the quality and multifunctionality of green spaces" (Hansen et al., 2017:99).	Hansen et al., 2017.
16	Safety	"Public spaces must be redesigned according to safety principles" (Cilliers (2019:14) to mitigate crime and anti-social behaviour.	Cilliers, 2019.
17	Governance	"A clear and detailed understanding of the governance context is key when considering a sustainable urban landscape. Implementing any planning proposals… requires knowledge of who makes decisions concerning which mandate and how the decision-making process works. The aim is to facilitate cooperative governance and integrated decision-making between planning and environmental management" (Cilliers et al., 2014:266).	Cilliers et al., 2014.
18	Continuity (long-term)	"… GI projects … [must incorporate] … post-implementation monitoring or empirical measurements of outcomes of the ecosystem services and functions they claim to provide… GI must require frequent investment, management and updates, and municipalities must be able to frequently release new information about their projects, their goals, what was accomplished and what their prospects are regarding green/blue spaces. …GI plans must have a monitoring system well identified or periodic reports with the evolution of the planned green projects" (Monteiro et al., 2020:9).	Monteiro et al., 2020.

2.9 Policy documents

This section introduces the South African national, provincial and local (City of Tshwane) policy documents relevant to the application of GI in the city. This review relates to research sub-question 4, which aims to determine which South African spatial planning and development policies, frameworks, and by-laws incorporate GI, if at all. The objective is to identify the gaps in these policy documents that weaken the inclusion and evaluation of GI at the SDP stage.

This section presents in three parts, namely (1) the document identification process, (2) the purpose of the documents for planning at national, provincial and municipal levels, and (3) the spatial planning and environmental development principles found in the policy documents.

2.9.1 Policy document Identification process

The policy document identification process comprised two stages. The first stage produced an initial list of policy documents to be reviewed as part of this study and was compiled on 31 January 2022 with the assistance of Ms Annelise Grobler, director at Landscape Dynamics Environmental Consultants and a registered practitioner with the Environmental Assessment Practitioners Association of South Africa (EAPASA). Secondly, additional policy documents were sourced by conducting an internet search using the Google search engine on official webpages of South African metropolitan municipalities and national institutions involved in environmental and spatial planning and research. The City of Tshwane's official website (City of Tshwane, 2023f) was accessed as shown in the box below. Scoping interviews were conducted with public officials and private sector environmental practitioners involved with spatial planning at the City of Tshwane. Volume 2: Contextual Framework of the draft City of Tshwane Review of the Open Space Framework 2020 (City of Tshwane, unpublished b) was also considered, and policy documents cited in Chapter 3 of that volume are included. A draft list of policy documents was compiled and tested with the participants of the semi-structured interviews. The initial list of policy documents reviewed is shown in Table 2-6. The final policy documents reviewed are listed in Tables 2-7 to 2-10 below. A short description highlighting the main aim of each policy document appears in column 2 of the tables. Thereafter, a desktop review of the policy documents and other important national resources relevant to GI spatial planning and design was conducted to identify shared principles.

1. Home Page → Documents → Promulgates By-Laws / and Draft By-laws.
2. About City of Tshwane → Departments → Governance and Support → Economic Development and Spatial Planning → City Planning and Development Division

3. About City of Tshwane → Departments → Chief Operations Office → Environment and Agriculture Management → Environmental Management and Parks Division

No planning policies were found on the City of Tshwane's Environment and Agriculture Management webpage. The documents in column 3 of Table 2-4 were sourced from the City of Tshwane's Environment and Agriculture Management Development Application Requirements Letter dated 2019 and the 2022 draft revision (City of Tshwane, 2019; City of Tshwane, unpublished b).

Table 2-6. Initial list of national, provincial and municipal policy documents that apply to GI in the City of Tshwane

Government sphere	**City of Tshwane: Economic Development and Spatial Planning** (Source: The City of Tshwane official website)	**City of Tshwane: Environment and Agriculture Management** (Source: Environment and Agriculture Management Development Application Requirements Letter, 2019 and 2022 draft)
NATIONAL policy documents	National Development Plan 2030 (Republic of South Africa, 2012) National Building Regulations and Building Standards Act 103 of 1977 (Republic of South Africa, 1977) Spatial Land Use Management Act 16 of 2013 (Republic of South Africa, 2013)	National Environmental Management Act 107 of 1998 (Republic of South Africa, 1998c) National Environmental Management Act: Air Quality Act 39 of 2004 (Republic of South Africa, 2004a) Spatial Land Use Management Act 16 of 2013 (Republic of South Africa, 2013)
PROVINCIAL policy documents	Gauteng Spatial Development Framework, 2030 (Gauteng Province, 2022)	Gauteng Conservation Plan version 3.3 (C-PLAN v3.3) (Gauteng Province, 2014) The Gauteng Provincial Environmental Management Framework (Gauteng Province, 2015) The Ridges Guideline (Gauteng Province, 2019)
LOCAL City of Tshwane policy documents	City of Tshwane Integrated Development Plans 2021/2022; 2022/2023 (City of Tshwane, 2023e) City of Tshwane Metropolitan Spatial Development Framework, 2030 (City of Tshwane, 2021b) City of Tshwane Regionalised Spatial Development Frameworks, 2018 (City of Tshwane, 2018b) Draft Green Building Development and Net-zero Carbon Building Policy v1.3, 2022 (City of Tshwane, unpublished, c)	The Bioregional Plan for the City of Tshwane (City of Tshwane, unpublished e) The City of Tshwane Land Use By-Law, 2016 (City of Tshwane, 2016) The City of Tshwane Open Space Framework (City of Tshwane, 2005; City of Tshwane, unpublished a; City of Tshwane, unpublished b.) The Streetscape Design Guidelines for Different Types of Hard Urban Spaces (City of Tshwane, 2007) City of Tshwane Town Planning Scheme (2008) revised 2014 (City of Tshwane, 2014) Green Building Development By-Law, 2013 (City of Tshwane, 2013)

2.9.2 The regulatory and policy context

The following section describes the key policy documents that inform this study. National, provincial, and municipal legislation, regulations and policies relating to environmental and spatial planning and land-use management are included.

South Africa is a constitutional democracy with a three-tier system of government that functions at the national, provincial and local levels. All three spheres of government have legislative and executive authority (South African Government, 2023). Chapter 2, Section 24 of the Constitution of South Africa (Republic of South Africa, 1996) states that everyone has the right to "an environment which is not harmful to their health or well-being." To protect this basic human right to a clean and healthy environment, the Constitution assigns the responsibility for environmental management to all three spheres of government (City of Tshwane, unpublished b).

(i) National level

Parliament makes laws for the country under the Constitution (Republic of South Africa, 1996). Table 2-5 contains the national laws relevant to GI and this study.

Table 2-7. National legislation relevant to GI

NATIONAL LEVEL	
LEGISLATION	SHORT DESCRIPTION
The Constitution of South Africa, 1996	"Protects the rights of citizens to have the environment protected for the benefit of present and future generations, to prevent pollution and ecological degradation, to promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development" (Republic of South Africa, 1996).
National Development Plan, 2030 (NDP)	The NDP directs and coordinates development and government initiatives in South Africa. Reference is made to protecting the natural environment and "public places where people from different social groups mix" (The National Planning Commission (2011: 234). "The NDP promotes spatial justice, spatial sustainability, spatial efficiency, spatial resilience and good administration" (Republic of South Africa, 2012).
Spatial Planning and Land Use Management Act (16 of 2016) (SPLUMA)	"SPLUMA governs planning permissions and approvals, sets parameters for new developments, and provides for different lawful land uses in the country; establishes a clear mandate and framework for open space planning and management at a local municipal level. This act provides for a uniform system of land-use governance in the country, and its principles align with the National Development Plan, 2030" (Republic of South Africa, 2013).
National Environmental Management Act (107 of 1998) (NEMA)	NEMA "aims to provide for cooperative environmental governance by establishing principles for decision-making on environmental matters" (Republic of South Africa, 1998c).
National Biodiversity Act (10 of 2004) (NEMBA)	NEMBA "intends to provide for managing and conserving South Africa's biodiversity within the framework of NEMA" (Republic of South Africa, 2004).

National Water Act (36 of 1998) (NWA)	NWA "applies to open spaces where water bodies, wetlands, and watercourses are affected" (Republic of South Africa, 1998a).
National Forests Act (84 of 1998) (NFA)	NFA contains a list of protected trees (Republic of South Africa, 1998b).
Conservation of Resources Act (43 of 83) (CARA)	CARA contains a list of categorised invasive species (Republic of South Africa, 1983).
National Heritage Resources Act (25 of 1994) (NRHA)	NHRA governs local authorities' protection and management of conservation-worthy places and areas, including open spaces (Republic of South Africa, 1994).

(ii) Provincial level

Provincial government departments are mandated to ensure that local-level land-use planning and environmental management, including open space planning, remain consistent with national goals and objectives. The City of Tshwane is located within the Gauteng Province of South Africa and coordinates and collaborates with the Gauteng Provincial Government (City of Tshwane, unpublished b). Table 2-7 contains the provincial policies most pertinent to GI.

Table 2-8. Provincial policies relevant to GI

PROVINCIAL LEVEL	
LEGISLATION, POLICIES AND BY-LAWS	SHORT DESCRIPTION
Gauteng Department of Agriculture and Rural Development (GDARD) - Conservation Plan version 3.3 (C-PLAN v3.3)	GDARD tool to ensure adequate, timely and fair service delivery to clients of GDARD, and will be critical in providing adequate protection of biodiversity and the environment in Gauteng Province (Gauteng Province, 2014).
The Ridges Guideline 2019	GDARD guideline on the conservation and sustainable use and development of the province's ridges (Gauteng Province, 2019).
Gauteng Provincial Spatial Development Framework, 2030 (GSDF)	Provincial SDFs must coordinate, integrate, and align provincial plans and development strategies with national government policies, departments, and municipalities (Gauteng Province, 2022).

(iii) Local level

Table 2-8 lists the city's seven policy documents most relevant to GI as identified during the semi-structured interview process.

Table 2-9. City of Tshwane policies relevant to GI

LOCAL LEVEL	
LEGISLATION, POLICIES AND BY-LAWS	SHORT DESCRIPTION
Tshwane Town Planning Scheme, 2008 (revised 2014)	The TTPS includes land zoned as Public and Private Open spaces on which specific land uses may be developed with the consent of the Municipality. It also contains development conditions applicable to all property developments. It sets out the city's requirements for Site Development Plans (SDP) and Landscape Development Plans (LDP) in Clause 31 (City of Tshwane, 2014).
Integrated Development Plan (revised annually) (IDP)	Integrated Development Plan provides the city with strategic direction and operational planning by aligning resources, linking and integrating policies and plans, coordinating development proposals, and setting annual budgets (City of Tshwane, 2023e).
City of Tshwane Land Use Management By-law, 2016 (LUM By-law)	Deals with land-use and development applications within the city boundaries (City of Tshwane, 2016).
Metropolitan Spatial Development Framework, 2030 (MSDF)	The City of Tshwane Metropolitan Spatial Development Plan 2030 incorporates the main principles guiding the development of open spaces in the City of Tshwane reflected in the Tshwane Open Space Framework (City of Tshwane, 2021b).
Regionalised Spatial Development Frameworks for Regions 1-7, 2018 (RSDF)	The Regional Spatial Development Plans for Regions 1-7 include Open Spaces and Conservation Areas under Environmental Structuring Concept. The Regional Spatial Development Plan briefly discusses the different types of open spaces and refers to the Tshwane Open Space Framework (City of Tshwane, 2018b).
City of Tshwane Open Space Framework Tshwane Open Space Framework 2005 (still the official version), the 2015 review and the 2020 update, but neither have been ratified by the City of Tshwane's Council. (TOSF)	The Tshwane Open Space Framework is a high-level policy framework that addresses open space conservation, protection, management, and development concerns. The overarching policy document provides the framework for developing Local Open Space Plans (LOSP) for each of the city's seven Regions (City of Tshwane, 2005; City of Tshwane, unpublished a and b).
Local Open Space Plans (2008 and 2012) (LOSP)	The LOSPs contain high-level open space management and design guidelines formulated specifically per region. These guidelines are not comprehensive or detailed and refer mainly to ecological protection, conservation, and the recreational development of open spaces (KH Landscape Architects, 2008 and 2012).
Environment and Agriculture Management Department - Development Application Requirements (DAR) letter 2019 (and 2021 draft) (DAR)	The document sets out the departments' minimum Environment and Agriculture Management requirements for land development applications, which include open spaces. The Environmental Planning and Open Space Management approves Landscape Development Plans as part of the Site

	Development Plan application process (City of Tshwane, 2019 and City of Tshwane, unpublished, d).

(iv) Other important resources

Other noteworthy South African documents guiding public open space development are the Council for Scientific and Industrial Research's "Green Book" (Council for Scientific and Industrial Research, 2019), an online interactive tool, the national Department of Human Settlements "Red Book" (Department of Human Settlements, 2019) and the Draft Guidelines for the Provision of Open Space (Isikhungusethu Environmental Services and Louw and Dewar, 2017) published by the national Department of Rural Development and Land Reform.

Table 2-10. Other important South African resources relevant to GI

OTHER IMPORTANT RESOURCES	
LEGISLATION, POLICIES AND BY-LAWS	SHORT DESCRIPTION
The Neighbourhood Planning and Design Guide (the **RED BOOK**), Department of Human Settlements, 2019.	A series of guidelines dealing with the planning and design of services and infrastructure with practical information regarding settlement layout, housing, social facilities, public open space, transportation, water, sanitation, stormwater, solid waste management, energy, and cross-cutting issues (Department of Human Settlements, 2019).
Green Book: Adapting Settlements for the Future, 2019 (the **GREEN BOOK**), Council for Scientific and Industrial Research, 2019.	The Green Book online tool supports municipal planning by developing climate-resilient settlements. It ultimately facilitates mainstreaming climate change adaptation into local government planning instruments and processes (Council for Scientific and Industrial Research, 2019).
Draft Guidelines for the provision of Open Space prepared for the Department of Rural Development and Land Reform (Isikhungusethu Environmental Services and Louw and Dewar, 2017).	Provides national guidelines for the planning, managing, and maintaining the land for parks and other forms of open spaces in South Africa, in terms of Section 50 of the Spatial Planning and Land Management Act (Act 16 of 2013), (Isikhungusethu Environmental Services and Louw and Dewar, 2017).

All 23 South African planning policy documents reviewed impact the use, management, and development of open spaces at a high level. There is a need for specific and comprehensive GI guidelines supported by national and provincial legislation and Council-approved policies to be relevant and enforceable (Cilliers 2019). The analysis of the policy documents is described in Chapter 3, Section 3.4.2(i).

2.9.3 GI principles found in the City of Tshwane's policy documents

Table 2-11 indicates the GI principles found in the city's policy documentation.

Table 2-11. GI principles in the City of Tshwane policy documents

City of Tshwane Spatial Planning Policy Documents	GI Principles
City of Tshwane Integrated Development Plan 2021/26 (City of Tshwane, 2023e)	None
City of Tshwane Town Planning Scheme, 2008 (revised 2014), (City of Tshwane, 2014)	None
City of Tshwane Land-Use Management By-law, 2016 (City of Tshwane, 2016)	None
City of Tshwane Metropolitan Spatial Development Framework, 2021 (City of Tshwane, 2021b)	Multi-functionality, connectivity, scale
City of Tshwane Regionalised Spatial Development Frameworks: Regions 1-7, 2018 (City of Tshwane, 2018b)	None
Tshwane Open Space Framework, 2005 (City of Tshwane, 2005), Tshwane Open Space Framework 2015 review (City of Tshwane, unpublished a), Tshwane Open Space Framework 2020 draft vision (City of Tshwane, unpublished b)	Create, protect and conserve the open space network and natural resources; connectivity, multi-scale; flexibility; adaptability; multi-functionality; quality; diversity; redundancy; biodiversity protection; accessibility; safety; strategic planning or organic evolvement; social inclusion and cross-sectoral partnerships; continuity.
Local Open Space Plans (2008-2012) (KH Landscape Architects 2008 and 2012)	Create, protect and conserve the open space network and natural resources; connectivity, multi-scale; flexibility; adaptability; multi-functionality; quality; diversity; redundancy; biodiversity protection; accessibility; safety; strategic planning or organic evolvement; social inclusion and cross-sectoral partnerships; continuity.
Environmental Planning and Open Space Management Development Application Requirements Letter, 2019 (City of Tshwane, 2019) and the 2022 draft (City of Tshwane, unpublished d)	Implicit principles: multifunctionality, protect and conserve, accessibility, quality, green-grey integration.

Table 2-10 indicates that GI principles do not appear in City of Tshwane policy documents, such as the City of Tshwane Town Planning Scheme, the annually updated Integrated Development Plans or the Regionalised Spatial Development Frameworks. The exception is the Metropolitan Spatial Development Framework, which references the three GI principles of multifunctionality, scale and connectivity. A few implicit GI principles in the Environmental Planning and Open Space Management Development Application Requirements Letter contain the requirements for open

space provision at the SDP stage. The Tshwane Open Space Framework (City of Tshwane, 2005) contains the most references to GI and ecosystem services and their benefits. However, although the framework was revised in 2015 and again in 2020, the City of Tshwane's Council has not ratified either of those newer versions. Effectively, this means that the 2005 version of the document is still the legal edition.

2.10 Summary

The literature confirms that support for the concept and implementation of GI in the Global North is well established. The same cannot be said for the Global South (except for China). Researchers agree that Global North concepts cannot be transferred directly to the Global South due to the region's varied and unique political and socio-economic landscape. Innovative, context-based implementation strategies relevant across different scales, communities and geographic regions are required.

The challenges associated with the application of GI in urban developments and its benefits have been extensively researched for SSA. Still, there is a gap in the research regarding context-based, implementable GI guidelines for the SDP stage for the region.

Ignorance and the lack of consensus among decision-makers and practitioners regarding GI and its implementation approaches are still common.

The literature shows that the challenges experienced in SSA countries with implementing GI are interrelated and affect one another. In the same way, the opportunities are interconnected and strengthen one another. Several opportunities may solve one challenge, whilst one opportunity may provide solutions for several challenges. The literature demonstrates that most African countries experience similar challenges. Simply put, the rapid rate of urbanisation creates an unprecedented demand for housing and basic infrastructure services in African cities. Municipal authorities and planning regulators cannot meet the demand for various reasons (financial, technical, skills and knowledge, lack of suitable land, corruption, competing needs of stakeholders, etc.). This creates a disparity between social, environmental and economic needs, threatening sustainable urban development. Under current conditions, green space is perceived to be of less value than other socio-economic pressures.

Cross-departmental collaboration and support of the concept of GI are required to breach institutional silos. Researchers argue that only then will the successful implementation and

maintenance of GI become feasible. To provide GI planning and design principles and guidelines with the necessary gravitas, they must be included in policy documents approved by city authorities.

The literature points out numerous opportunities that can change the status quo regarding incorporating GI into mainstream urban planning and development in SSA cities. A change in the current method of operating in local authorities is required. A new way of conducting business requires partnerships with sister city departments, citizens, the private sector, academia and local planning professionals. Developing the necessary enabling policies and procedures which streamline planning processes and incentivise property developers and landowners is vital. Ongoing research to develop context-specific solutions for SSA and case studies from all over the region is critical. These can be monitored to build science-based evidence for successful GI implementation.

The South African government operate at three tiers, namely, national, provincial and local levels. The incorporation of GI planning principles at the three legislative tiers varies. National legislation and provincial policies all contain some high-level, over-arching spatial development and environmental planning principles. At the municipal level, GI principles are not incorporated in high-level strategic policy documents such as the Tshwane Town Planning Scheme, the Integrated Development Plan, or the Regionalised Spatial Development Frameworks. Only three GI principles are mentioned in the Metropolitan Spatial Development Framework. The Tshwane Open Space Framework 2005 contains the most references to GI and ecosystem services and their benefits but is outdated. The 2015 and 2020 versions of the frameworks do not have legal standing, as the City of Tshwane's Council has not approved either. Thus, there are opportunities at various points in the city's hierarchy of policy documents for GI principles to be incorporated.

Chapter 3 Structuring the Study: Research Design & Methodology

3.1 Introduction

This chapter is presented in seven sections. Section 3.2 explores various research designs and provides a rationale for the selected research design. Section 3.3 describes the study area and places the research in its geographic and political context. Section 3.4 discusses the research methodology, including the sampling strategy, data collection methods, and the process to analyse the collected data. The limitations of the research methodology are described in Section 3.5. Section 3.6 discusses the ethical considerations considered during the research, and the chapter concludes with Section 3.7, which summarises the chapter. Figure 3-1 illustrates the chapter structure graphically.

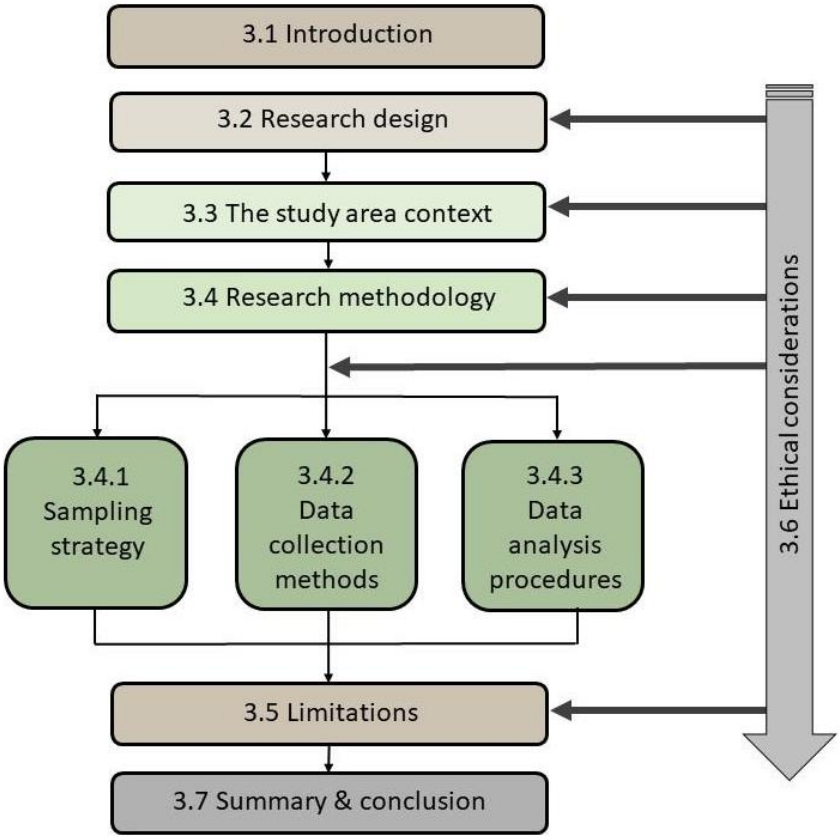


Figure 3-1. Structure of Chapter 3

3.2 Selected Research Design

Scholars describe research design as the outline of how the researcher will conduct the study to solve the research problem and answer the research questions (Crotty, 1998; Guba and Lincoln, 1994; Scotland, 2012; Makombe, 2017).

Du Toit (2015) encourages researchers to ask themselves what the overall logic of their study is and what the most appropriate design would be. In this case, the core logic of the study is the interpretation of participants' lived experiences regarding GI and its application in the City of Tshwane. Du Toit (2015) argues that the correct selection and customising of a prototypical research design will maximise the validity of the researcher's findings. The researcher applied the six considerations presented by Du Toit (2015) to select a research design described below.

The research is motivated by theoretical aims and is situated in an academic context to advance what is known about the application of GI planning principles in the City of Tshwane. The research further focuses on spatial planning documents and their application in the City of Tshwane. Therefore, this study is considered *applied* and *interpretative* research, according to Du Toit (2015). The methodological paradigm of this study is interpretative as it aims "to describe meaningful social action that will allow us to understand social reality and meaning, which is socially constructed and constantly changing" (Scotland, 2012). For these reasons, the methodological approach of this study revolves around the qualitative interpretation of data, in contrast with quantitative studies that revolve around quantitative analysis and interpretation (Du Toit, 2015). The study makes use of both primary and secondary data sources. Based on the above considerations, a case study method was selected. Figure 3-2 illustrates the research design, according to Du Toit (2015), most suitable for answering the research question.

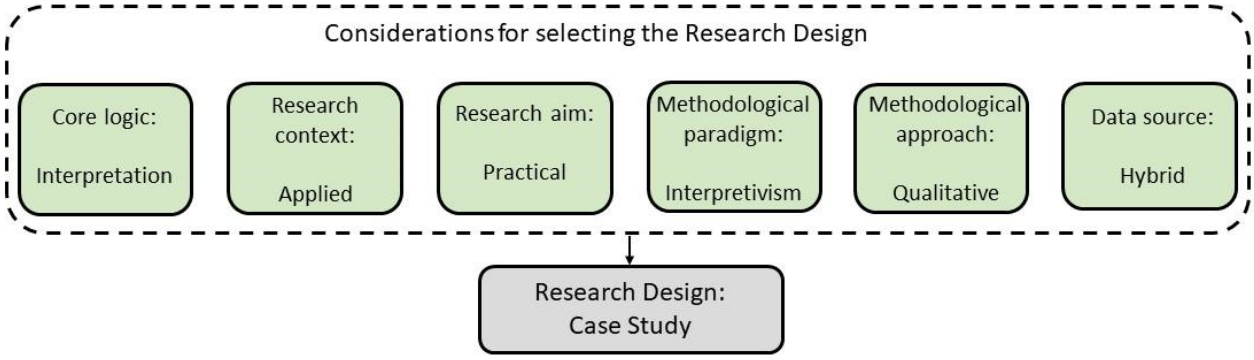


Figure 3-2. The research design for this study based on Du Toit (2015)

Authors who researched topics related to how people use, design and value open space and selected to use a qualitative approach for their research are listed in Table 3-1.

Table 3-1. Authors who applied similar research designs

Author	Topic	Paradigm	Methodological approach	Data collection methods	Data analysis methods
Breed (2015)	Social production of ecosystem services through the articulation of values in landscape design practice in South Africa.	Constructivist	Qualitative	Semi-structured interviews	Content analysis
Stander (2019)	The creation of lived public spaces by African migrants and people of diverse ethnicity in the Pretoria CDB and its implications for urban planning - A phenomenological investigation	Interpretivist phenomenological	Qualitative	Interviews and observations	Interpretivist phenomenological analysis
Makakavhule (2021)	(An)other space is possible: An exploration of the conflicts and contestations in the realisation of a "democratising" Public Space in the City of Tshwane.	Interpretivist	Qualitative	Semi-structured interviews	Interpretivist phenomenological analysis
Shand (2023)	Nature-based Park making: interpreting nearby nature narratives to promote environmental justice in City of Tshwane community parks.	Pragmatic and ethnographic	Qualitative	Semi-structured interviews Observations GIS-based geo-visualisation	Content analysis

3.2.1 Research paradigm: Interpretivism

Mackenzie and Knipe (2006) state that the “paradigm” describes the research’s philosophical intent or underlying theoretical framework. It outlines the way information is studied and interpreted by the researcher.

The theoretical paradigm adopted for this dissertation is that of the interpretivism paradigm. The interpretivist researcher believes “knowledge and meaningful reality are constructed in and out of the interaction between humans and their world and are developed and transmitted in a social

context" (Scotland, 2012:9). The interpretivist researcher approaches research with the intention of understanding "the world of human experience" (Cohen and Manion, 1994:36).

The interpretivism research paradigm best suits this study because it considers the social, environmental and cultural context influencing people's thoughts and ideas. The paradigm considers social agency that is context-dependent and socially constructed with multiple equally valid realities that exist in parallel (Du Toit, 2015). Other researchers who adopted interpretivism as a research paradigm are Breed (2015), Stander (2019) and Makakavhule (2021). All three studies focus on spatial planning matters, human values, and their interaction with space (see Table 3-1).

According to Alharahsheh and Pius (2020), the interpretivism paradigm enables researchers to utilise qualitative methods most suited to gain deep insights based on a specific context [and human experience]. Saunders et al. (2019) contend that ontological, epistemological, and axiological assumptions and beliefs philosophically underpin a paradigm.

(i) Ontology: Realism

The fundamental underlying ontological assumption behind interpretivism is that "reality is socially constructed" (Mertens, 2005:17). The ontological position of interpretivism is relativism (Saunders et al., 2019; Scotland, 2012; Khan, 2014). Relativist ontology is the belief that reality is a subjective experience (Denzin and Lincoln, 2005; Creswell, 2007) that differs from person to person. "A person's historical background, geographical and cultural context, and social experiences mould their reality and differ from person to person" (Guba and Lincoln, 1994:110).

(ii) Epistemology: Subjectivism

The epistemology assumptions of the interpretivist paradigm are that of subjectivism. The world does not exist independently of our knowledge or experience (Scotland, 2012; Saunders et al., 2019). "Epistemology poses the following questions: What is the relationship between the knower and what is known? How do we know what we know? What counts as knowledge?" (Tuli, 2010:99).

(iii) Axiology: Value-bound

Axiology refers to the role of the researchers' values, biases, and ethics in their search for knowledge (Mertens, 2005; Saunders et al.,2019). It also asks how the researcher should deal with the value-laden information collected in the field from the participants. The axiological assumptions underpinning the interpretivism paradigm are that the researcher and participants' values should be considered integral and reflexive to the research process (Saunders et al., 2019).

Figure 3-3 summarises the research design most suited for this study.

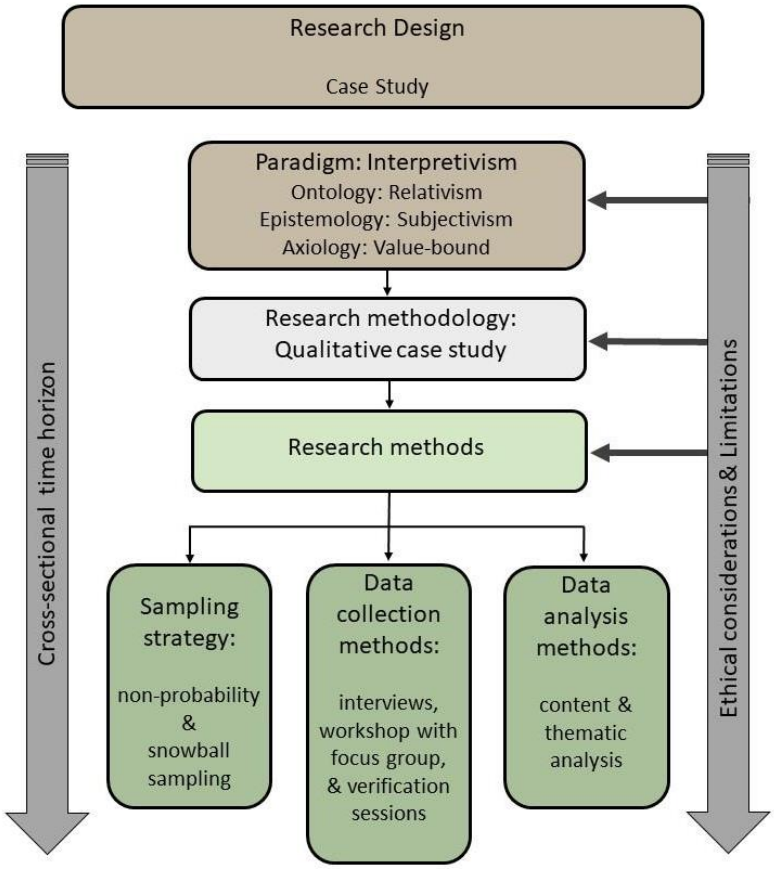


Figure 3-3. Summary of the selected research design for this study

3.3 The Study Area

3.3.1 Geographic context

The City of Tshwane Metropolitan Municipality forms part of the Gauteng Province of the Republic of South Africa. Gauteng is the country's fastest-growing and most densely populated province (Pfab et al., 2017), with 26.6% of the Republic of South Africa citizens residing there. Despite being the smallest province in the country (approximately 18 174km²), Gauteng has a rich biodiversity (Pfab et al., 2017). The Gauteng Department of Agriculture and Rural Development (GDARD) has set conservation targets to protect the province's rich biodiversity considering the rapid urban development through the Gauteng Conservation Plan version 3.3 (C-Plan 3-3) (Gauteng Province, 2014). The C-Plan 3-3 identifies areas within 44% of the province's land cover to achieve these conservation targets. Pfab et al. (2017:1) report that "only 8% of features are close to meeting their targets or are adequately conserved in the current protected area network of 23 protected areas covering 2.4% of the province, while 73% of features are absent or poorly represented". The City of Tshwane comprises more than 30% of the northern portion of the Gauteng Province (City of

Tshwane, 2023d). This places the city in a pivotal position to contribute to provincial and national biodiversity protection.

According to the official City of Tshwane website (City of Tshwane, 2023d), the City of Tshwane is the largest metropolitan municipality by area in South Africa and the third-largest city worldwide (after New York and Tokyo/ Yokohama). The city covers an area of 6298km² (City of Tshwane 2022d) and has a population of almost 3,6 million (City of Tshwane 2022c). The city is the 4th largest city economy in South Africa, contributing 25% to the provincial gross domestic product (GDP) and 9% to the national GDP (City of Tshwane, 2023b).

The City of Tshwane is landlocked and surrounded by four other South African provinces: Limpopo, Mpumalanga, the Free State, and the North-West (see Figure 3.4).

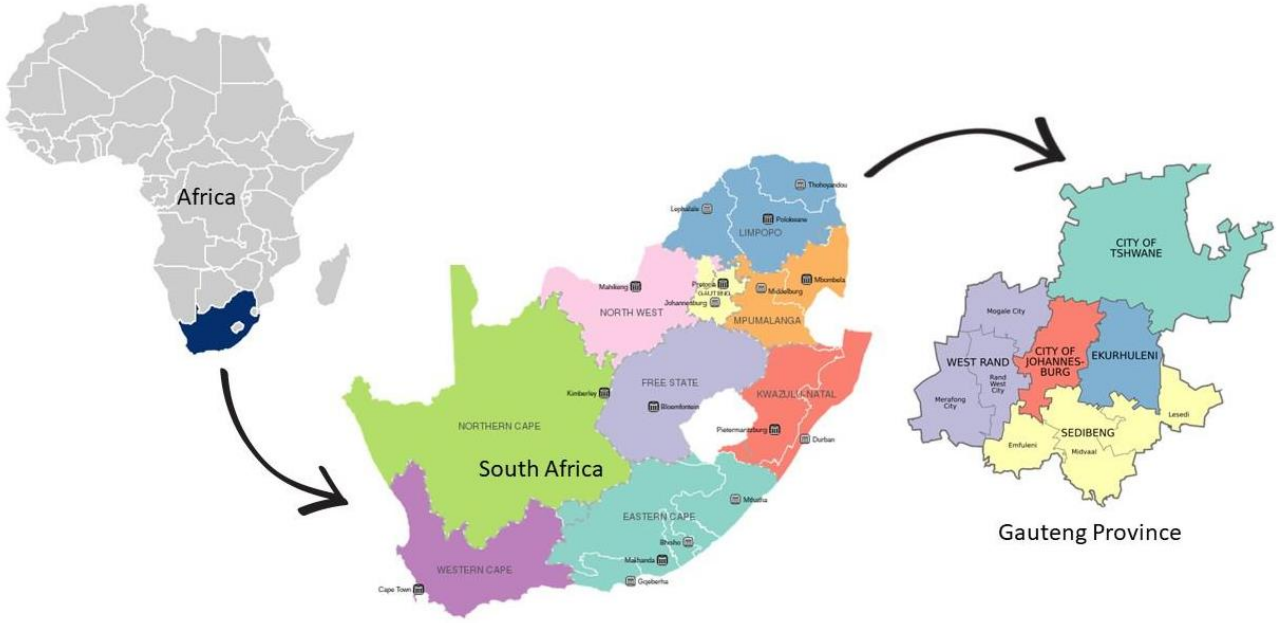


Figure 3-4. City of Tshwane in context (adapted from the City of Tshwane Draft 2022-2026 Integrated Development Plan, March 2022)

The City of Tshwane is divided into seven administrative regions (City of Tshwane, 2021b) (see Figure 3-5).

> "The City's regional services model and regional structures are an integral part of its rationale to bring services closer to the people and to transform regions into superb places to live, work and play while capitalising on each region's uniqueness to create strong, resilient and prosperous areas.
>
> Residents can access key services like water, sanitation, electricity and transport directly from the regions they reside in through our regional offices. Daily functions such as maintenance, repairs and information desks are also delivered directly in the different regions" (City of Tshwane, 2023c).

Figure 3-5. The seven administrative regions of the City of Tshwane (source: VectorStock)

The city falls within two biomes: the Savanna Biome in the north and the Grassland Biome in the southern areas (South African National Biodiversity Institute, 2006). The South African Weather Service's Annual State of the Climate report (2021) states that the City of Tshwane's climate classification is Cwa: Summer rain with hot summers according to the Köppen climate classification system. The city is prone to severe thunderstorms with a significant likelihood of hail events during late spring and early summer (November to December). The city receives an annual average rainfall of 645mm, with a maximum temperature of approximately 30°C in December and a minimum temperature of approximately 3.8°C in June (South African Weather Services, 2023).

3.3.2 Local government context

South Africa became a democratic country in 1994 and has one of the most progressive constitutions in the world (Oechsli and Walker, 2015). The country follows a five-year national, provincial, and municipal election cycle (Electoral Commission of South Africa, 2023). The Executive Mayor is the elected political head, and the City Manager is the city's administrative head (City of Tshwane, 2023d). Twelve functional departments report to the City Manager (City of Tshwane, 2023d) (see Figure 3.6).

Five of the twelve city departments function under the management of the Governance and Support Office, one of which is the Economic Development and Spatial Planning Department. The Economic

Development and Spatial Planning Department is an important stakeholder in the scope of this study. The department's mandate covers spatial plans, land-use schemes, land development applications, geographic information system (GIS) and spatial data, site development plans, urban design, outdoor advertising, streetscape management, green buildings, co-operatives, and public-private partnerships (City of Tshwane, unpublished b).

The Office of the Chief Operations Officer manages the remaining seven departments. The following four departments formed part of the research study, namely Roads and Transport, Environment and Agriculture Management, Community and Social Development, and Human Settlements, because they impact the city's implementation of GI (City of Tshwane, unpublished b). Figure 1-4 illustrates the City of Tshwane's macro-organisational structure as of 2022.

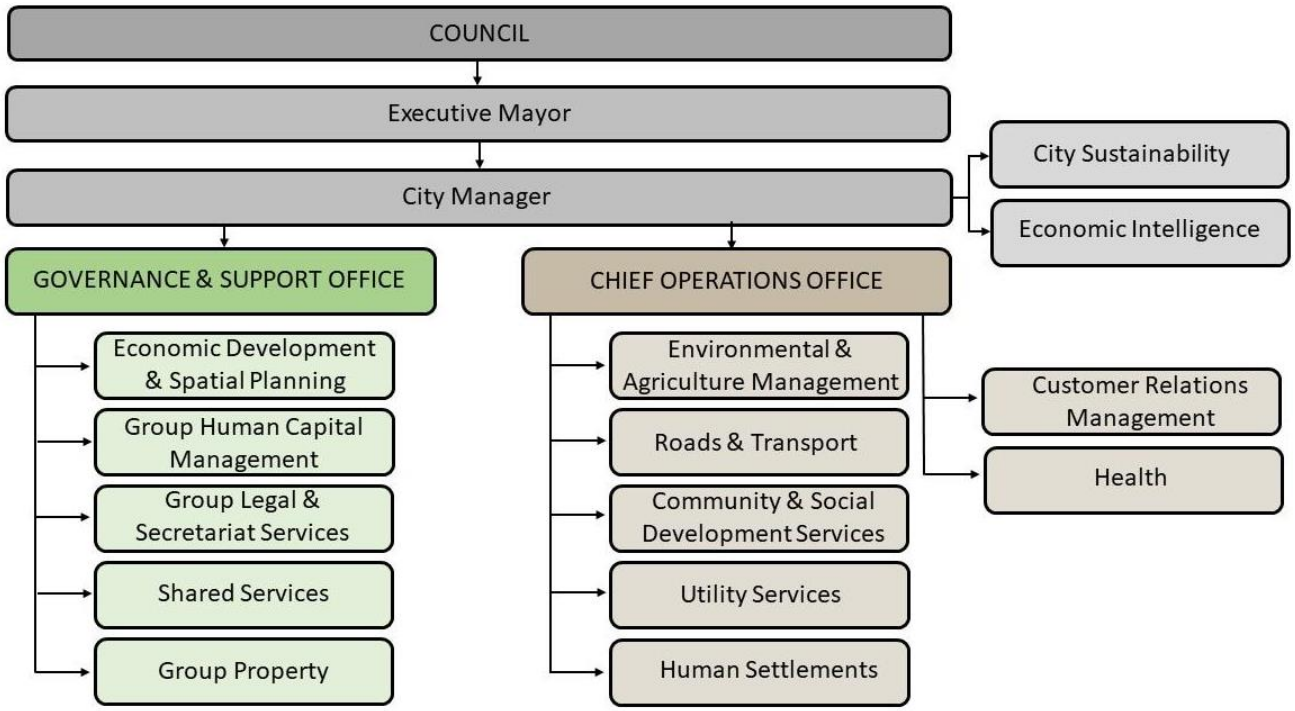


Figure 3-6. The simplified City of Tshwane macro-organisational structure (2022)

3.3.3 The Planning Structure in the City of Tshwane

The following is a brief background of the planning structure in the City of Tshwane.

Spatial planning in the City of Tshwane follows the structure presented in the Spatial Planning and Land Use Management Act, 16 of 2013 (Republic of South Africa, 2013).

The Spatial Planning and Land Use Management Act, 16 of 2013 aims to "provide a framework for spatial planning and land use management in the Republic" and "provide for the inclusive,

developmental, equitable and efficient spatial planning at the different spheres of government" (Republic of South Africa, 2013). Chapter 2, Section 7 of the Act sets out the development principles that, in terms of Section 6 of the Act, guide "(b) the preparation, adoption and implementation of any spatial development framework, policy or by-law concerning spatial planning and the development or use of land" and "(c) the sustainable use and development of land".

The four principles in the Spatial Planning and Land Use Management Act, 16 of 2013 that deal with the outcomes of planning, design and development are (i) spatial justice; (ii) spatial sustainability; (iii) efficiency; and (iv) spatial resilience (Republic of South Africa, 2013). These four principles, plus the fifth principle of good administration, are entrenched in the National Development Plan, 2030 (Republic of South Africa, 2021) and the Gauteng Spatial Development Framework, 2030 (Gauteng Province, 2022).

Kűssel (S. Kűssel, 2023, pers. comm. 25 January) explains that the city prepares a Metropolitan Spatial Development Framework in terms of the Spatial Planning and Land Use Management Act 16 of 2013 that demonstrates the spatial intent of the city. All land development decisions in terms of the Act or any other law relating to land development must be consistent with a Metropolitan Spatial Development Framework unless site-specific circumstances justify deviations from the provisions thereof.

The City of Tshwane has developed a regional approach for its seven regions (refer to 3.3.1). The Regionalised Spatial Development Frameworks translate and integrate the municipality's differential sectorial plans and policies into local development proposals and integrate all the sectoral plans of the city into a single, comprehensive development plan for the region (S. Kűssel, 2023, pers. comm. 25 January).

The Tshwane Open Space Framework, in conjunction with the other policies and plans of the Environment and Agriculture Management department, provides a critical basis for developing the MSDF and RSDFs (S. Kűssel, 2023, pers. comm. 25 January). The Tshwane Open Space Framework is thus a sectorial plan that deals with all aspects of the Environment and Open Space during the planning cycle and guides planning, development, and operational phases. The Tshwane Open Space Framework includes several tiers of spatial plans over and above the Policy itself. These include the Metropolitan Open Space Plan, Regional Open Space Plans and, in special nodes, Local Open Space plans. These plans are all developed to proactively place the city's position in the public domain and give a spatial expression to the Tshwane Open Space Framework (S. Kűssel, 2023, pers. comm. 25 January).

The Metropolitan Spatial Development Framework forms part of a suite of policy documents that informs the city's Integrated Development Plan. The Integrated Development Plan is a single, inclusive, strategic plan that considers the city's future development and is required in terms of the Local Government: Municipal Systems Act 32 of 2000 (Republic of South Africa, 2000). According to Section 25(1) of the Local Government: Municipal Systems 32 of 2000, the Integrated Development Plan is intended to provide strategic direction and operational planning for the city (for the 5-year term of the elected Council). It aligns the resources and capacity of the municipality with the implementation plan and forms the policy framework on which annual budgets must be based (City of Tshwane, 2023e). Figure 3-7 broadly illustrates the relationship between the most pertinent national and provincial legislation and policy documents that influence the City of Tshwane's land development planning process and how the internal environmental and planning policy documents inform (or should inform) one another.

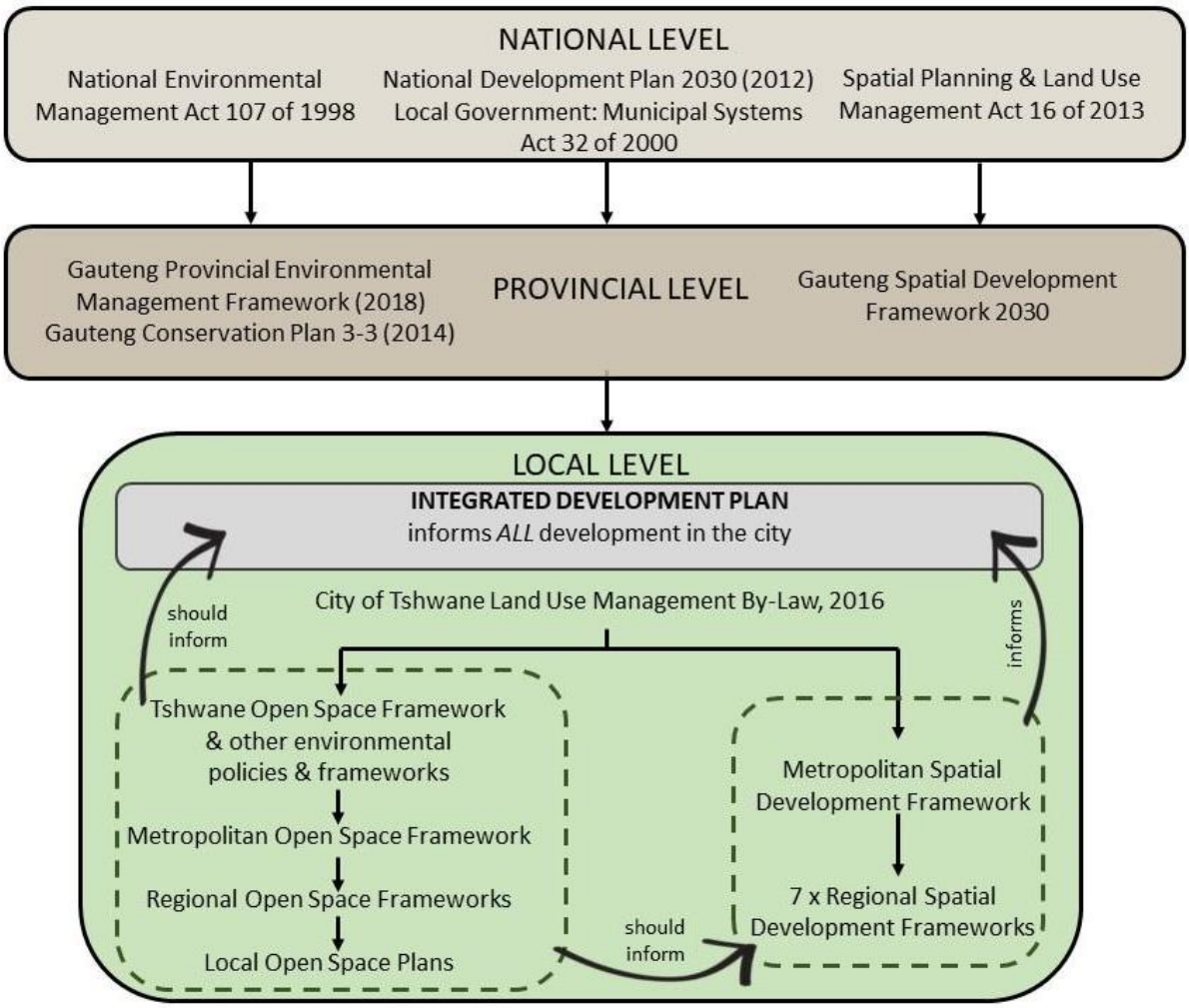


Figure 3-7. Illustration of the relationship between the national, provincial and City of Tshwane's environmental and planning polices

3.4 Methodological approach: Qualitative case study

The qualitative case study methodology was selected for this research because the study uses inductive reasoning and aims to develop a set of findings by examining the sample population's lived experiences (Streefkerk, 2022) with specific reference to the process of GI application in the City of Tshwane (see 3.2). This contrasts with the quantitative approach, which uses deductive reasoning and aims to test an existing theory (Streefkerk, 2022). Rashid et al. (2019) cite three reasons that justify the application of the qualitative case study research methodology. Firstly, if the problem under investigation requires an in-depth exploration of the phenomenon; secondly, if value is determined contextually by the actors involved; and thirdly, the study is aimed to discover the processes involved. This study's approach conforms to all three justifications, as cited by Rashid et al. (2019). This study aims to propose planning guidelines that could improve decision-making for the application of GI at the SDP stage in the City of Tshwane. The qualitative research methodology adopted involved collecting in-depth qualitative data from four sources and validating the outcomes by means of triangulation.

3.4.1 Data collection

The study used three primary and one secondary data collection method, each designed to address the research sub-questions in Chapter 1, Section 1.3 and to create several options for respondent participation and data verification. The three primary data collection methods are semi-structured interviews, a participatory workshop preceded by an online survey, and post-workshop clarification meetings. The secondary data collection method was a desktop review of the policy documents (see Chapter 2, Section 2.9.1 for a detailed description of the policy document identification process). Crowe et al. (2011:6) advocate "the use of multiple sources of data" (data triangulation) to increase the validity of a study, which supports the use of several data collection sources as applied to this study. Figure 3-8 illustrates the data collection methods used to gain data to answer the research sub-questions.

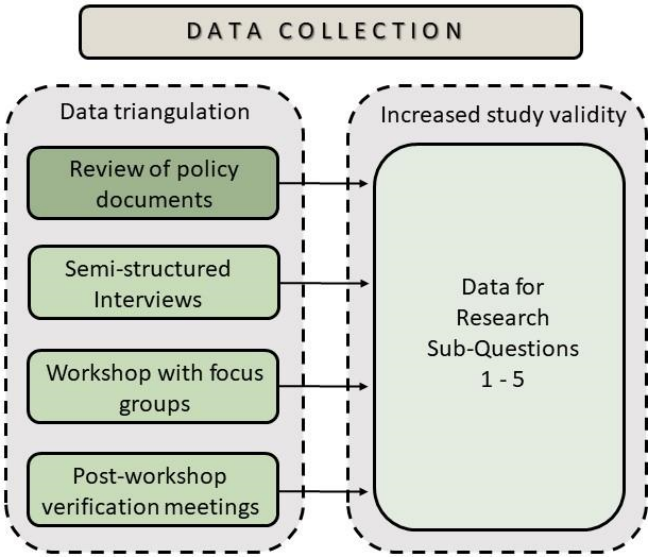


Figure 3-8. Primary and secondary data collection sources related to the research sub-questions

(a) Data collection method: Policy documents

The secondary data was collected by means of a desktop review of the policy documents. See Chapter 2, Section 2.9.1 for a detailed description of the policy document identification process and See section 3.4.2(i) for a description of the document analysis process.

(b) Data collection method: Semi-structured interviews

Interviews are a widely used data collection instrument applied in qualitative research to gather information about a participant's beliefs, views and experiences regarding a specific area of concern or phenomenon (Ryan et al., 2009). Semi-structured interviews were selected for this study as they offer a flexible interview process. The process relies on preparing open-ended questions on a predetermined topic. This approach allows the researcher to clarify technical terms and concepts and for unanticipated responses to arise through open-ended questioning (Ryan et al., 2009). Ryan et al. (2009) argue that this instrument facilitates the collection of more in-depth, richer data than formally structured interviews. Semi-structured interviews are used as data-capturing methods for qualitative studies by various researchers studying social agency (see Table 3.1).

According to Durdella (2019), semi-structured interview guides balance interview questions with interview dynamics, allowing for a flexible process using a mix of questions, prompts, and topics as the conversations evolve. The researcher drafted the questions for the semi-structured interviews based on the main research question and five research sub-questions. The sequencing of the questions was structured to commence with easy, non-threatening demographic questions regarding the academic and employment history of the participant. The questions focussing on the research topic followed.

The researcher first prepared a draft open-ended questionnaire to guide the scoping interviews. Three scoping interviews were undertaken to test whether the prepared questions would solicit the required answers to the research questions. The scoping interviews were conducted with one private sector consultant and two public sector employees involved with spatial planning at the City of Tshwane. The adjustments made to the draft questionnaire for the remaining interviews were:

- Rearrangement of the question order to facilitate a logical flow of the conversations;
- Some questions were edited and posed differently for more clarity;
- Omission of some questions that did not solicit answers that were useful to the study; and,
- More detailed questions were added.

After the scoping interviews had been concluded and the draft interview questionnaire amended, the formal semi-structured interview process commenced.

The formal questions were divided into five clear sections to address the five research sub-questions. Section 1 dealt with the term GI and aimed to gain insight into the interviewee's understanding and knowledge of the concept. Section 2 dealt with the challenges and opportunities experienced with applying GI in the City of Tshwane. Section 3 aimed to obtain insight into the land development application process in the city, the mandate and role different city departments play in the city's spatial development, problems with the current process, and how these could be addressed. Interviewees were also asked which spatial planning policies, frameworks, and by-laws are or should include guidelines for applying GI. Section 4 probed the possible avenues which could be pursued to ensure the inclusion and application of GI in the city's legal spatial frameworks. And finally, section 5 aimed to identify existing good examples of successful case studies where GI has been applied. The interviewees could provide any other comments that would add to the research findings. The researcher provided the interviewees with her contact details for further communication. The final interview questionnaire is available in Appendix D.

(b-i) Semi-structured interview sampling strategy

The sample population for this study was selected utilising non-probability purposive and snowball sampling (McCombes, 2023).

The purposive sample selection aimed to include experienced participants with long-standing insight and knowledge of both the city and the land-use planning application and approval process at the SDP stage. This sampling method was appropriate for the in-depth questioning methods used during the interview process, which required the participants' comprehensive institutional understanding and insight (Kelly as cited in Terre Blanche et al. 2006:288). The semi-structured interviews were

conducted with the City of Tshwane officials[5] directly involved in the day-to-day evaluation of land development applications and the functioning of GI in the city.

The main focus of the study was on the Environmental Planning and Open Space Management Division. The Director selected the initial group of 11 key City of Tshwane officials directly involved with the land development application process (specifically GI implementation) to be involved in the study. During the semi-structured interviews, five other city officials from peripheral departments were identified through snowball sampling. The latter are experts on the research topic and could add additional perspectives to the research based on their specific institutional experience and knowledge. Two private practice landscape architects who work with the City of Tshwane's land development applications were also included to obtain balanced viewpoints. The average duration of the 18 interviews was 60 minutes.

The designations of the officials interviewed varied from Director, Deputy Director, Acting Director, and Functional Head. This means that only senior management staff were interviewed. The officials' fields of expertise range from environmental science, town planning, landscape architecture, project management, horticulture, nature conservation management, geography, interior architecture, innovation and development, agriculture, and environmental management. They are at either master's, bachelor's, or national diploma level. Civil engineers from the Transportation Department (Roads and Stormwater Division) were also approached and included in the interviews.

Some of the officials interviewed work in operations, whilst others work in strategic planning and policymaking, such as land development applications, environmental management and compliance, formalisation of informal housing settlements, social development, spatial planning and infrastructure development.

The final sample size of City of Tshwane officials involved in the semi-structured interviews is 16 out of a sample population of 1475 staff involved with land-use planning (see Table 3-2). Kelly, cited in Terre Blanch et al. (2006:288), recommends a guideline of between six and 20 sampling units for a homogeneous sample, depending on the duration of the interviews. Therefore, the 16 sampling units interviewed for an average of 60 minutes are justified for this study.

[5] The total number of officials employed by the City of Tshwane during 2019/2020 was 28,281, with a vacancy percentage of 29.81% (Municipalities of South Africa, 2023).

Table 3-2. Number of city officials involved in land-use planning during 2019/2020 (source: adapted from approved City of Tshwane Organisation Structure 2019/2020)

City of Tshwane Department	Total staff per department	Staff involved with land-use planning	Study sample size
Office of the City Manager	136	unknown	1
Economic Development and Spatial Planning	797	214	0
Roads and Transport	1472	570	1
Environment and Agriculture Management	2373	643	11
Community and Social Development Services	477	31	1
Human Settlements	111	17	1
Totals	5366	1475	16

All city officials interviewed have been employed by the City of Tshwane for more than eight years. The official with the longest period of employment with the city has completed 39 years of service. On average, the officials interviewed have been employed by the City of Tshwane for over 22 years, which validates their contributions to the study as they are long-term city employees conversant with the procedures and processes followed at the city. The officials interviewed can, therefore, be seen as experts in the GI processes of the City of Tshwane.

To obtain a more holistic perspective, the researcher interviewed two private sector consultants (landscape architects) who work on land development proposals for developments in the City of Tshwane, as mentioned above. The two private sector practitioners were interviewed at this stage purely to gain a supplementary view to that gained from the city officials. The two landscape architects have 22 and 10 years of private practice working experience, respectively. They are registered as professional landscape architects with the South African Council for the Landscape Architectural Professions (SACLAP). These interviews aimed to gain a perspective from the private sector regarding the challenges experienced and opportunities that may exist with implementing GI at the SDP stage in the City of Tshwane.

The South African Council for the Landscape Architectural Professions (SACLAP) provided data on the number of registered landscape architects and technologists in South Africa and Gauteng. No data regarding the number of registered landscape architects and technologists who reside and operate in the city was available from the Environment and Open Space Planning Division of the municipality, SACLAP or the Institute for Landscape Architecture in South Africa (ILASA). Therefore, for this study, it is estimated that 50% of all SACLAP registered professionals who reside in Gauteng are involved with land-use planning developments in the City of Tshwane.

The final sample size of registered landscape architects and technologists involved with land-use planning at the City of Tshwane and interviewed is two out of an estimated sample population of 80 (see Table 3-3).

Table 3-3. Sample population and sample size of landscape architects involved in land-use planning at the City of Tshwane (Source: South African Council for the Landscape Architectural Professions, 2023)

Professional registration category with the South African Council of the Landscape Architectural Professions (SACLAP) on 04 April 2023	Located in Gauteng	Estimated number involved with land-use planning at the CoT	Study sample size
Professional landscape architects	137	69	2
Professional landscape technologists	22	11	0
Totals	159	80	2

The final sample size was 16 out of 1475 staff involved with land-use planning at the City of Tshwane and two out of 80 registered landscape architects and technologists.

A total of 14 semi-structured interviews were conducted with 16 city officials and two registered landscape architects.

(b-ii) Semi-structured interview process

Sixteen (16) City of Tshwane officials were interviewed between December 2021 and May 2022. Eleven (11) of the interviews were conducted one-on-one to encourage open and uninhibited conversations with the understanding that all opinions and remarks were made in strict confidence and anonymously according to the University of Pretoria's Ethics regulations (refer to Section 3.6). The remainder of the officials were interviewed in three small group interviews, which were held with colleagues from the same division who felt comfortable conversing with the researcher with their colleague/s present.

The researcher contacted each prospective city official telephonically to invite their participation in the study. A follow-up email with background information regarding the study, its position within the larger GRIP research project, proof of the researcher's ethic clearance by the University of Pretoria and a permission letter from the City of Tshwane: Knowledge Management department for city officials to participate in the study were attached.

The interviews took place in settings the city officials selected to put them at ease. The aim of the study and the open-ended prepared questions were discussed with the participants. They were asked if they had any concerns regarding the interview or the questions. The participants then gave

written consent (see Appendix E) to be interviewed and audio recorded with permission to be quoted anonymously. The researcher informed the city officials that they could request that any parts of the interview be deleted and not used in the study.

The interviews were recorded on an iPhone XR using the "Voice Memo" application and supplemented by manual note-taking. The audio recordings were uploaded to a password-protected file on the researcher's desktop computer. The physical written notes are stored in a securely locked file cabinet.

(c) Data collection method: Participatory workshop (with focus groups)

The second method in the data collection process entailed a participatory workshop. The Association for Qualitative Research (2022) defines a workshop as "An interactive session, often taking a full day or more, in which clients, researchers and other participants such as customers work intensively on an issue or question. The process often combines elements of qualitative research, brainstorming and problem-solving." The workshop aimed to co-develop a GI definition and planning guidelines for the city. It also sought to obtain recommendations on where to place the guidelines within the city's hierarchy of spatial planning documents with private- and public-sector input. It was also used to give feedback to the research participants on the data collected regarding the identified challenges and opportunities that the officials faced with applying GI.

The workshop process commenced with an online survey a week before the event. An online survey is a structured questionnaire completed by the target audience who fill out an online form. The value of an online survey lies in its flexibility and convenience. It is not a time-consuming or expensive data collection tool, allowing for controlled sampling (Evans and Mathur, 2005; Braun et al., 2021). The rationale for the online survey was to prompt the workshop participants and stimulate their thinking on the topics to be discussed at the workshop in preparation for the event. The survey questions were formulated around the research questions that were the workshop's focus (see Appendix F).

<u>Online survey section A:</u>

The survey participants were asked to indicate on a scale of 1 to 10 (where 1 = not relevant and 10 = spot on) which green space principles they believed are important for improving GI functionality and benefits in the City of Tshwane. The participants merely indicated their preference and were not asked to give a numeric value to the principle they preferred, as with a Likert scale-type survey. The purpose of the information illustrated in Table 5-6 on pages 131 & 132 is to show how the ranking of the GI principles changed quite substantially from the survey to the workshop focus groups.

Online survey section B:

The survey participants were provided with three GI definitions and asked to select the one that they felt was the most appropriate for the City of Tshwane. They could also provide their preferred definition.

Online survey section C:

The final two questions were formulated around whether GI management, GI planning and/or the GI decision-making process was functioning well or was problematic in the City of Tshwane. The rationale behind these two questions was to establish where the greatest institutional challenges and opportunities occurred with the application of GI, according to the participants.

Only 17 of 23 people participated in the survey.

During the workshop, the focus group method was selected to add rigour and triangulate the results by challenging and clarifying data already collected from the interviews and document review. According to Powell and Single (1996), a "focus group is a group of individuals selected and assembled by researchers to discuss and comment on, from personal experience, the topic that is the subject of the research". Gill et al. (2008) contend that focus groups help generate information on collective views and understanding of the participants' experiences and beliefs. The Workshop Agenda is available in Appendix G).

(c-i) Sample population and sample size: Participatory workshop

The workshop participant invitee list determined the sample population for the pre-workshop online survey (see item 3 below). All workshop invitees who had accepted the invitation to attend the workshop were emailed the survey questionnaire. Seventeen anonymous responses were received.

The workshop participants were strategically invited based on their expertise in land use applications at the City of Tshwane. All city officials interviewed during the semi-structured interview received an invitation to join the workshop. Additional "expert" city officials, specifically from Economic Development and Spatial Planning, were invited as they play a vital role in the land development application process at the City of Tshwane. The original group of invited participants identified additional city officials and the CSIR researchers who could contribute to the study through snowball sampling. These recruits form part of the workshop's final sample population. The researcher selected the built environment practitioners based on their practice experience and experience with SDP applications at the City of Tshwane.

The developers invited to participate were identified by the Acting Deputy Director of Development Facilitation (City of Tshwane: Economic Development and Spatial Planning) based on his position as chairperson of the City of Tshwane's monthly project management meetings with city developers. One developer could not participate but sent a delegate to participate in the study. Two of the six invited developers participated in the process.

A total of twenty-three (23) stakeholders participated in the workshop. The sample population and sample size for the workshop are shown in Table 3-4.

Table 3-4. Sample population and sample size for the workshop

	City Officials	Additional CoT officials	Property developers	Built environment practitioners	CSIR researchers	
Invited	18	7	6	6	3	Sample population 40
Accepted and participated	13	1	2	5	2	Sample size 23

(c-ii) Data collection process: Participatory workshop

A pre-workshop online survey was prepared using Google Forms and emailed to the sample group a week before the event. The survey formulation aimed to encourage responses from the participants (Annexure F). The researcher selected "Google Forms" software because it is freely available and easy to use, and results are available in real-time. The survey was emailed to the target audience and contained a link to the Google Form questionnaire. The respondents completed the questionnaire by clicking on the link, responding to the questions and submitting the completed survey by using the submit button on the final page of the questionnaire. Twenty-five (25) pre-workshop questionnaires were distributed, and 17 responses (68%) were received and electronically captured.

The workshop occurred on Friday, 29 July 2022, from 9:00 to 12:30 at the University of Pretoria's Future Africa campus on the university's experimental farm in Hatfield, Pretoria.

The workshop's format and content were co-developed between the researcher and her supervisor. Dr Christina Breed facilitated the workshop. Dr Breed is a professional landscape architect and senior lecturer at the University of Pretoria. Five observers (one lecturer and four masters' students,

including the researcher) from the University of Pretoria, Department of Architecture, assisted Dr Breed.

The workshop's objectives are aligned with the study's objectives (see Chapter 1) and aim to contribute to the study's findings. The purpose was to test the ideas and recommendations gained from the individual semi-structured interviews and document review phases with smaller focus groups of various professionals. The objectives of the workshop are listed below:

- To share and test the relevance of draft research findings for a GI definition and planning principles relevant to the city with selected key stakeholders from industry, the built environment professions, and city officials (relates to research sub-questions 2 and 3);
- To co-develop a joint vision for the provision of GI at a city-wide level (relates to research sub-questions 1, 2, 3, 4 and 5);
- To clarify expectations regarding the contents and format of a workable GI guideline document (relates to research sub-question 5); and,
- To gain input on a) current decision-making and b) how it can be improved [regarding incorporating GI spatial planning principles in the city's land-use development application process] (relates to research sub-questions 1, 4 and 5).

Five workshop activities were carefully designed to encourage participation and co-creation of outcomes by the attendees, namely:

- Editing of the draft definition for GI for the City of Tshwane.
- Smaller focus group ranking and discussion of draft spatial planning GI principles.
- A large focus group discussion was facilitated to develop a shared view regarding the main objective for the provision of GI at the SDP stage.
- Smaller focus group discussions and selection of the preferred format and contents for the proposed GI spatial planning guideline document.
- A final combined group discussion to share ideas on the decision-making process regarding implementing GI in the City of Tshwane.

Workshop Session 1: Introduction (9:00 - 9:30)

Dr Breed opened the workshop and explained that the research forms part of the GRIP research project Work Package 4: Urban GI Planning (refer to Section 1.2). The researcher briefly reported on the status quo of the research study. The desktop studies and semi-structured interviews were completed. The researcher presented the key findings from the semi-structured interviews. These were not discussed, as this was not the workshop's focus.

Next, the workshop participants took part in the first small group activity with two or three people in a group. The exercise aimed to co-create a GI definition for the City of Tshwane (refer to Section 5.2.1). A draft definition compiled from the three definitions in the pre-workshop online questionnaire was the point of departure. The small groups had five minutes to edit the proposed GI definition. Audio recordings were made by Dictaphone. A total of 3 recordings of between 4 minutes 15 seconds and 5 minutes 3 seconds were transcribed for content analyses.

Workshop Session 2: Draft GI Principles (9:30 - 10:00)

The researcher presented the draft findings on GI planning principles applicable to the local context of the City of Tshwane collated from the literature and the City of Tshwane's spatial planning regulatory frameworks. The participants were purposively divided into three focus groups to ensure the representation of the expertise present in all the groups. This was important as it ensured the formulation of three independent opinions in the three focus groups. Each group was asked to rank the draft guiding principles in order of importance (top three) for the City of Tshwane. The omission and addition of principles were permitted. The focus groups spent approximately 20 minutes debating the rankings, then presented their rankings and agreed on a final, combined workshop ranking.

Workshop Session 3: Draft GI Planning Guidelines for SDP applications (10:25 - 11:30)

The participants motivated their beliefs regarding the key objective of the city's requirement for the inclusion of GI (public open space) in residential land development applications at the SDP stage. The desired outcome of this activity was to develop a joint vision for the provision of open space in the city.

After that, the three focus groups were given five SDP guideline formats[6] from four South African metropolitan municipalities: Cape Town, Johannesburg, eThekwini and Tshwane. They were asked to assess which format and content would be appropriate and usable for an SDP guideline document for the City of Tshwane. The desired outcome of this activity was to obtain consensus on the most accessible, user-friendly format for an SDP guideline document for the City of Tshwane.

[6] 1- Development Management Information Guidelines Series Booklet 7: Landscape Plan (City of Cape Town, 2010)
2 - Development Assessment Guides (eThekwini Metropolitan Municipality, 2010)
3 - Development Application Requirements (City of Tshwane, 2019)
4 - Application Form 12 Site Development Plan (City of Johannesburg, 2019)
5 - Understanding the Building Plan Submissions/ Approval Process (eThekwini Metropolitan Municipality, 2017)

Workshop Session 4 (final): Decision-making and wrap-up (11:50 - 12:30)

The participants were asked to respond to three questions regarding the decision-making process at the City of Tshwane and to motivate their answers. The questions were:

- Who owns it?
- Who is involved?
- What is the process?

The desired outcome of this activity was to obtain recommendations from the participants on how to streamline the incorporation of GI in the land development application process.

Dr Breed closed the workshop and explained that the next step would be for the research team to amend the draft GI definition and spatial guiding principles for the City of Tshwane and circulate the workshop outcomes and revised documents to the participants for further comment. All the participants indicated they wished to remain part of the process.

The five facilitators from the University of Pretoria documented the proceedings by taking handwritten notes and photographs with their cell phones and making audio recordings with three Dictaphones. Each focus group had one facilitator allocated to the group. The observers ensured that the discussions remained focused on the workshop objectives and that all participants could express their opinions. The fourth facilitator took general notes, and Dr Breed moved from one table to the next to clarify the aim and outcome of each activity and monitor progress.

(d) Data collection method: Post-workshop clarification meetings

Four post-workshop clarification meetings were held to confirm and verify data collected at the workshop and during the interviews. These follow-up meetings were held with key stakeholders who could clarify and validate the aspects that required corroboration to add rigour and triangulate the results by challenging and clarifying data already collected. It was also used to give feedback and test and verify the data collected at the workshop.

(d-i) Sample population and sample size: post-workshop clarification sessions

One in-person clarification meeting was held with an independent town planner, and three other clarification sessions with key city officials were conducted. One meeting was held with two officials from the Economic and Spatial Development Department and two with officials from the Environmental Management and Open Space Planning Division (one in-person with five city officials and one online session with two officials). The sample size of these post-workshop conversations is ten.

(d-ii) Data collection process: Post-workshop clarification meetings

The first meeting was held with an independent town planner in private practice to discuss the implication of some clauses in the city's Town Planning Scheme, which refer to the city's obligation to provide public open space. This meeting was not recorded by audio device but through informal handwritten notes at the interviewee's request. Formal minutes were not drafted nor distributed after the meeting. The meeting duration was 63 minutes.

The second clarification meeting occurred with two city officials from Economic Development and Spatial Planning. Firstly, to confirm which of the city policy documents should include the GI spatial planning principles, and secondly, how could the application of the GI guiding principles by all city departments, developers and built environment professionals be ensured. The meeting was recorded by means of an audio recording and handwritten notes. The draft minutes of the meeting were distributed to all attendees for verification and corrections. The meeting duration was one hour and fifteen minutes.

A third clarification meeting took place with five Environment and Agriculture Management Department representatives. The purpose of the meeting was to give the Director: Environmental Management and Open Space Planning feedback from the workshop and to confirm some of the workshop outcomes. The officials were invited to express any concerns regarding the research outcomes in a controlled environment where they could freely speak. The Environment and Agriculture Management Department officials concurred that they were all comfortable with the workshop outcomes and recommendations. The meeting was recorded by means of an audio recording and handwritten notes. The draft minutes of the meeting were distributed to all attendees for verification and corrections. The meeting duration was fifty-three minutes.

Lastly, an online meeting was held with two city officials from the Environment and Agriculture Management Department to test and validate the conclusions drawn from all the data collection processes. The clarification discussions tested and validated the data captured and concluded the data collection phase of the study. The meeting lasted forty-eight minutes. Handwritten notes were taken of the proceedings, and follow-up email correspondence was employed to clarify uncertainties and request additional information.

(e) Summary: Data collection

Thirty-three stakeholders participated in the three data collection phases of the study, consisting of 21 city officials, eight private sector-built environment practitioners, two CSIR researchers, and two city property developers. Table 3-5 below summarises the respondent profile and activities they

participated in. The online pre-workshop survey results are not included, as the submissions were made anonymously.

Table 3-5. Summary sample sizes and activity participation schedule

Participant	City of Tshwane department	Semi-structured interviews	Workshop	Post-workshop discussions
City of Tshwane 1	City Planning, City Sustainability, Community and Social Development, Economic Intelligence, Environmental Compliance, Environmental Impact Management, Environmental Planning and Open Space, Human Settlements, Landscape Planning and Urban Design, Nature Conservation, Open Space Planning and Applications, Resorts, Roads and Stormwater.	X		XX
City of Tshwane 2		X	X	XX
City of Tshwane 3		X	X	
City of Tshwane 4		X	X	
City of Tshwane 5		X	X	X
City of Tshwane 6		X	X	X
City of Tshwane 7		X	X	
City of Tshwane 8		X		
City of Tshwane 9		X		
City of Tshwane 10		X		
City of Tshwane 11		X		
City of Tshwane 12		X		
City of Tshwane 13		X	X	X
City of Tshwane 14		X	X	
City of Tshwane 15		X	X	
City of Tshwane 16		X		
City of Tshwane 17			X	X
City of Tshwane 18				X
City of Tshwane 19			X	
City of Tshwane 20			X	
City of Tshwane 21			X	
TOTAL City of Tshwane officials		16 participants in 12 interviews	13 participants	9 participants in 3 sessions
Practitioner 1	Civil Engineer Landscape Arch Town Planner Town Planner Urban Designer		X	X
Practitioner 2		X	X	
Practitioner 3		X		
Practitioner 4			X	

Practitioner 5			X	
Practitioner 6			X	
Practitioner 7			X	
Practitioner 8				X
TOTAL Built Environment Practitioners (BEP)		2 participants in 2 interviews	6 participants	2 participants in 2 sessions
CSIR 1	Researcher		X	
CSIR 2			X	
TOTAL Council for Scientific and Industrial Research observers		0 participants	2 participants	0 participants
Developer 1	Developer		X	
Developer 2			X	
TOTAL Developers		0 participants	2 participants	0 participants
TOTAL SAMPLE SIZE: 33		18	23	11
		Semi-structured interviews	Workshop	Post-workshop discussions

3.4.2 Data analysis procedures

The methods and procedures followed to analyse the data collected follow. The data analysis process selected for this study loosely follows Maying's (2014) "Inductive Category Formation" form of content analysis. This relatively quick, economical, and specific procedure aims to reduce material to its core categories. Inductive category formation aims to arrive at summarised categories inductively from the material and not theoretical considerations. According to Mayring (2014), inductive category formation for qualitative content analysis is a very effective procedure. The text is interpreted within its context, i.e., the material is examined regarding its origin and effect. Figure 3-9 illustrates the data analysis process.

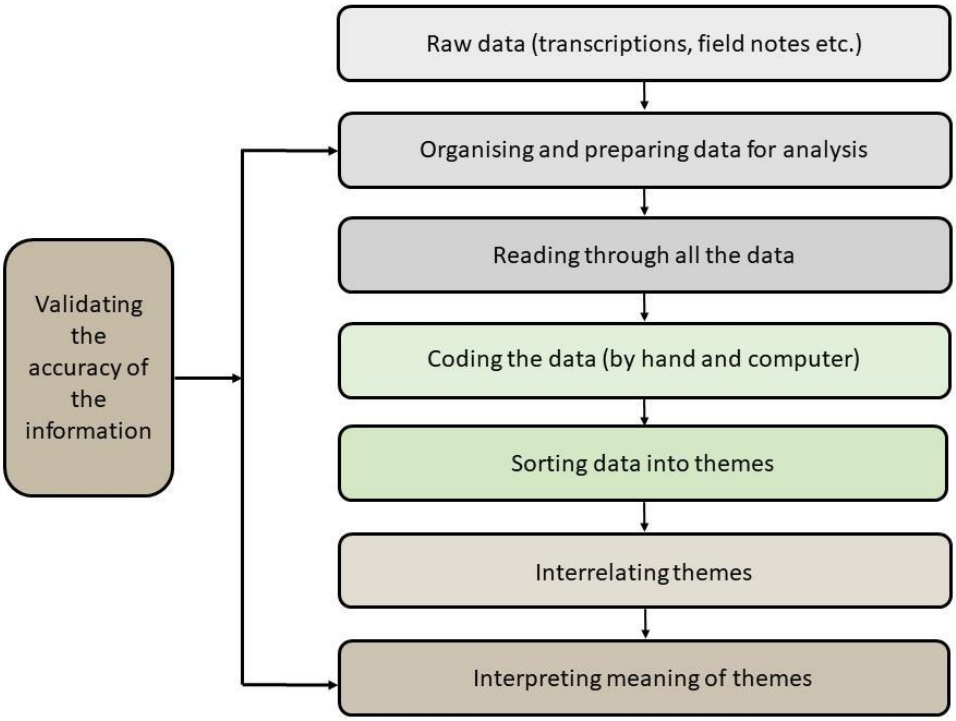


Figure 3-9. Data analysis and interpretation process (source: adapted from Creswell 2014)

(i) Policy document analysis method

Each policy document was reviewed deductively (with reference to a preliminary list compiled from the literature, specifically Monteiro et al., 2020; Pauleit et al., 2017 and Pauleit et al., 2021) and inductively (Saldaña and Omasta, 2018) and the content (words, phrases, clauses, parts of sentences or complete sentences, paragraphs) (Mayring, 2014; McCombes, 2022) of each was analysed in search for GI planning principles, which were identified and copied into an excel spreadsheet. The content analysis process involved the identification of recurring principles into themes by searching for the interrelations between coded terms and phrases (Creswell, 2014) to develop a list of recurring environmental and spatial planning principles in the national, provincial and local policy documents. The spatial and environmental planning principles extracted and consolidated from the policy documents are illustrated in Chapter 5, Table 5.2.

(ii) Interview analysis method

The voice recordings were transcribed verbatim using the *Otter.ai* version 22 audio transcription programme and manually cross-checked (Rashid et al. 2019) with interview notes to correct errors made by the audio transcription program (Creswell, 2014). A coherent text representing the original wording and grammatical structure was produced (Mayring, 2014).

Each interview was reviewed using the same inductive and content analysis process as described in (i) above by deriving themes that came up during the interviews and searching for their interrelations (Creswell, 2014) to develop a list of opportunities and challenges faced regarding the implementation of GI in the City of Tshwane.

(iii) Participatory workshop data analysis method

Pre-workshop online questionnaire

The maximum possible total score of 160 per principle was calculated as follows:

> 10 (maximum score a respondent could assign to a principle) multiplied by the total number of respondents (16). Therefore, the maximum total score: 10 x 16 = 160.

The assigned scores of each principle were calculated by adding the individual scores out of a maximum of 10 allocated to the principle by each of the 16 respondents to get a total out of 160. The principles obtained a relatively low variance in scores.

Workshop Activity a

As described previously, the workshop participants took part in a small group activity to co-create a GI definition for the City of Tshwane. The research team collected the results of this small group session for further analysis. The researcher examined the hard copies of the GI definitions that the workshop participants edited. All suggestions regarding specific words and phrases to be included or omitted were listed and categorised (see Chapter 5, Table 5-2). The proposals were compared to recommendations made during the interviews, the online pre-workshop questionnaire and literature (both Global North and Global South) to triangulate the data (Rashid et al., 2019). Considering all of the inputs and recommendations, a revised GI definition for the City of Tshwane was drafted (see Chapter 5, Section 5.2.1).

Workshop Activities b - e

The workshop audio recordings from three Dictaphones and the written notes from the facilitators of the proceedings were uploaded to a secure University of Pretoria Google Drive folder with restricted access. The researcher checked the quality of the recordings and removed duplications. An independent transcriber transcribed the best-quality recordings that covered all the sessions. The electronic MS Word transcriptions received from the transcriber were manually cross-checked by the researcher and verified against the original audio recordings and handwritten notes. Corrections were made where necessary.

Each transcription was reviewed inductively (Saldaña and Omasta, 2018), and the content (words, phrases, clauses, parts of sentences or complete sentences, paragraphs) (Mayring 2014; McCombes, 2022) of each transcription was analysed, coded and interpreted. Similar codes were grouped together in an Excel spreadsheet. The qualitative coding allowed for data interpretations to be structured into meaningful findings (Delve, 2022.). Coding in qualitative research allows the researcher to be reflexive, critical, and rigorous with their findings (Devle, 2022). The co-developed outputs from the five workshop activities were incorporated into each aspect of the research study (refer to Chapters 5 and 6 for detailed findings).

(iv) Post-workshop clarification meetings analysis

The post-workshop clarification meetings were not analysed. They were conducted to test, validate and confirm outcomes from interviews, participatory workshop and document review processes.

3.4.3 Summary: Data collection and analysis process

Figure 3-10 summarises the data collection from multiple data collection sources, the analysis and interpretation of the data and how that relates to the findings of the research questions.

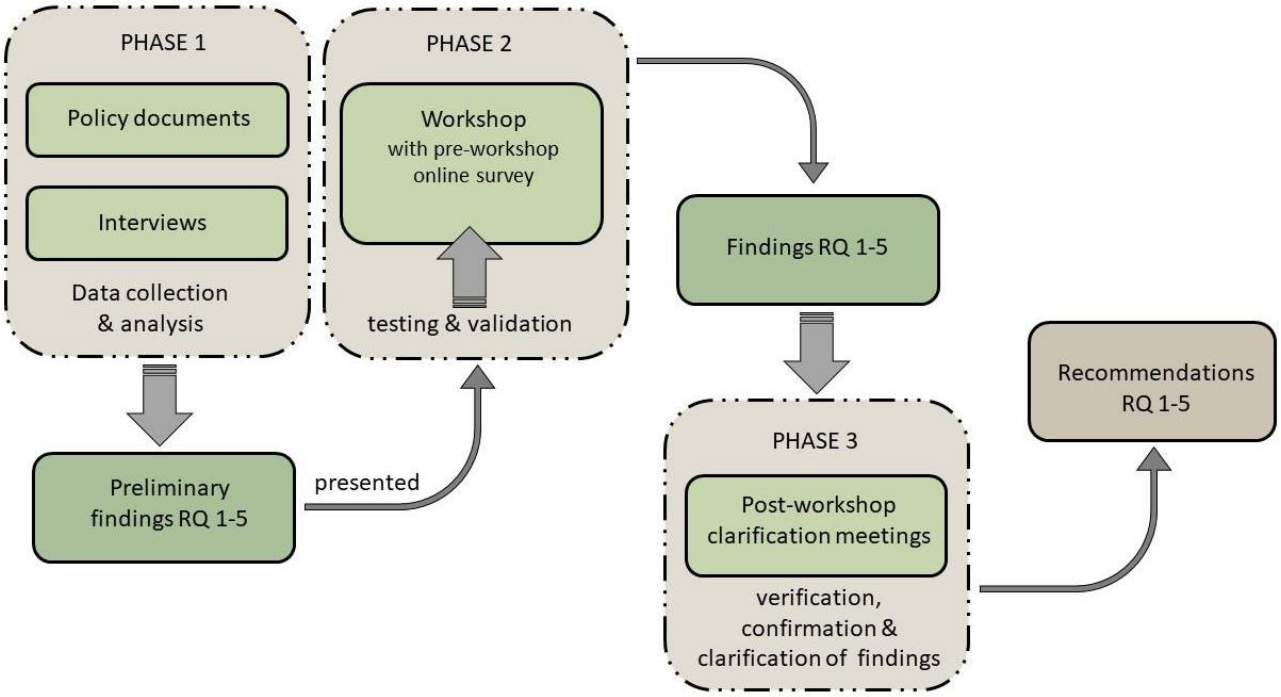


Figure 3-10. Data sources and their relationship to the research questions and recommendations

Table 3-6 summarises the relationship between the study objectives and the data sources, data collection methods, sample sizes and data analysis techniques.

Table 3-6. Summary of data collection methods, sources, sample size and analysis techniques related to the research objectives.

Data collection methods	Data sources		Sample size	Data analysis methods
Desktop review	Secondary data sources	Literature	40 initial samples 31 selected samples	Content and thematic analysis
		SA policy documents (Refer to Tables 2-6; 2-7; 2-8)	30	
		Other important documents (Refer to Table 2-9)	3	
Semi-structured interviews	Primary data sources	City officials (16), Built environment professionals (2).	18	
Online questionnaire		City officials, Built environment professionals, Developers, CSIR researchers.	17 anonymous responses	
Participatory workshop (with focus groups)		City officials (13), Built environment professionals (6), Developers (2), CSIR researchers (2).	23	
Post-workshop discussions		Independent town planner (1), Environment and Agriculture Management officials (7), City Planning officials (2), Built Environment Practitioner (1).	11	

3.5 Limitations

3.5.1 Limitations - documents

As mentioned in Chapter 1, Section 1.5.2, some documents reviewed have not completed the city's internal approval process and are still in draft format and unpublished. These documents were deemed correct when they were considered part of the study.

3.5.2 Limitations - participants

No formal interviews were conducted with developers. However, the researcher has completed numerous Landscape Development Plans for six different city developers over the past five years and understands the developers' general attitude, priorities and considerations towards providing GI in their developments. The two landscape architects interviewed also brought their experience of the attitudes and considerations of their developer client base to the research data collected. Similarly, the city officials interviewed could comment on their experiences with developers regarding the willingness to implement GI. Six developers were invited to the workshop, but only two accepted. The two developers who participated both promoted the incorporation of GI into their land development projects. The perceptions from a larger sample of developers may have brought other insights to the study and enriched the findings.

The data collection sample population did not include community members as the study focuses on the city's internal procedures. The processes at the city allow for public participation once a draft policy has obtained approval internally. However, raw, unpublished data from 200 household surveys conducted by the GRIP research team (refer to Chapter 1, Section 1.5.1(v)) was taken note of by the researcher.

City planning officials did not participate in the interview stage of the study. This limitation was addressed by inviting five Economic Development and Spatial Planning officials to the participatory workshop, yet only one attended. A follow-up meeting was arranged to facilitate further input from that department and overcome this limitation.

Neither of the city officials invited from Environmental Compliance was able to attend the workshop. They had both been part of the semi-structured interviews, and their in-depth inputs were well-documented during the interview stage of the data collection process.

Most public sector interviewees were at the senior management level, which might have resulted in a degree of opinion bias.

The final draft GI definition and 20 GI guiding principles for the City of Tshwane were emailed to all workshop attendees for further comments. None responded, although they had all indicated their willingness to do so at the workshop.

3.5.3 Limitations – workshop

The workshop attendees were engaged in the process and actively participated in the group activities and open discussions. The workshop time limitation meant that some conversations

were curbed to ensure that all agenda topics could be addressed. Post-workshop meetings were arranged to assign more time to those discussions. The researchers invited participants to email any information pertinent to the study that could further contribute to the research.

Every effort was made to give all participants an equal opportunity to voice their opinions freely and without fear of prejudice or not allowing individuals to dominate the conversations. However, it is still possible that not all participants expressed their views equally forcefully. For the same reason, the follow-up clarification sessions were held with particular groups and individuals.

3.6 Ethical considerations

The study was submitted for review by the Research Ethics Committee, Faculty of Engineering, Built Environment and Information Technology of the University of Pretoria. The committee reviewed the study and then provided the researcher with a letter that gave clearance for the study to be conducted under very specific conditions. The letter's reference number is EBIT/45/2021 Line 1 (see Appendix A). Refer to Appendix B for the researcher's signed Declaration of Originality.

A similar process was followed as part of the requirements to conduct research among officials at the City of Tshwane. The Director of Knowledge Management, City Strategy and Organisational Performance Division of the City of Tshwane granted the researcher permission to engage with city officials on GI matters (see Appendix C).

The University of Pretoria's Code of Ethics for Scholarly Activities was downloaded and read. The general guidelines of the Code of Ethics were observed in the preparation of the interview questionnaire, consent forms, and declaration, which were drafted and submitted for review by the Ethics Committee for sensitivity. The study observed the ethical guidelines of the University of Pretoria as follows:

- Participants were treated as independent agents and informed of the purpose and objectives of the study and the structure of the interview, workshop and follow-up meetings. Their voluntary rights to participate in the data collection activities were pointed out. Therefore, the ethical principle of self-determination was upheld.
- The researcher and her study leader made their contact details available to all participants in the study if they required further clarifications or had any questions, queries or concerns regarding the process.
- The participants' anonymity was respected and maintained at all times, and no information that may identify any of the respondents will be used or made public.

- Participants provided written and verbal consent to be interviewed, recorded or quoted as part of the thesis or future publications. If they requested that certain parts of the interview cannot be made known, it was deleted and not used in the study.
- Confidentiality was maintained by storing data collected confidential and safely on a computer hard drive and in the cloud (iCloud) that is password protected.

3.7 Chapter Summary

In this chapter, the research design and methodology used for this study have been outlined. It covers the data capture process, population and size sampling, analysis methods used, ethical considerations, and the limitations of the methodology. Figure 3-7 summarizes the research design created for this study.

The chapter explains the interpretivist research philosophy that the researcher committed to for data collection and analysis. This led to the adoption of a case study qualitative approach for the study, as it was found to be the most suitable methodology to capture the different functions and responsibilities of the city departments in charge of the SDP approval process. Additionally, it aimed to identify the frustrations experienced by officials in those departments with the process.

The primary qualitative data were analysed using content analysis procedures, while the secondary data was also subjected to the same process.

The study's approach has some limitations in that no community participation was undertaken and that the only direct engagement with developers occurred at the once-off co-creation workshop. However, these limitations were mitigated by the researcher having access to raw data collected by the GRIP team from 200 households regarding their attitudes to GI. Furthermore, the researcher has over 35 years of private practice experience in the built environment, which gives her a thorough understanding of developers' attitudes toward applying GI in their developments. The city officials who participated in the study are all vastly experienced with the challenges and opportunities faced by the city in incorporating GI in spatial planning applications. The methodology included three data collection methods and an expert sample, providing a good and full view of the chosen case study.

Sixteen council officials and two landscape architects were interviewed, and 23 participants attended the co-creation workshop, including representatives from the city, built environment professions, and the Council for Scientific and Industrial Research. All study participants have vast experience in the land development application process at the City of Tshwane and are considered experts in their

field. The data collected, and findings were tested and verified at five post-workshop clarification meetings. Therefore, the methodology used is deemed sound and accurate.

Chapter 4 Study Findings: GI application challenges and opportunities

4.1 Chapter Introduction

This chapter will deliberate the findings of research sub-question 1, which asks: *What are the institutional challenges, and what opportunities exist regarding the incorporation of GI as part of the SDP process in the City of Tshwane?*

The chapter responds to the following objective: To establish what institutional challenges city officials face and what opportunities exist regarding the incorporation of GI into the SDP process in the City of Tshwane. This objective can be broken down into two parts:

i) To identify the role players who evaluate and approve land development applications that influence the application of GI at the City of Tshwane and,

ii) To document the challenges and opportunities for the improved application of GI in the City of Tshwane.

The structure of this chapter is illustrated in Figure 4-1 below.

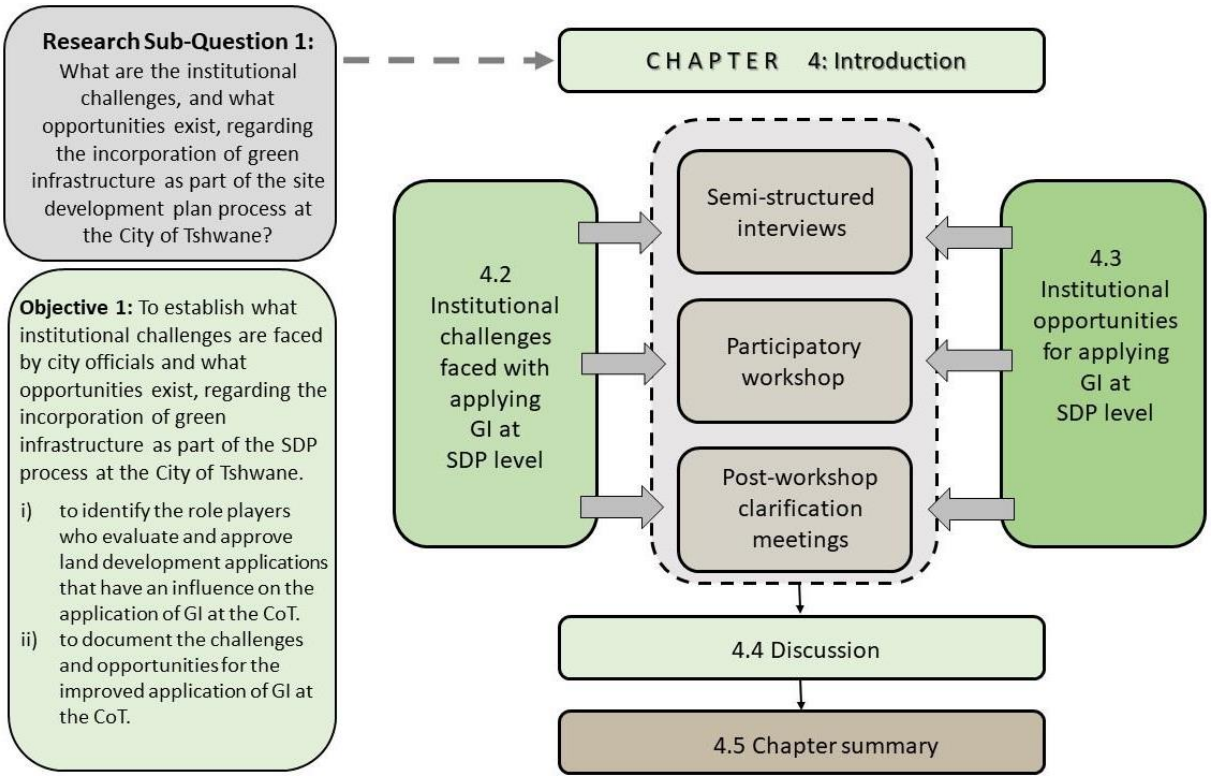


Figure 4-1. Structure of Chapter 4

The term “challenge/s” is used synonymously with barriers, risks, constraints, limitations, and trade-offs in the literature and by the respondents. For this dissertation, the words ‘*challenge or challenges*’ will be deemed to mean any of the previously mentioned terms. The challenges related to applying GI planning guidelines are discussed in four sections below: desktop review, semi-structured interviews, participatory workshop and post-workshop clarification meetings. After that, the opportunities which may enable the implementation of the GI guiding principles are presented in the same order.

4.2 Institutional challenges faced with implementing GI

The challenges identified for the application of GI spatial planning and design guidelines by the city officials interviewed during the semi-structured interviews are grouped thematically. Thirteen main challenges emerged. Possible mitigation measures to overcome challenges faced with the application of GI in the City of Tshwane are discussed in the following section.

Table 4-1 summarises the results from the institutional challenges identified with implementing GI at the City of Tshwane as supported by findings from the different data collection methods employed.

Table 4-1. Summary of findings on institutional challenges supported by primary data sources

Challenges	**Methods**		
	Interviews	Workshop	Post-workshop meetings
Poor collaboration	√	√	√
Conflicting policies, regulations, and processes	√	√	√
Scarce resources	√	√	√
Enforcement, compliance, and post-construction monitoring	√	√	
Work ethics	√		√
Competing interests	√	√	√
Failed bureaucracy	√	√	√
Land invasion	√	√	
Lack of social and political buy-in	√	√	√
Knowledge and skills	√	√	√

Disservices associated with GI	√	√	
Quality of existing GI	√	√	√
Other aspects	√	√	

4.2.1 Semi-structured Interviews: Challenges

The challenges experienced with applying GI by the city officials interviewed are grouped thematically into 13 main challenges (see Table 4-1). These main challenges are discussed in more detail below.

(i) Poor Collaboration

(At all three spheres of government and internally in the City of Tshwane)

All the city officials interviewed identified the existence of a strong "silo mentality" interdepartmentally in the city and between local, provincial and national government departments. The respondents explained that priorities and resources are not aligned (City Officials 3, 4 and 11), which results in poor collaboration and communication between departments and frustration on behalf of the city officials. A unified vision shared by the different government spheres and the city's functional departments is lacking.

It is a challenge co-ordinating resources, not understanding and not being able to cooperate and collaborate, realising that… we are for the same thing … And if I'm [the city] *doing it, it shouldn't be a problem. You* [province] *can move to another area and do something else.* City Official 11

Several city officials (2, 6, 7, 11 and 12) mentioned that they had a poor internal working relationship with the City Planning and Development Division.

City Planning and Development Division is unapproachable. City Official 7

City Planning continues to approve developments despite infrastructure services running over capacity as these new building projects generate income for the city. Short-term wins (income from approved developments) exacerbate the already over-loaded infrastructural capacity, resulting in environmental, health, and safety risks (City Official 12).

Frustration with general municipal service delivery, particularly with the Waste Management Division, was also voiced (City Officials 11 and 12).

Our roads deteriorate, there's no provision for wastewater treatment or landfill [although] *we don't want to landfill. If I have recyclables, I have nowhere to take them. There are no garden refuge sites. So, all those services are lacking from the city's side, no buy-back centres so that I can separate my waste.* City Official 11

City Official 7 mentioned that internal politics marginalises efficient officials due to political affiliations.

Another challenge faced regarding collaboration is where the application of GI is hindered, for example, by resistance from the Human Settlements department regarding the provision of the required public open space for new social housing developments (City Officials 1, 2, 4).

(ii) Conflicting Policies, Regulations and Processes

All spheres of government and internally at the City of Tshwane.

Many of the officials interviewed expressed frustration with conflicting policies, regulations and processes in all government spheres and internally between the City of Tshwane departments.

City Official 6 mentioned that despite the objective of the Spatial Planning and Land Use Management Act 16 of 2013 to vest control of land development with local government, provincial and national governments continue to draw up and enforce policies that are not practical for local government to implement.

Many challenges specifically concerning the Gauteng Department of Agriculture and Rural Development (GDARD) were mentioned during the interview process and are listed below:

- Developers bypass the city's land development approval processes and go directly to GDARD to obtain approvals (City Officials 8, 9, 10 and 15).
- GDARD over-rule their own plan, the Gauteng Conservation Plan version 3.3 (Gauteng Province, 2014), and approves developments the city does not support (City Officials 8, 9 and 10).
- City Officials 11 and 12 expressed the need to align the City Planning and Development Division and GDARD policies with the city's environmental procedures to ensure a united outcome. Rezoning and subdivision of property is no longer a listed activity under the

National Environmental Management Act 107 of 1998 (Republic of South Africa, 1998c) that would have triggered an Environmental Impact Assessment in the past. This has created a loophole for developers to circumvent the city's township establishment process (City Official 6).

- The issuing of fines in terms of the National Environmental Management Act 107 of 1998 (Republic of South Africa, 1998c) regulations because of the illegal land invasion of environmentally sensitive areas in the City of Tshwane is counter-productive as the city is hindered by other legislation which prevents them from removing land invaders after 24 hours without a court order (City Official 12).

We [the City of City of Tshwane] *get three to four* [non-compliance] *notices per month from the province or national* [government] *for land invasions* [of sensitive ecological areas] *because it's on our property. It's not our activity, but we are the owners, so we are liable. The city has paid around R15 million to the Gauteng province in fines for NEMA* [the National Environmental Management Act 107 of 1998]. City Official 12

According to City Official 6, the Draft Green Building Development and Net-zero Carbon Building Policy (City of Tshwane, unpublished c) applies to architecture, not the natural environment. According to the City Official, there was no consultation between City Sustainability and Environment and Agriculture Management to agree on whether the by-law is practical.

Another major stumbling block is the lack of high-level internal vision, as management plans are not aligned (City Official 7).

There is a lot of conflict between the RSDF [the Regionalised Spatial Development Frameworks for Regions 1-7] *and green policies in the city.* City Official 3

Densification (rezoning and sub-division) within the urban edge is actively promoted by the City Planning and Development Division (e.g., Menlo Park, a suburb in Pretoria East). However, the required quantity of public open space to be provided by a development still stands, creating conflict between the city and developers, as developers cannot provide the required public open space for the higher approved densities (City Official 2).

Endowment paid instead of public open space provisioning and fines paid in terms of the National Environmental Management Act 107 of 1998 (Republic of South Africa, 1998c) for non-compliance disappear into a communal city coffer and cannot be ring-fenced because of the Municipal Finance

Management Act, 53 of 2003 regulations (Republic of South Africa, 2003). These funds can, therefore, not be set aside and allocated to environmental mitigation, rehabilitation, and implementation of GI (City Officials 1, 2, 5 and 15).

The Municipal Finance Management Act, 53 of 2003 (Republic of South Africa, 2003) prohibits the city from developing on a school site (or any other community site), which hampers the efficient application of resources by developing shared communal facilities (City Official 7).

Conflicting interpretation of policies and by-laws internally causes frustration for city officials, built environment professionals, and developers (City Official # 13).
Many interviewees (City Officials 8, 9, 10, 13) believe that the national government must apply legislation regarding GI provision and green building applications; otherwise, such requirements will remain unenforceable locally. Developers respond by threatening to move their developments to other cities with more lenient GI and green building requirements.

(iii) Scarce Resources

Resources have been divided into five types and are discussed individually below in the following order: Human resources, financial resources, suitable developable land, ageing and run-down infrastructure and the physical area of the city.

Human resources

Fifteen of the sixteen officials interviewed stated that a shortage of human capital and capacity placed severe pressure on the city's ability to function correctly.

Specialists such as environmental engineers and landscape architects are required and should get involved at the beginning of the projects. City Official 5

However, City Official 7 offered a contradictory view on the subject (which links to Section 4.2.1 (e)):
I think there's more than enough staff… officials see if there's an excuse not to do portfolio functions.

Financial capacity

The financial situation of the City of Tshwane is dire (City Officials 3, 4 and 7).

Municipalities are struggling to collect rates and taxes to deliver basic services, and this is compounded by the rapid urbanisation of unemployed illegal immigrants and people from rural areas. City Official 3

Management and maintenance of facilities is a problem as the budget is very, very limited, as are resources and equipment. City Official 7

The implementation and maintenance of GI are perceived as expensive and a luxury by all spheres of government that are budget-strapped. City Official 4

This perception is compounded by the lack of budgets allocated to repair old GI (City Officials 8, 9 and 10).

Very little CAPEX [capital expenditure] *is provided for park development; thus, pocket parks are targeted. Since 2018, no budget has been set aside in IDP* [Integrated Development Plan] *money to develop parks, and the city keeps growing*. City Official 5

Yet, despite the severe lack of financial and human resources, some dedicated officials still accomplish many achievements.

How they manage to keep those facilities going, for example, Lucas Moripe Stadium [in Atteridgeville] *and Pilditch Stadium* in [Pretoria West], *with the budgets they have, I don't know. But sometimes you get officials that just can do it.* City Official 7

<u>Developable land</u>

Well-located government-owned land suitable for housing project developments is scarce within the urban edge[7] (City Official 3).

<u>Ageing and rundown service infrastructure</u>

Service infrastructure is over-capacitated and old (for example, wastewater treatment works overflow, pollute the city's wetlands, peatlands, rivers, and dams and impact the city's drinking water (City Officials 8, 9, 10, 11 and 12). The state of the city's electrical substations is just as precarious.

[7] **Urban Edge:** "A virtual development boundary and inter-related policy that controls urban sprawl by mandating the area inside the boundary for higher-density urban development and the area outside the boundary to be used for lower-density, green open spaces and no effect. Development should only be permitted outside the urban edge within existing small towns and rural nodes and where the environment and agriculture are not compromised. The urban edge forms the boundary between urban development and the valuable natural and agricultural hinterland to contain the metropolitan areas' lateral growth". (City of Tshwane, 2021).

The physical size of the City of Tshwane

As mentioned in Chapter 3, the physical size of the City of Tshwane makes it an enormous task to protect all the natural areas within the city's jurisdiction, particularly considering scarce financial and human resources.

The City of Tshwane is the third biggest municipality in the world [by area 6389km²]*. How is it possible for us to protect all the open spaces?* City Official 3

(iv) Enforcement, Compliance, and Post-construction Monitoring

Enforcement and compliance monitoring and the implementation of legislation, spatial policy frameworks and city by-laws is the responsibility of various entities in the city, namely, the building inspectors from the Economic Development and Spatial Planning department, the Metro Police, the Green Scorpions and environmental management inspectors from the Environment and Agriculture Management department (City Official 11). Yet due to the factors mentioned above, such as the stretched capacity of officials to check compliance (City Official 11), the vast area of jurisdiction (City Official 3) and a Metro Police service that is not reliable or trustworthy (City Official 7), the level of compliance is low (City Official 12).

Environmental compliance in the city is very low, internally and externally… but we hardened our stance this year [2022] *against the city to elevate its compliance in terms of NEMA* [the National Environmental Management Act 107 of 1998]*.* City Official 12

Not enough security, at the same time it is impossible to patrol all GI assets. City Official 7

Building rubble is a problem, and wetlands, unfortunately, are the dumping site for disposing of building rubble everywhere. City Official 11

Informality in the city, through informal settlements or informal recycling, places tremendous pressure on natural infrastructure. Homeless people intentionally invade and settle in environmentally sensitive areas such as riparian zones, wetlands, within flood lines to skip the housing queue as they know the city is obliged to move them to safety and provide them with housing (City Officials 3, 6, 8, 9, 10, 11, 12, 13). Informal recyclers sort through their recyclables in open areas, often next to watercourses, leaving unwanted waste to pollute green spaces and water bodies (City Officials 11 and 12).

So, in most instances, I think informality of any activity just takes advantage of those spaces [undeveloped open space] *because they are just easy spaces that are not really* [seen to be] *owned. They are seen as government land.* City Official 12

Encroachment into all our sensitive environments, flood lines, wetlands, and ridges in areas where development is not supposed to happen. City Official 4

The city's Human Settlements department struggles to comply with providing public open space and recreation facilities as the land they must formalise is already occupied brownfields (City Official 3).

According to City Official 11, developers don't seem to have any regard for complying with the city's requirements for the provision of green space. Property developers and the Human Settlements department avoid providing public open space. The provision of GI is not included in the city's tender documentation as part of the disqualification criteria or written in the by-laws or regulations, making it challenging to enforce the implementation thereof (City Official 5).

Construction commences before plans are approved (City Official 5). Structures are then already built and cannot be moved to provide the required public open space. Some developers are dishonest and develop in designated open space areas such as buffer zones and recreational areas after the occupational certificate for the development has been issued (City Officials 6 and 12).

(v) Work Ethics

Many of the officials interviewed expressed their frustration with the poor work ethic of many of their colleagues.

The problem lies with top management – some of them, not all, are there because of political interference. And really, they are there for the money. They are not there for the job and the passion for the city. City Official 7

The South African Sunday newspaper, Die Rapport (04 June 2023, page 11), quotes the new Executive Mayor of Tshwane expressing his frustration with the African National Congress's (ANC) 'cadre' (political activists) deployments in the city, which, he claims, enables these officials to facilitate and allow corruption. Councillor Brink laments in this newspaper that getting rid of these officials is exceptionally challenging (Kok, 2023).

Furthermore, South African labour laws make it extremely difficult for an employer to dismiss an employee (City Official 7), causing some employees to be complacent. This complacency is widespread in the City of Tshwane and results in frustration among dedicated, hardworking officials.

Lack of accountability and taking responsibility on the side of city officials because the city's performance management system does not work. And because it is not tied to the local government mandate. City Official 6

People just get renumerated and continue getting bonuses and all other benefits. And I think that's why no one cares. And there's no supervision, and there's no monitoring. City Official 7

The [negative] *attitude, specifically with Building Control and Waste Management officials and some managers and divisional heads* [is frustrating as they] *don't want to cooperate and do their job.* City Official 12

The system being created is good [the Draft Green Building Development and Net-zero Carbon Building Policy for the City of Tshwane, 2021]*. Just the implementation of it. Or the willingness of some officials to implement.* City Official 7

In his monthly media statement of June 2022 (City of Tshwane, 2022), the (then) executive Mayor of the City of Tshwane informed residents of the adoption by the Council of the amended Individual Performance Management Policy for city officials:

> *I am pleased to inform you that the City of Tshwane Council adopted the amended Individual Performance Management Policy during its ordinary Council sitting on Thursday, 30 June 2022. The policy is aimed at driving a culture of high performance within the metro to improve our services to residents. It will also ensure that proper accountability is entrenched at the individual level within departments. Through this policy, employees will have to work towards achieving all their set key performance indicators over the course of the financial year by setting a benchmark of 100% achievement. As public servants, we are expected to deliver quality and professional services to all our residents. With this amended policy, I am confident that the City's performance standards will improve.*

(vi) Competing Interests

Many interest groups with divergent agendas are involved in the city's spatial development arena. Property developers, politicians, city departments, civil society, and other government spheres all compete to promote their interests. Most often, GI is not seen as a priority, and consequently, the natural environment suffers when balancing the pressures exerted by social needs such as housing (City Officials 3 and 6).

Competing needs which are directly not considering the cradle of it all [the environment]. *When we look at how the environment is ignored when certain things have to be implemented in the name of social and economic development, it's as if the environment doesn't matter.* City Official 6

According to City Official 4, everyone wants developable land for their own priorities, so when a development application report is circulated internally for comments, the Human Settlements department will purposely give negative comments to stop the proposed development and obtain access to that land for housing developments.

Simultaneously, Human Settlements struggle to comply with providing open space and recreational facilities (specifically regarding brownfields, as mentioned before). The housing need in the city is massive (City Official 3). Social housing beneficiaries regard all available space within a housing development as fit for housing units.

The city regularly meets with resistance from invaders of sensitive environmental areas to be moved. An example of such a case is the informal settlement spreading along the banks of a portion of the Wolwespruit east of Delmas Road (R50) between Solomon Mahlangu Drive (M10) and Nossob Street in the suburb of Moreleta Park in the east of the city. The city agreed with the illegal invaders to move them to a prepared and serviced site next to the Gautrain station in Centurion. The Human Rights Commission stopped the relocation process by convincing the illegal land invaders not to move. The only outcome of this case was wasteful expenditure (City Official 4).

People are not open to being moved [out of sensitive areas] *away from economic opportunities or employment.* City Official 12

Similar political and top management interference interferes with the work of city officials. The Economic Freedom Fighters (a political party) deliberately encourage people to invade and settle on undeveloped land to force the city to provide housing (City Official 3) as social needs and human rights take precedence over the environment (City Official 4).

Politics in the city is crippling. City Official 6

Informal recyclers create both positive and negative impacts from their activities. The adverse effects on GI occur at the casual sorting sites near water bodies. Unrecyclable waste materials end up in the watercourses and pollute the city’s river systems (City Officials 11 and 12).

Private developers do not see the economic benefits of GI when they are only involved with the development for the short term (developing units for sale) (City Official 5). Developers may only be interested in investing in GI if they are in the rental market, and they will benefit from the long-term payback from GI (City Official 5). Many developers will choose fines or pay endowments before providing public open space in their developments (City Official 5).

Developers see [open or green] *spaces as money.* City Official 2

Developers are only concerned about their site and not about the implications of the development on the whole ecosystem. City Official 3

City Planning views development as income (City Official 8). Internal town planners do not adhere to the "Red Book"[8] rules. The National Department of Human Settlements publishes the Red Book, which prescribes the inclusion of public open space for liveable human settlements. (City Official 7).

A big problem that concerns me is that development keeps on being approved, but no money gets invested into park infrastructure. City Official 5

Objections to developing low-income social housing projects are made by surrounding residents and the City Planning and Development Division. The attitude of surrounding residents is that low-income housing can be developed elsewhere but "*not in my backyard"* (City Official 12).

(vii) Failed bureaucracy

The planning cycle is lengthy and complicated, and many role players are involved in establishing a township. This is even more challenging when another sphere of government owns the developable land. Many steps must be taken before ground can be broken, such as obtaining a power of attorney to act on behalf of the other party. (City Official 3).

It takes a minimum of five to ten years to get a [social housing] *township approved.* City Official 3

Getting a greenfield site approved to relocate people is lengthy. The developer must obtain an environmental authorisation and install service infrastructure, which is time-consuming and expensive (City Official 11).

[8] **Red Book**: The Neighbourhood Planning and Design Guide issued by the National Department of Human Settlements is commonly known as the Red Book. "It is a guide to provide practical information related to the planning and design of the range of services and infrastructure typically provided as part of a neighbourhood development project". (Republic of South Africa, 2019).

Contractual failures between the city and service providers result in multi-million-rand facilities that cannot operate, hampering GI projects. An example mentioned by City Officials 11 and 12 is that of a multi-purpose Material Recycling Facility, composting plant, and Construction and Demolition waste processing facility at the Kwaggasrand Landfill Site, which is complete but not operational.

Unspent budgets result in lost opportunities for providing infrastructure services and creating liveable environments for city residents.

The Human Settlements department is allocated massive budgets which they are not spending, of which 15% must be allocated to social facilities. City Official 7

City Official 7 feels that it is incomprehensible that although South Africa is a water-scarce country, the city still uses potable water to irrigate sports fields. The city does not harvest rainwater (City Official 7).

(viii) Land Invasion

Informal settlements spring up daily throughout the city, mostly in sensitive environmental areas adjacent to water courses (City Officials 3, 6, 8, 9, 10,11, 12).

According to City Officials 11 and 12, the first step in solving this massive problem is for the national government to address the root causes of land invasion, namely job creation, social upliftment programs, and the problem of illegal immigrants and the housing deficit.

First, solve the socio-economic problem [that leads to land invasion and degradation of environmentally sensitive areas], and *then environmental solutions will follow.* City Official 11

However, according to City Officials 3 and 4, the majority (approximately 80%) of invaders of sensitive areas are undocumented, non-national migrants. Legislation prevents undocumented, non-national migrants' access to government housing in South Africa. Thus, even if sufficient housing is available (which is mostly not the case), most people living in environmentally sensitive areas cannot be moved to formalised settlements.

(ix) Lack of Social and Political Buy-in

Green issues are not a priority for people reliant on a social grant (City Officials 3 and 7).

GI interventions like solar panels and water tanks are expensive and not affordable.

City Official 7

City Official 3 explained that at the start of a new human settlement development project she was involved in, the community did not want to leave any space open for social and recreational facilities. They insisted that every square meter of land must accommodate housing units. However, once they had settled, they changed their stance.

They come back later and ask for those very things like schools, community centres, etc., once the houses have been built. City Official 3

According to City Officials 4 and 7, politicians see people as ''votes'', putting social needs above environmental concerns.

Pressure from politicians because they want to impress [the voter] *and they put pressure on Human Settlements to formalise informal settlements, and that's when it all goes to the dumps.*

City Official 11

At the same time, if Human Settlement dares to resist, the community riots or travels en masse to Tshwane House (the metro centre) to intimidate and threaten the officials (City Officials 11 and 3).

Most GI benefits often only become evident over the long term except when a natural disaster strikes. Such occurrences have immediate adverse environmental, health, and safety impacts on the community. Examples are flood events that can result in infrastructural damage, loss of life or sewer spillage contaminating watercourses. (City Official 8).

Communities do not relate to spaces if they are not engaged and included in the planning and design process (City Official 3).

GI is often neglected and perceived as unsafe crime hot spots because of poor or no maintenance and is therefore not valued. This perception leads to vandalism of GI, and illegal dumping becomes common practice (City Officials 3, 4 and 7).

Some officials interviewed perceive the attitude of residents towards GI as negative and commented as follows:

People [citizens] *are aware* [of environmental issues*]; they just don't care.* City Official 11

It's not my problem. City Official 12

Citizens must change their mindset; every little bit makes a difference. City Official 11

In historically disadvantaged areas, community members are not interested in more water-wise options as they are perceived to be inferior products (City Official 7). An example is the planting of indigenous, water-wise Couch grass *(Cynodon dactylon*) instead of Kikuyu lawn (*Pennisetum clandestinum)* for sports fields, which gets rejected by the community.

(x) Knowledge and Skills

The City Officials stated that all stakeholders (officials, professionals, residents, politicians and developers) are generally uninformed regarding the concept of GI and need to be educated on the value and benefits thereof (City Officials 2 and 7). GI is not considered a priority or budgeted for (City Officials 8, 9 and 10).

In addition, the *"how"* part of it is not understood (City Official 6). In other words, how to plan for, design and implement GI. GI services are not appreciated because they are often free, but society does not realise that GI provides socio-economic benefits for the city (City Officials 8, 9 and 10). Conversely, budget-strapped government departments view GI as a luxury (City Official 7).

The understanding that the environment is the base of everything is lacking. City Official 6
Not everyone is aware of the importance of biodiversity. City Official 4
If we appreciated how the whole thing [ecosystem] *works as a network, we wouldn't be fragmenting it.* City Official 3

<u>Inside the City of Tshwane metro</u>

The city needs to employ more professional landscape architects and green engineers to support departments such as Human Settlements and the utility departments (City Official 5).

Infrastructure such as roads and piping still gets designed using old standards and old styles of design. City Official 5

Poor administration, lack of forward-planning, and inept management (e.g., City Planning and Development Division cancelling their lease in December 2021 without ensuring that their new premises are ready to be occupied, cited by City Official 7 results in severe delays in processing land development applications.

Building inspectors tasked with enforcing the Draft Green Building Development and Net-zero Carbon Building Policy for the City of Tshwane (City of Tshwane, unpublished c) feel they are not qualified (City Official 11).

Top management often insists that city projects follow examples from GN countries that are not contextually appropriate (City Official 7).

Politicians

Mayoral Committee Members are politicians. They do not always understand the importance of GI and fail to maximise opportunities to secure funding for GI development at budgetary debates (City Official 13).

Developers

Developers do not appoint an entire professional team, which includes a qualified landscape architect, at the start of a project to ensure public open space requirements are met.

Developers need to appoint more experienced and qualified consultants. City Official 2

Developers just come in with machinery and ruin the ecosystems. City Official 7

Practitioners

Town Planners are uninformed regarding public open space requirements and fail to brief their clients upfront. This leads to conflicts at the SDP approval stage (City Officials 2, 5 and 13). Several City Officials believe that the environment comes as an afterthought for town planners.

Developers must appoint qualified and experienced practitioners to avoid delays in the land development approval process.

Practitioners who are not capable of doing the work and do not know exactly what needs to be done are appointed by developers. Developers need to appoint more experienced and qualified consultants. City Official 2

Landscape Architects are involved in the projects when it is too late to change the township layout and provide the amount of open space required (City Officials 2, 5 and 13).

Society

City Official 6 felt that citizens do not understand the value of GI. This view was contradicted by City Official 7, who said, "*People* [citizens] *are aware* [of environmental issues*]; they just don't care.*

Technical Support

Internal town planning data on council-owned land is not current (City Official 7). The city's Geographic Information System database is outdated (City Official 2) and does not update information about the location of city-owned facilities (City Official 7).

(xi) Disservices associated with GI

Disservices associated with GI negatively influence society's appreciation of thereof. An example is the research study conducted by the University of Cape Town's engineering department, which showed that the quality of run-off water exiting permeable paving layers is poorer than before it entered the system (City Official 15).

Some GI measures are perceived as too complicated and expensive for the city to implement (City Official 7). Some other GI disservices are associated with the quality of existing GI discussed below.

(xii) Quality of existing GI

City residents generally view GI as uninviting, as is evident in the responses regarding the quality of existing open space.

- Lack of basic infrastructure such as seating, protection from the elements, litter bins, and other amenities (City Official 6)
- General neglect with poor or no maintenance (City Officials 3, 8,9,10,11 and 12).
- Green spaces are perceived as crime-ridden and unsafe due to the lack of surveillance; lack of security (City Officials 3, 4 and 6)
- Vandalism is enormous (City Officials 3,4 and 7);
- Illegal dumping is uncontrollable (City Officials 8, 11 and 12);
- Green spaces are polluted - waste, water and air (City Officials 3, 6 -12, 14, and 15)
- Alien species invade green spaces (City Officials 8, 9 and 10)
- Erosion leads to the slitting of water bodies (City Officials 8, 9, 10 and 15)

Nobody takes care of it. Nobody maintains it. City Official 11

(xiii) Other aspects

Other challenges regarding the application or the appreciation of GI mentioned by the city officials interviewed are:

- Accessibility: distance of the existing GI facilities from home (City Official 6);
- Distribution: a concentration of existing GI facilities in Region 3 (City Official 7);
- Policies such as the 'Adopt-a-Spot'[9] allow solely for the maintenance and beautification of public spaces by community members; fruit or vegetables may not be propagated in those areas (City Official 5);
- EIA specialists get paid by the developer and are not independent (City Official 5);
- The poor historical planning legacy (the 1960s,1970s and even 1980s) where developments went ahead with a total disregard for the environment (City Official 7);
- Adverse geotechnical conditions such as dolomite (City Official 13);
- Rivers originate outside of the City of Tshwane (in Ekurhuleni and Johannesburg) and deposit silt and pollution downstream in the City of Tshwane metropolitan areas (City Official 3); and,
- Climate change (City Official 14).

4.2.2 Participatory Workshop: Challenges

The workshop did not focus on the challenges faced with applying urban GI in the City of Tshwane, but several came up as part of the deliberations. The most significant are mentioned below:

Practitioner 1 argued that the emphasis on purely preserving GI must change. He strongly believed that trying to conserve and protect all open space and placing it in 'glass houses' is an outdated and controversial approach considering the apartheid history of the country.

Many participants voiced their concerns regarding the rapid and uncontrolled spread of informal settlements throughout the City of Tshwane since 2018. Urban GI is the preferred target for land invaders, especially along water courses. According to City Official 3, there were 210 informal settlements in the city in 2018. This number increased to 455 in 2022 and is growing daily.

[9] **Adopt-a-Spot "**means the process through which applicants approach the city to adopt a piece of City of Tshwane-owned land for the purpose of maintenance and beautification within a specific timeframe at no cost to the city" (City of Tshwane, 2018a).

Some participants said that poor maintenance and lack of post-construction monitoring and enforcement of by-laws affect urban GI's quality, safety, and security and also attract illegal dumping (City Officials 2 and 13).

City Official 15 stated that access equally distributed to centrally located and functional urban GI for all city residents, as opposed to the current concentration of public open space in Region 3, was another problem that needs attention.

A significant challenge debated by the participants is the pressure that densification within the urban edge (see 4.2.1. c-iii) places on urban GI. A strategy for the fair provision of urban GI required in high-density areas is urgently needed (City Officials 2, 5, 13, 15 and Developers 1 and 2).

There is still a general lack of understanding of the benefits that GI can contribute to urban development or the city as a whole, alone or in combination with traditional infrastructure (Practitioner 1, City Official 17).

Developers cannot access the city's UGI requirements at the start of the land application process (City Official 13) and cannot be creative with posing GI provision solutions (Developer 1).

Since GI is not budgeted as part of the bulk infrastructure payments that are allocated for new developments, there is a lack of money for communal and public GI implementation and maintenance in most neighbourhoods and city's regions (City Official 17).

4.2.3 Post-workshop clarification meetings: Challenges

Five post-workshop focus group meetings were held with different stakeholders to test some of the outcomes from both the workshop and the interviews. At these sessions, some of the previously identified challenges were confirmed, namely:

- There are differing interpretations of some spatial planning policies and by-laws by city officials internally between departments and externally between city officials, developers, and built environment professionals (City Official 13 and Practitioner 8). These ambiguous interpretations are a source of great frustration for all parties involved, creating tension and delays in the approval process.
- Economic Development and Spatial Planning are considered pro-development at the cost of open space provision (City Officials 11 and 12 and Practitioner 8).

- All city departments do not take up the opportunities for emphasis or insertion of GI guidelines and priorities, and there is an expectation that the Environmental Planning Department must do this (City Official 15).
- Practitioner 1 believes there is a disjuncture between the Integrated Development Plan (refer to 3.3.3) and the implementation of city development projects on the ground. All projects listed in the IDP are not allocated funding, which could negatively affect the proposal of an Open Space Master Plan to fund GI provisioning.

4.3 Institutional Opportunities for Implementing GI

The city officials interviewed were asked to identify opportunities for incorporating GI in the City of Tshwane. The opportunities identified for GI spatial planning guidelines by the city officials interviewed during the semi-structured interviews are grouped thematically. Eight (8) main opportunities emerged.

Table 4-2 summarises the results from the institutional opportunities identified to apply GI at the City of Tshwane as supported by findings from the different data collection methods.

Table 4-2. Summary of findings on institutional opportunities supported by different data sources

Opportunities	Methods		
	Interviews	Workshop	Post-workshop meetings
Promote institutional buy-in	√	√	
Promote internal cooperative governance	√	√	
Promote cooperative governance between all spheres of government	√	√	
Entrench GI guidelines into spatial policies and by-laws	√	√	√
Streamline the land development application process	√	√	√
Promote cross-sectoral partnerships	√	√	
Communicate the benefits of GI	√	√	
Generate funding to develop and maintain GI	√	√	

4.3.1 Semi-structured interviews: Opportunities

The city officials interviewed were asked to identify opportunities and make proposals for new or amendments to existing policies, regulations, and any other means to apply GI at the City of Tshwane. The opportunities identified for applying GI planning guidelines by the city officials interviewed are grouped thematically, and eight main opportunities emerged. Mitigation measures to overcome challenges faced with applying GI in the City of Tshwane are also discussed.

(i) Promote Institutional Buy-in

The city needs a champion/s who is passionate about green issues and has a position of power, leadership, authority, and influence to promote GI and green issues to politicians, developers, and citizens. This champion could be the Executive Mayor, the Member of the Mayoral Committee, the City Manager, or direct representatives (City Officials 3, 4, 7, 11, 12 and 14).

The City of Tshwane must develop a unified vision for GI for the municipality with buy-in from all the city departments that impact GI and building guidelines and practices (City Officials 2, 3, 4, 7 and 14).

An effective, high-level GI task team with jurisdiction must be established in the City Manager's office with representatives from all the city's departments (City Official 12).

(ii) Promote Internal Cooperative Governance

One of the biggest challenges all the respondents identified was the '*silo mentality*' that exists internally between city departments. Each department focuses only on its mandate, and collaboration between departments is lacking.

Although not the focus of this study, breaking down the silo mentality and promoting cooperative governance may lead to a broader understanding and commitment to the concept of GI interdepartmentally and improve the chances of successful application. The city could approach this problem by:

- Promoting a unified vision for GI internally, as mentioned before, for all City of Tshwane employees to understand the value-chain versus a silo approach (City Officials 2, 3, 4 and 7);
- Coordinating departmental functions and internal development priorities and financial resources between city departments through the Integrated Development Plan in terms of GI, such as pursuing an off-grid approach as a priority through the application of GI options and Green Building principles (rainwater harvesting, solar power, biological toilets, recycling of greywater

for irrigation, solar geysers, etc.) to reduce the pressure on over-loaded conventional infrastructural capacity (City Officials 4, 7 and 14);

- Improving internal communication, collaboration, and working relationships between core value-chain departments, namely Environmental Management and Open Space Planning Division, City Planning and Development Division, Waste Management Division, Roads and Stormwater Division etc. (City Officials 3, 11 and 12).

We need to start working together with our colleagues in the Roads and Stormwater department because even in terms of roads, we should stop and look at other interventions that are there just from normal tar which we are using, which is a heat island.

City Official 11

- Coordinating the work of officials to ensure accountability for all project life-cycle phases of GI, including maintenance and repairs (City Officials 5 and 11);
- Align conflicting spatial planning policies, by-laws and requirements (City Official 13).

City Official 3 felt that extending the urban edge to unlock more land suitable for housing could take the pressure off GI. This view contradicts the Metropolitan Spatial Development Framework, 2030 and the Economic Development and Spatial Planning department's policies, which actively promote densification to contain development within the urban edge.

(iii) Promote Cooperative Governance between all Spheres of Government

City Officials 11 and 12 advocate urgent engagement with the Gauteng Province (specifically the Gauteng Department of Agriculture and Rural Development) is required. Areas of conflict that hamper the successful execution of each party's roles and responsibilities need clarification. For example, conflicting policies and policy applications, monitoring construction in sensitive areas, implementing GI per the Environmental Impact Assessment Record of Decision and Environmental Management Programme, and issuing non-compliance notices and fines.

Engagement with the national government regarding illegal immigrants (Department of Home Affairs), job creation, and social programs inter alias are also priorities (City Officials 3, 11 and 12).

National government must tackle the root cause. City Official 12

(iv) Entrench GI Guidelines into Spatial Policies and By-Laws

The City Officials proposed several practical solutions to enable the enforcement of GI spatial planning guidelines.

Spatial development frameworks and policies that the Council ratifies should include GI planning guidelines. A GI By-law (including the GI planning for SDPs) should be developed, complementing the Draft Green Building Development and Net-zero Carbon Building By-law (City of Tshwane, unpublished c). The GI implementation requirements should also be included in the city's Supply Chain Management tender documents as mandatory requirements and disqualifying criteria if the bidder does not comply (City Official 5).

The draft Green Building Development and Net-zero Carbon Building By-law for the City of Tshwane, 2021, should be made mandatory for all new developments to ease pressure on the service grid City Official 4). However, City Official 11 stated that the draft Green Building Development and Net-zero Carbon Building By-law (City of Tshwane, unpublished c) is primarily relevant to architecture and that no consultation had occurred between City Sustainability, the Environment and Agriculture Management Department and the National Home Builders Registration Council to agree on whether it is practical.

One possible solution is an effective “Compliance and Enforcement Unit” that implements a follow-up program to monitor GI maintenance in developments. Alternatively, GI compliance monitoring could be placed with Building Control, who can enforce it by withholding the Occupation Certificate for new developments (City Officials 11 and 12). Additionally, the City of Tshwane needs to develop GI maintenance guidelines; otherwise, the maintenance teams do not understand the benefits and need for GI and will revert to conventional infrastructure and methods (City Official 8).

(v) Streamline the Land Development Application Process

According to the Environment and Agriculture Management Department city officials interviewed, a core reason that land development applications are not approved with the first submission of the SDP is that developers do not appoint a complete team of suitably qualified built environment practitioners at the start of the project. This prolongs the approval process if plans are non-compliant. Developers are encouraged to appoint experienced landscape architects at the beginning of the project so that the developments can meet their public open space provisioning requirements from the onset. Additionally, developers’ agents should consult with the Environment and Agriculture Management department before the final submission of the Site Development Plan.

On the other hand, the city needs to appoint more qualified landscape architects internally to support departments like Human Settlements and Roads and Stormwater (City Official 5) to facilitate the incorporation of GI in public-sector projects.

As mentioned above, illustrative sketches indicating the city's preferences for GI development should form part of the public open space requirements policies (City Official 5).

City Official 7 believes that city departments should plan much longer in advance. The city has an online project database on which city departments can list their projects for prioritisation and budget allocation for implementation. All city departments have access to this system.

(vi) Promote Cross-sectoral Partnerships

Potential partnerships between various parties were identified as potentially beneficial relationships that could improve the overall implementation, accepting co-ownership, and long-term success of GI in the city. These are listed below:

- Maintain a close working relationship between the University of Pretoria and the City of Tshwane, where students can participate in city projects and processes (City Officials 1 and 3).
- Encourage active citizenship through community organisations like "Friends[10] of the Faerie Glen Nature Reserve" and "Friends of the Bronberg Conservation Areas," who alert the city when non-compliant land development applications may slip through the system (City Officials 2 and 3).
- Pursue cross-sectoral partnerships to raise funds to unlock infrastructure provision and the development potential of other regions (City Official 3). An example of such a partnership happened in Mamelodi between the community and Build-It (a private-sector building materials store). Build-it provided materials and tools, and the city paid for the labour provided by the community who fixed the broken fence.

So, we [the city] *are working with the community to take ownership.* City Official 3

According to City Official 3, another successful example of the city and private sector working together is at the Six Fountains residential development (Pretoria East), where the developers were open to recommendations by the City to include GI infrastructure, such as attenuation ponds and gabions for flood prevention.

Including commercial aspects in open spaces, such as the privately managed restaurant in the Austin Roberts Bird Sanctuary in Groenkloof, can generate funds to maintain these open spaces.

Instead of accepting endowment instead of public open space, allow developers to build and maintain parks, streets, etc. City Official 6

[10] **Friends Groups: "**a non-profit civic organisation of interested residents to advance and encourage appreciation, understanding, enjoyment, and public use of public amenities and to cooperate with the city to improve the cultural, social and environmental activities of the community" (Wildlife and Environment Society of South Africa, n.d.).

An example offered by City Official, 7 of the above, occurred in Soshanguve Block F, where the city built three soccer fields. Atterbury Property (a city property developer) built a community library to replace the one that was demolished in Lynnwood with the construction of the Lynnwood Bridge Shopping Centre.

(vii) Communicate the Benefits of GI

The city officials had many ideas to boost buy-in from society and politicians for implementing GI. These create awareness by developing demonstration (or showcase) sites where the city and the university collaborate with the community to test what works and does not work when applying GI principles. The city could then replicate the successful showcase sites throughout its regions.

Relocate these examples in other areas throughout the city and see if we have demonstratable cost savings through GI that can accrue. City Official 8

At the same time, educating all stakeholders (officials, professionals, developers, community, and politicians) on the benefits and value of GI needs to be communicated and promoted to the communities and politicians. GI contributes to the "Greening of the City"[11] objective by reducing the carbon footprint, cooling down urban areas, and increasing food security and job creation. For example, citrus trees' health benefits to fight against influenza should be made known (City Official 6). Highlight the economic and social benefits of the environment, such as mineral extraction and wetlands cleaning drinking water (City Officials 8, 9 and 10).

The shadow of a tree can cool an area down, equal to 15 air conditioners. City Official 9

City Official 8 stated that the wetland at Rietvlei Nature Reserve has an immensely positive impact cleaning by the badly polluted water that enters the City of Tshwane municipality from the Ekurhuleni Metropolitan Municipality. Water is clean enough to drink when it exits the wetland system. The nature reserve is a conservation area that supplies drinking water to the City of Tshwane.

That vlei [wetland] *is an irreplaceable natural water purifying system. It will cost millions and millions to build a traditional engineering water purifying infrastructure facility which could operate as efficiently.* City Official 8

Using youth as communicators by creating awareness of the value of biodiversity and that we have to protect it, which is non-negotiable. City Official 12

[11] **Greening of the City:** The Department of Environment and Agricultural Management runs a greening programme that oversees the planting of indigenous tree species throughout the city with an annual goal of 10 000 trees. This programme both assists with carbon sequestration as well as tempering the urban heat island effect (City of Tshwane, 2023a).

Communication is crucial to ensure a facility is successful. The community needs to take ownership, and they need to be informed, and they need to be educated about these things. City Official 7

Many city officials thought incentives were the only way to motivate citizens to implement and maintain GI. Mexico City and Rio de Janeiro examples were cited, where recyclable products are exchanged for vegetables. Another possibility is for the state to subsidise residential water storage tanks to promote rainwater harvesting (City Officials 3, 8,9,10 and 15).

Incentives, subsidies and green tax rebates for the installation of GI for individual homes and businesses. City Official 8

City Official 3 felt strongly that the local communities must be involved from the start of a project, i.e., the design stage, so they will take ownership and identify with the space. The official believes the community should be engaged through a Project Steering Committee that includes the ward councillor and ward committee, dedicated city officials and a committed community.

So, we are working together with the community to take ownership. City Official 7

City officials believed that attractive, good quality, well-maintained open space increases the land value of properties adjacent to the GI. More multi-functional parks like Rietondale Park that serve all ages should be created throughout the city.

City Official 3 suggested promoting food security by planting fruit trees in social housing developments. They mentioned that the Human Settlements department has funding to be allocated to the city nursery to grow fruit trees that can be planted when informal settlements are formalised. The official suggested that the city nursery donate one indigenous tree and one fruit tree per housing unit to green informal settlements while promoting food security.

(vii) Generate Funding to Develop and Maintain GI

The subject of the affordability of GI came up regularly with the City Officials. The officials offered many possible solutions, which are touched on briefly below.

Some forms of tourism should be included as part of the natural open spaces and conservation areas that will draw people to the facility and enhance its economic viability, such as the public swimming pool and braai (barbeque) areas at the Fountains Valley Nature Reserve, Groenkloof. In doing so, the facilities which make a profit subsidise the ones that don't or cannot generate an income (City Official 9).

Balance the running costs of facilities with the income generated by others. City Official 10

The social part is the spin-off, and it's very important, but also the important ecological services that this GI (nature reserves) gives to the residents of the City of Tshwane. City Official 9

City Official 8 was particularly passionate about the value and benefits of retrofitting old GI and giving it a new lease on life.

Although the officials acknowledged that some GI projects come at a higher financial cost, they believed that this was not a reason not to promote GI applications.

So yes, sustainability projects are expensive…but we are saying we need to promote them because the benefits are unmatchable. City Official 4

4.3.2 Participatory Workshop: Opportunities

The researcher presented the challenges and opportunities identified during the interviews as part of the PowerPoint presentation at the workshop. This session was not the workshop's focus, and time was not allocated to the deliberation thereof. This was merely a feedback session, and workshop participants were not required to engage with this part of the presentation. However, the participants mentioned some opportunities during the workshop debates and discussions, namely:

- GI will be protected, conserved, and valued by residents if made accessible and useable (Practitioner 1).
- Pilot studies that demonstrate the benefits of GI are required.

  "I mean we need to … focus [on] *local and start branching it out from there, … Council should … go … earmark five or six nodes in the city …. and then from those nodes you* [branch out] (Practitioner 3).
- Capitalise GI by developing a high-level open space master plan with a budget similar to the long-term master plans prepared by the utility departments for future planning for bulk services infrastructure. The cost of GI application can then be diverted into the project cost of new developments (City Official 17).
- Multiple entry points for GI principles in city spatial documents are required, particularly at the Regionalised Spatial Development Framework stage. Applying GI planning principles only at the Site Development Plan stage is too late in the land development application process (City Official 15).
- Allow creativity by developers to supply required public open space (Developer 1).

- Finding a way to ring-fence the money paid for endowment instead of providing or upgrading public open space by developers and ensuring the money is used to develop or upgrade GI within a specific urban area (City Official 14).
- Include sidewalks as part of public open space provision to enhance connectivity and walkability of the city (City Official 15 and Practitioner 1).

4.3.3 Post-workshop Clarification Meetings: Opportunities

City officials identified four specific opportunities where GI guiding principles could be included in the city's spatial documents, namely:

- The Regionalised Spatial Development Frameworks 2023
- The City Planning Division's Site Development Plan requirements form
- The Human Settlements Plan
- Tshwane Open Space Framework

4.4 Discussion

This chapter responds to research sub-question 1, which seeks to (i) identify the role players who evaluate and approve land development applications that influence the application of GI at the City of Tshwane and (ii) to document the challenges and opportunities for the improved application of GI in the City of Tshwane.

Tables 4-3 and 4-4 compare the findings from the literature, the semi-structured interviews, the participatory workshop and post-workshop clarification meetings regarding institutional challenges and opportunities related to the application of GI in the City of Tshwane. The comparative tables show that the different sources support the findings. The tables provide a concise and comprehensive list of local opportunities and constraints. From these, the most pertinent challenges and opportunities will be discussed related to the literature.

Table 4-3. Comparative findings regarding institutional challenges

Challenges	Literature	Semi-structured interviews	Workshop	Post-workshop meetings
(1) Rapid population growth and urbanisation	√	√	√	√
(2) Limited institutional ability/ knowledge and skills/ scarce resources	√	√		
(3) An ineffective public sector/ poor collaboration/enforcement, compliance, post-construction monitoring /failed bureaucracy and inefficiency/poor work ethic	√	√	√	√
(4) Urban land-use planning systems/ conflicting policies, regulations and processes	√	√	√	√
(5) Development pressure	√	√	√	√
(6) Land invasions	√	√	√	√
(7) The 'green-value' gap / social and political buy-in	√	√	√	√
(8) A multitude of competing actors/ competing interests	√	√	√	√
(9) The role of other stakeholders	√	√	√	√
(10) A lack of supporting data/ technical support	√	√	√	√
(11) The adverse impact of climate change	√	√	√	
(12) Quality of existing GI	√	√	√	
(13) Disservices associated with GI	√	√		
(14) Miscellaneous	√	√	√	√

Table 4-4. Comparative findings regarding institutional opportunities

Opportunities	Literature	Semi-structured interviews	Workshop	Post-workshop meetings
(1) Addressing the green-value gap / obtaining institutional buy-in/communicating the benefits of GI	√	√	√	√
(2) Empowering institutions to obtain institutional buy-in/ streamline the land development application process/ promote internal cooperative governance / promote collaborative governance between all spheres of government	√	√	√	√
(3) Integrating GI concepts into urban planning frameworks and functions/entrenching GI guidelines into spatial policies and by-laws	√	√	√	√
(4) Active citizen participation/ promote cross-sectoral partnerships	√	√	√	√
(5) Adopting a transdisciplinary planning approach	√	√	√	
(6) Updating technical databases	√	√	√	
(7) Conducting further research in the field	√	√	√	√
(8) Generate funding to develop and maintain GI, including incentives	√	√	√	

South African government institutions face enormous basic service delivery challenges, and the City of Tshwane is no different. With so many critical socio-economic needs, the value of and benefits the natural environment can contribute to a healthy, resilient city are not always fully understood. Figure 4-2 illustrates the complex challenges faced by the City of Tshwane with applying GI planning.

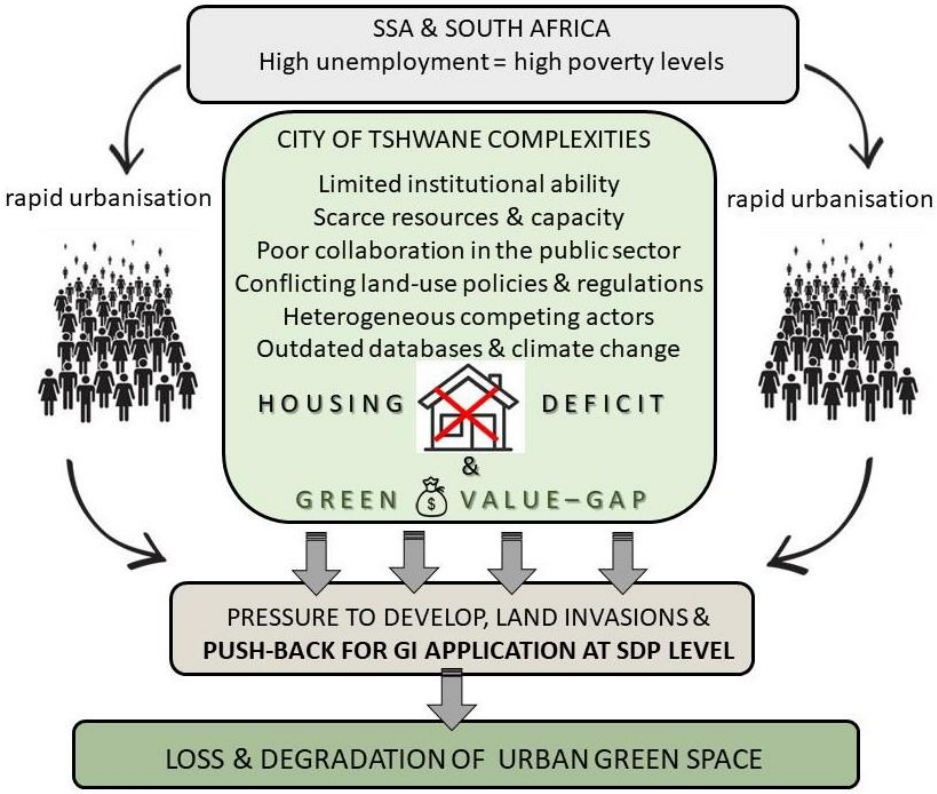


Figure 4-2. Summary of complex challenges faced by the CoT with the application of GI planning

As summarised in the figure above, the City of Tshwane experiences challenges with the protection and incorporation of GI in its urban fabric, as in many other SSA cities. Rapid urbanisation in urban areas, compounded with limited institutional resources and a lack of the necessary skilled and knowledgeable city officials, conflicting land-use management policies, and many stakeholders competing for the limited available resources, have resulted in green open space being underrated, undervalued and targeted for development. The high unemployment rate in South Africa of just under 33% (Municipalities of South Africa, 2023) has resulted in increased poverty levels, rendering people unable to purchase or lease formal housing. Informal settlements develop in vulnerable ecological areas, while developers resist providing open space in formal developments, which they believe cuts their profit margins. Adding to the already overwhelming challenges the city faces, most people living in informal settlements are undocumented, illegal immigrants (City Official 3). The literature, data collection interviews, workshop and post-workshop meetings confirm these findings (refer to Tables 4-3 and 4-4). Other SSA cities also experience similar challenges, such as encroachment and a green-value gap in Nigeria (Zakka et al., 2017), “limited resources, political interference and corruption” in Ghana (Cobbinah and Nyame, 2021:424), and political interference and an increased demand for urban land in Zimbabwe (Matamanda et al., 2019).

As much as there are pressing challenges for GI planning, there are also local opportunities to explore. Roles players involved in urban land use planning must endeavour to understand GI users' perceptions, preferences and values whilst promoting GI benefits. Improved collaboration internally between city departments and other role players involved with GI application could be facilitated by, for instance, including GI planning principles in spatial documents governing the SDP stage and at different entry points in the land development application process. Embracing an inclusive development process by forming cross-sectoral partnerships is an opportunity for the city to overcome some of the institutional challenges it faces regarding access to resources and taking ownership and responsibility for green assets by the communities. Finally, encouraging transdisciplinary approaches by the planning professions is another feasible opportunity to be pursued. Figure 4-3 summarises the opportunities for improved GI decision-making in the City of Tshwane. The following four sections will discuss the most promising opportunities identified to incorporate GI as a standard part of the SDP process in the City of Tshwane.

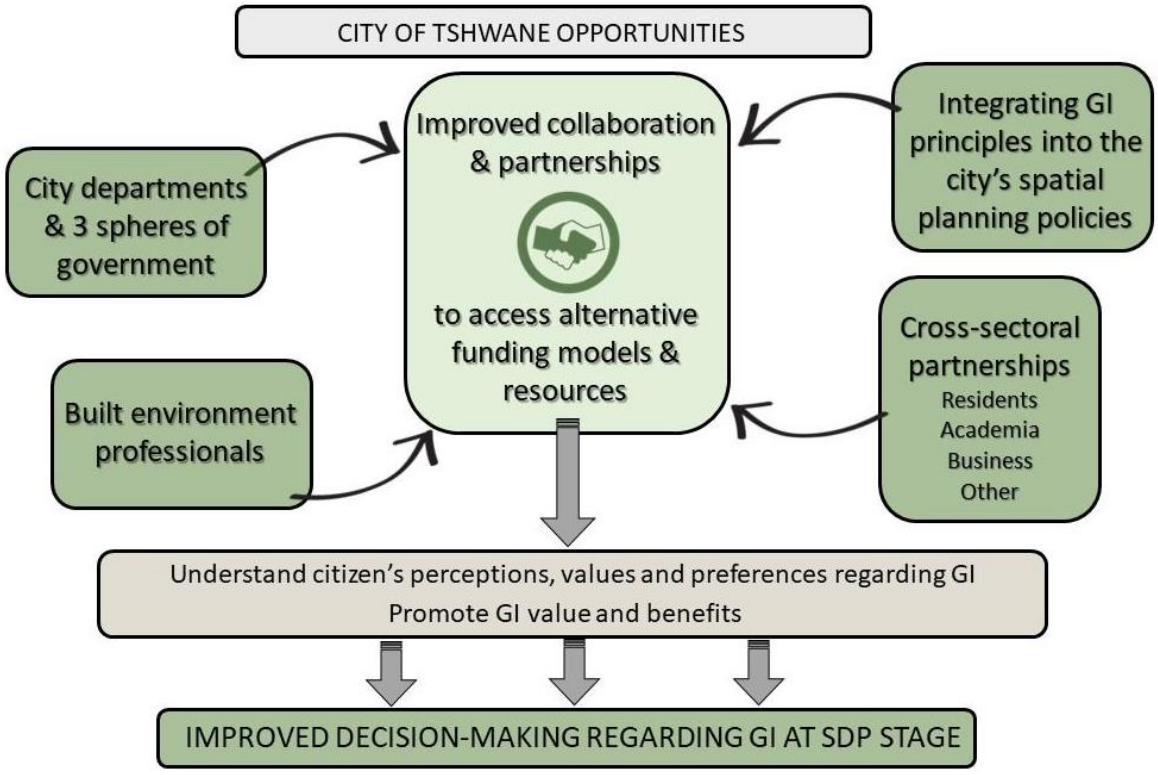


Figure 4-3. Summary of the opportunities for improved GI application in the CoT

4.4.1 Understand citizens' preferences and promote the value of GI

Several officials were of the opinion that when people do not have access to basic service and shelter, the value and benefits of open spaces and nature is not a main priority for them (City Officials 3 and 7). This does not mean that people do not value open space but that they have more pressing needs. Du Toit et al. (2018) attribute a perceived lack of concern with GI benefits to socio-cultural

values, traditions, perceptions, and the disservices GI provides. Dipeolu et al. (2021) argue that citizens' perceptions will become more positive if the factors influencing people's preferences for different types of GI are understood. Together with inclusive planning, design and management of open spaces, as advocated by City Official 3 and supported by Pauleit et al. (2017) and Monteiro et al. (2020), the knowledge and awareness of the benefits that GI can provide to all city stakeholders (citizens, politicians, developers, traditional leaders etc.) should be better promoted. Role players such as landscape architects and officials involved in environmental management need to actively spread information in their working environment about the values and benefits that GI can contribute to urban living for all citizens.

4.4.2 Enabling cross-sectoral partnerships to access alternative funding models and resources

The literature makes several proposals to improve poor institutional capacities, such as (1) training and development of officials (Arku et al., 2016), (2) amendments to legal policy frameworks to include GI applications supported by budgetary allocations (Amoako and Adom-Asamoah, 2019), (3) integrating environmental and spatial planning functions in the city organogram such as in the City of Cape Town (Cilliers et al., 2014), and (4) show-casing successful GI implementation (Arku et al., 2016). However, since the City of Tshwane's lack of resources for GI is likely to remain low (City Official 17), alternative funding models are required. This involves lobbying for changes to legislation such as the Municipal Finance Management Act 53 of 2003, which, for instance, prohibits endowments (payments made by developers in lieu of providing public open space) from being allocated explicitly to GI development (City Official 14). The Act also prohibits the city from investing funds for GI development on land not owned by the city, such as a school site. This limits the possibility of sharing facilities between communities and the city. The city could expand programmes such as "Adopt-a-Spot" (see Chapter 4, section 4.2.1m-iii) that currently allow for adopting and maintaining green spaces to further allow for controlled urban farming, for example, adding to food security and helping alleviate poverty. This will allow for co-management of GI benefits that go beyond city beautification initiatives.

Furthermore, as emphasised by the literature, encouraging cross-sectoral partnerships and active citizenship will stretch resources and lessen the demand on the city to deliver, manage and maintain all service infrastructure, including GI, as also recommended for Kumasi, Ghana by Cobbinah et al. (2019). Reducing the disservices created by poor-quality GI due to a lack of maintenance, such as safety and access constraints, is possible. If partnerships empower communities, they can take co-ownership and manage these spaces, as proven successful in Ibadan, Nigeria (Ogu (2000). This requires an adaptive management approach, as Breed et al. (2015) called for.

Realising the above opportunities is essential, specifically at the SDP stage, because urban planning is translated into projects on the ground, affecting citizens and directly influencing their quality of life.

4.4.3 Integrating GI Principles into spatial planning policies

Many authors, such as Cilliers et al. (2019) and Arku et al. (2016), support integrating GI principles into mainstream spatial planning policies in the SSA. The successful example of the Durban Metropolitan Open Space System, which is woven into all facets of the city of eThekwini's spatial planning systems, can be used as an example for the City of Tshwane and other SSA cities. The outcome of the collaborative workshop used as part of co-development in this research emphasised that GI integration should be included at the city's highest level of planning, the Integrated Development Plan, which sets the city's annual expenditure budgets (City of Tshwane, 2023e). However, during the post-workshop meetings, Practitioner 1 cautioned that a time lag exists between the Integrated Development Plan and the actual funding and implementation of city development projects listed in the Integrated Development Plan, which calls for opportunities that allow for more active participation from interested and affected residents during the implementation stages.

More emphasis on GI is necessary at the Metropolitan Spatial Development Framework stage, which only mentions connectivity, multi-functionality and multiscale (City of Tshwane, 2021b). At the same time, the inclusion of GI guidelines is critical in the City of Tshwane Land-Use Management By-Law, 2016 (City of Tshwane, 2016), the Tshwane Town Planning Scheme 2008 (revised 2014), and specifically in the Regionalised Spatial Development Frameworks. This study's results illustrate a lack of emphasis on GI within these documents and planning phases, which could be alleviated by enhancing collaboration and partnerships between all role players and sectors involved with the land development application process in the city (refer to 4.4.4).

GI principles are also required to follow through at the SDP stage at the lower end of the spatial plan hierarchy, where implementation of developments on the ground is the next step. Another opportunity is to incorporate GI guiding principles into the draft Green Building Development and Net-zero Carbon Building By-law for the City of Tshwane, 2021 (City of Tshwane, unpublished c), providing the necessary legal status for enforcement.

4.4.4 Closer collaboration by all stakeholders

Integration of professional approaches to GI is also essential for its successful application in the city (Cilliers et al., 2014; Van Zyl et al., 2021; Roux et al., 2017), as well as internally between city departments and externally between the three spheres of government. Better collaboration and stronger cooperation between different built-environment professions must be promoted. This is

possible through the Council for the Built Environment[12]. Encouraging closer collaboration among built-environment professionals involved in land development projects from project commencement to the SDP stage will streamline the application process, save the developer time and money, and contribute to more sustainable, healthier, higher-quality urban environments for city residents.

4.5 Conclusion

This chapter responded to research sub-question 1, which seeks to comprehend the complex challenges the City of Tshwane faces to deliver its mandate, specifically regarding GI. The research question also sought solutions for GI application from the literature and the study participants intimately involved with the day-to-day functioning of the City of Tshwane. The study attempted to gain balanced insights by engaging various city and private sector actors involved in the city's urban land development. Fourteen over-arching challenges and eight opportunities were identified by the participants and compared to other SSA countries through the literature.

Although the challenges faced in the GS are overwhelming and can be very difficult for public officials to navigate, opportunities exist that can enable the application of GI in land development projects in the City of Tshwane. The opportunities that hold the most promise for the SDP stage include promoting the value and benefits that GI can contribute to urban living for all citizens. These include the return on investment for quality, well-designed, multi-functional green spaces by developers; integration of GI principles into all spatial planning documents in the city to facilitate improved collaboration between city departments and streamline evaluation and approval processes; enabling cross-sectoral partnerships to spread the burden of service delivery and bring relief to the scarcity of resources hampering the effective execution of the city's mandates; and encouraging closer collaboration between built-environment professionals to guide the planning process more effectively.

Improved collaboration and partnerships across all sectors in the city will disseminate the benefits and value of GI and, in so doing, (1) improve decision-making regarding the implementation of GI at the SDP and other spatial planning stages and (2) unlock alternative funding and resource pools which will lessen the burden on local government as the custodian of GI in the city.

[12] **Council for the Built Environment** "is a Schedule 3A Public Entity that reports to the National Department of Public Works and Infrastructure. It is a regulatory body established under the Council for the Built Environment Act (No. 43 of 2000) (the CBE Act). The CBE was established to instil good conduct within built environment professions, mobilise transformation in the built environment professions, protect the public's interest and advise the South African Government on Built Environment related issues" (Council for the Built Environment, 2022).

Chapter 5 Study Findings: Local GI definition and planning guiding principles

5.1 Chapter Introduction

This chapter is presented in four sections. The first section presents the findings pertinent to developing a locally applicable GI definition. Research sub-question 2 asks: *What is a contextually appropriate definition for urban GI for sub-Saharan Africa and South African cities, particularly the City of Tshwane?* The steps taken to establish a definition for the City of Tshwane are briefly discussed. The outcome of the GI definition co-development processes follows. The second section presents the findings on developing a set of contextual GI planning guiding principles for the City of Tshwane. The methods follow, and the co-creation process is then described. Research sub-question 3 asks: *What contextually appropriate urban GI planning guiding principles will enhance the City of Tshwane's SDP process?* The third section of the chapter discusses the findings of research sub-questions 2 and 3. The chapter concludes with a summary of the outcomes of the two research sub-questions discussed. Figure 5-1 illustrates the structure of the chapter.

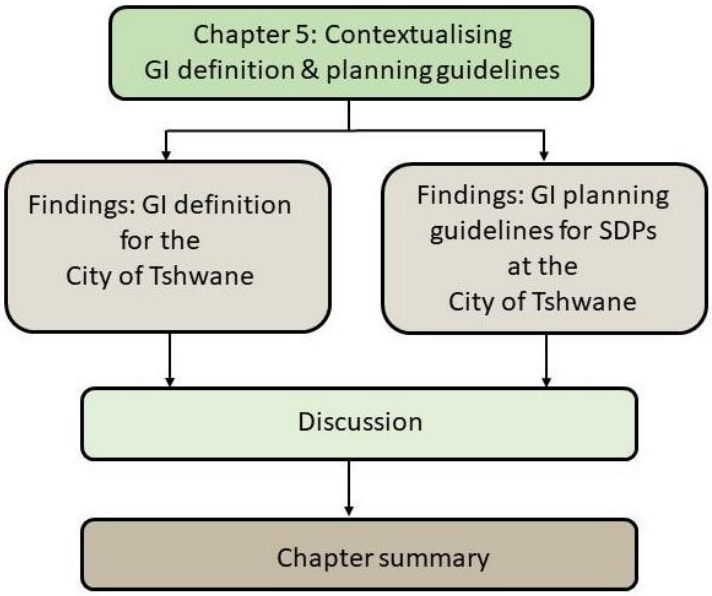


Figure 5-1. Structure of Chapter 5

5.2 Defining GI for the City of Tshwane

As discussed in Chapter 2, Section 2.1, the concept of GI has evolved over the years. Initially, it was primarily a network of connected green spaces with the primary goal of protecting and conserving natural areas.

The process of finding an applicable definition of GI for the City of Tshwane is illustrated in Figure 5-2. Firstly, definitions were extracted from the literature and spatial planning documents as described in Chapter 2. Some of the definitions were presented to the study participants as part of the semi-structured interviews, via the online questionnaire and at the workshop (see Appendices C and D). The process aimed to ensure that the proposed definition of GI for the City of Tshwane is appropriate and context-based.

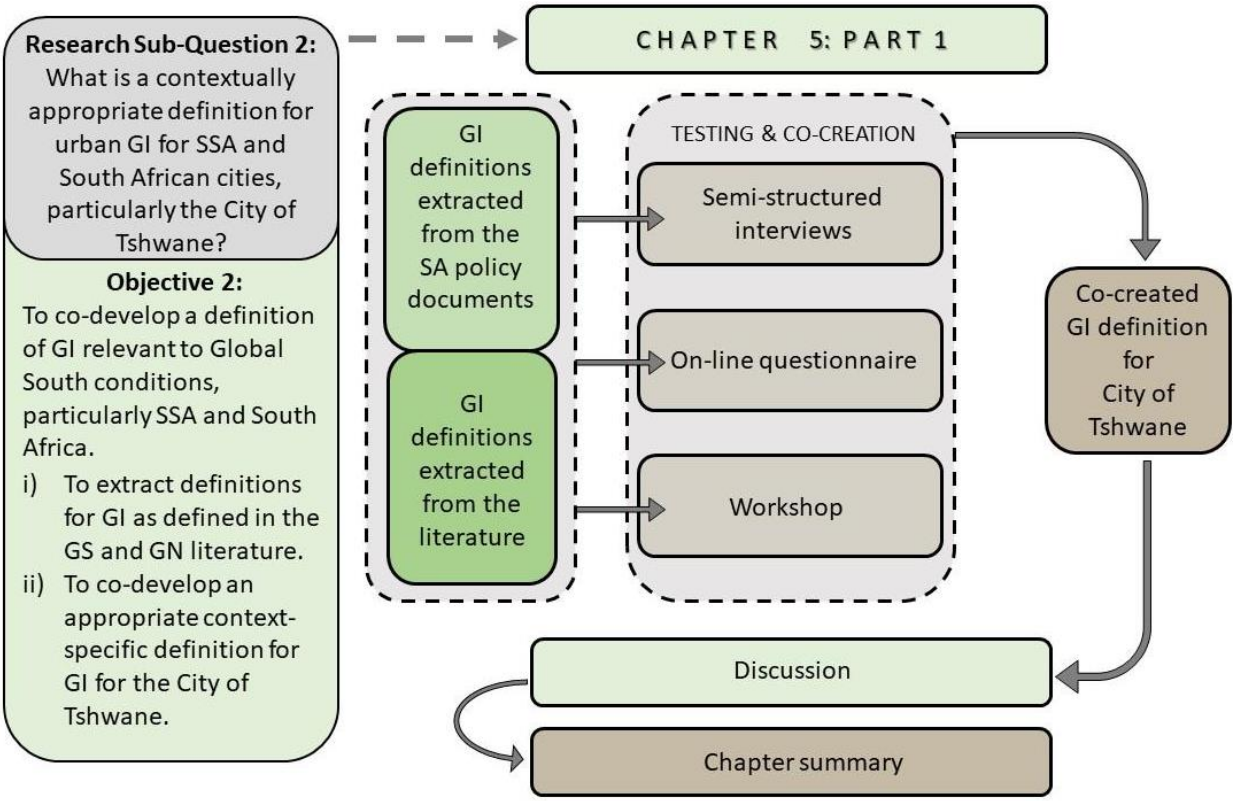


Figure 5-2. GI definition co-creation process to answer research sub-question 2

5.2.1 Defining GI Contextually

The formal part of the semi-structured interviews commenced by asking the participants about their understanding of GI. They were presented with two definitions to stimulate the conversation. The two definitions given are the first two definitions listed in Table 5-1 below. The participants were asked whether they think either of the definitions applies to the South African context or if they would define GI differently, and if so, how? Most city officials understood the concept of GI and believed that its application to the city's land development projects is essential. One city official was unsure of the meaning of the concept of GI, and another focused on green building elements. Both definitions were acceptable to the city officials.

Furthermore, the city officials were asked if they believed GI could positively contribute to the city's overall social, cultural, economic, and ecological health. All of the city officials agreed that GI could make a vital contribution to all the aspects mentioned. These questions aimed to provide the researcher with an understanding of the city officials' knowledge of the concept of GI and to establish common ground from which to start the interviews.

The online questionnaire was the second instrument used to engage the study participants regarding a definition of GI for the City of Tshwane. The purpose of posing the pre-workshop questions was to stimulate thinking on the topics to be engaged with regarding the application of GI in the City of Tshwane in preparation for the workshop event.

The online survey respondents were requested to select one of three possible definitions for GI which they believe is most suited to the City of Tshwane. The two definitions presented previously during the semi-structured interviews were augmented by a third definition extracted from the draft Tshwane Open Space Framework 2020 (City of Tshwane, unpublished b). Eight respondents chose the draft TOSF 2020 definition as their preferred option. Seven selected the Monteiro et al. (2020) option, and three opted for the European Union (EU) definition (European Union, 2013). One respondent indicated that all three options are equally appropriate. Table 5-1 shows the three possible choices and the online survey results.

Table 5-1. Definitions for GI included in the semi-structured interviews and the online questionnaire.

Source	Definition	Results of online survey
*EU (2013)	"GI is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings" (European Union, 2013).	**2 + 1** = 3**
*Monteiro et al., 2020	"Apart from ecological functions, GI can also contribute to social, cultural and economic benefits, which in turn support the establishment of sustainable, resilient, inclusive and competitive urban areas" (Monteiro et al., 2020).	**6 + 1** = 7**
Tshwane Open Space Framework (2020 draft)	"GI refers to open spaces, with both social and ecological functions, that are seen as infrastructure equal to roads, water, electricity, and the other traditional municipal services that have long taken precedence over open space" (City of Tshwane, unpublished b, volume 1:19).	**7 + 1** = 8**

**Presented at the semi-structured interviews* ***One respondent selected all three definitions*

The researcher compiled a draft definition from the three online questionnaire options, which was the basis for the workshop's first small group co-creation activity. The workshop participants were asked to edit the draft wording and submit their preferred version. The marked-up suggestions were collected for further processing by the researcher.

The draft GI definition presented for editing at the workshop is in the box below:

> GI is a strategically planned network of open space typologies that performs critical and fundamental ecological functions that delivers ecosystem services equal to traditional municipal infrastructure. GI provides economic, social and environmental benefits to the city and its inhabitants.

Table 5-2 indicates the outcomes of the workshop GI definition editing activity. The words to be avoided and concepts that the participants felt should be highlighted in the proposed definition for the city are listed.

Table 5-2. Editing suggestions by workshop participants for the draft GI definition

Words to avoid	**Concepts to include**
strategically*	strategically*
typologies	integrated
equal to	better than/ supports/ compliments grey infrastructure/ improve the functioning of
	walkable
	adaptable
	sustainable
	accessible
	non-green spaces, human-made public spaces
	grows organically/flexible/adaptable
	safe spaces
	multi-functionality
	climate impact mitigation/ risk reduction mechanism
	the physical environment within and between our cities, towns and villages
	risk reduction
	capitalised, costed (cost-benefit analysis)
	Sustainable Urban Drainage Systems (SUDS)

	planned and financed
	co-benefits
	responsive to scientific evidence-base
	public open space

**participants disagreed on whether the term 'strategically' must be included or omitted from the definition*

The workshop participants had strong opposing views on whether the term 'strategic' should be included in the definition of GI for the City of Tshwane. Some felt that the term was limiting and would result in the loss of less strategic sections of the city's GI network (Developer 1 and Practitioner 1). Others argued that 'strategic' referred to proper and thoughtful planning and would elevate the concept of GI in the city (City Official 6).

Based on the recommendations from the co-creation activity, the proposed definition for GI for the City of Tshwane is:

> In the City of Tshwane, we strive for safe GI that provides ecological, socio-cultural and economic benefits to all its citizens. GI is a connected system comprising green and blue, undeveloped and developed private and public open spaces. GI is equally important and can complement engineering infrastructure. GI must be accessible, walkable and multi-functional to enhance social justice and climate adaptation.

5.3 GI planning guiding principles for the City of Tshwane

The process followed to establish the proposed list of GI planning guiding principles that apply to local conditions is illustrated in Figure 5-3 and involves four phases.

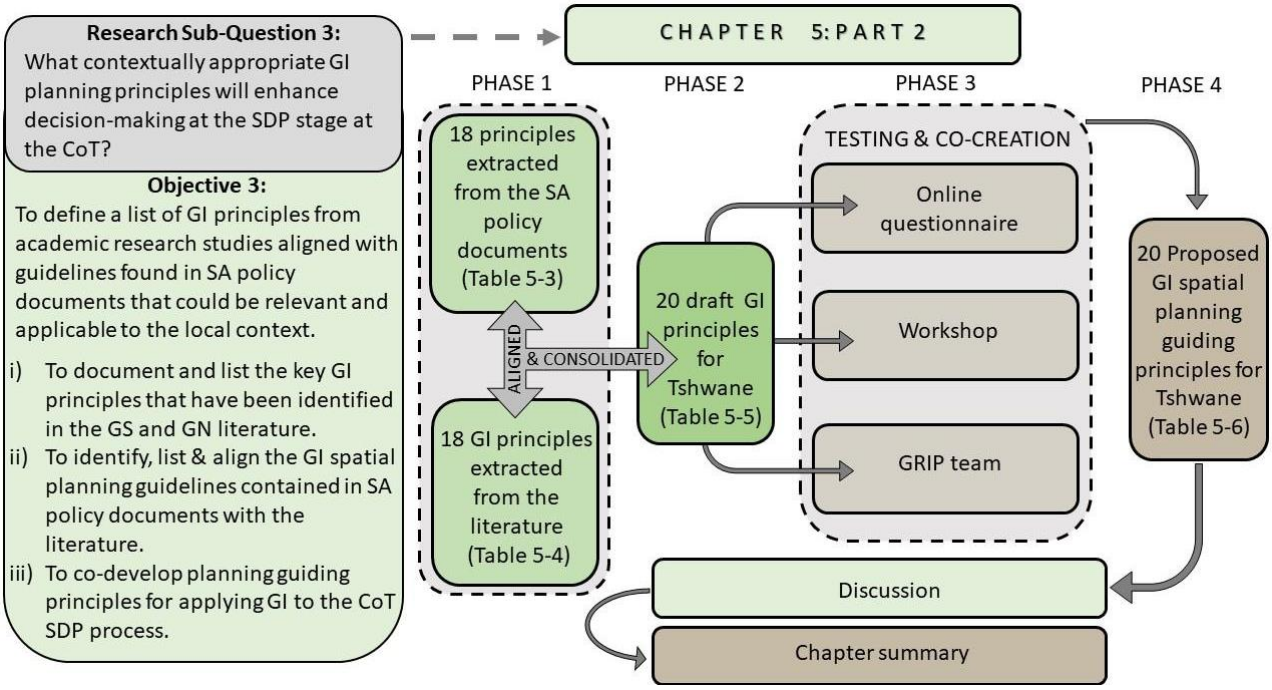


Figure 5-3. GI guiding principles co-development process to answer research sub-question 3

In phase one, 18 spatial development and environmental management planning principles were extracted from the South African policy documents (Table 5-3) and 18 GI planning principles from the literature (Tables 2-4 and 5-4). Next, the 36 principles were aligned and consolidated into a draft list of 20 GI principles (12 *planning* and eight *process*) after Pauleit et al. (2017) and Pauleit et al. (2021) (see Table 5-5).

During phase 3, the 12 GI planning principles were selected for testing and amended via the co-creation processes as part of the online questionnaire and participatory workshop as they align with the study's focus. The GRIP research team provided written feedback on the 20 draft GI planning and process principles. In phase 4, the guiding principles were amended according to the recommendations received. Each of the four phases is described in more depth below.

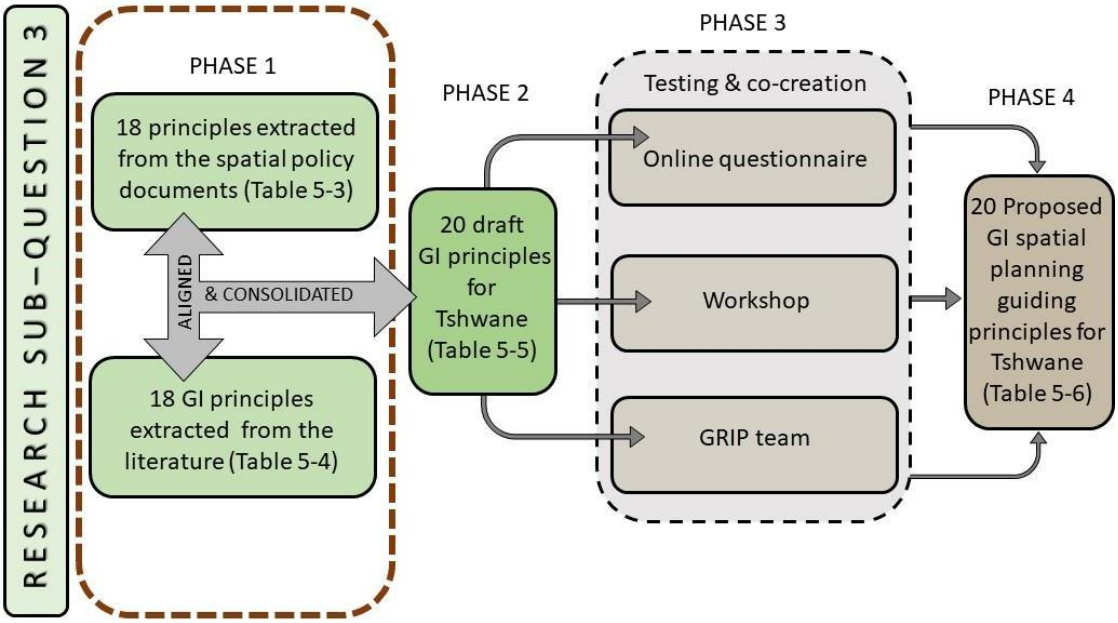


Figure 5-4. GI guiding principles co-development process: phase 1

Phase 1 comprised a desktop document review and was the first step to establishing a set of GI planning principles for the City of Tshwane for the SDP stage of the land development application approval process (Figure 5-4).

First, the national, provincial, and local government policy documents relevant to GI planning, plus other important South African institutional documents, were examined for references to GI spatial and environmental planning guidelines. Concurrently, GI planning guidelines were extracted from the literature reviewed. Table 5-3 below indicates the eighteen (18) principles extracted from the relevant local policy documents. Table 5-4 lists 18 GI planning guidelines extracted from the literature.

Table 5-3. GI Alignment of policy document spatial planning principles (left) and policy documents grouped at the national, provincial and local level

Spatial planning principles from policy documents	Sources													
	National						Provincial			City of Tshwane				
	National Development Plan 2030 (Republic of South Africa, 2012)	Spatial Planning and Land Use Management Act 16 of 2013. (Republic of South Africa, 2013)	National Environmental Management Act, 107 of 1998 (Republic of South Africa, 1998c)	Draft Guidelines for the Provision of Open Space (Isikhungusethu Environmental Services, Louw and Dewar, 2017)	Department of Human Settlements – Red Book (Department of Human Settlements, 2019)	Council for Scientific and Industrial Research (CSIR) – Green Book (Van Niekerk et al., 2019)	Gauteng Conservation Plan, 2014 v 3.3 (C-Plan-3) (Gauteng Province, 2014)	The Gauteng Ridges Policy (Gauteng Province, 2019)	Gauteng Province, 2022. GSDF 2030. (Gauteng Province, 2022)	Tshwane Town Planning Scheme, 2008 (revised 2014) (City of Tshwane, 2014)	Metropolitan Spatial Development Framework 2030 (City of Tshwane, 2021b)	Regionalised Spatial Development Framework (Regional Spatial Development Plan) for Region 1 and 3 Draft 2023 (City of Tshwane, 2018a; 2008b)	Tshwane Open Space Framework (City of Tshwane, 2005) 2020 draft (City of Tshwane, unpublished b)	Local Open Space Plans (LOSPs) (KH Landscape Architects. 2008; 2012)
1. Spatial and Environmental justice	X	X	X	X	X	X			X		X	X	X	X
2. Spatial and Environmental sustainability	X	X	X	X	X	X	X	X	X	X	X		X	X
3. Spatial resilience	X	X		X	X	X	X	X	X		X	X	X	X
4. Spatial and Environmental quality	X	X		X	X	X	X	X	X		X		X	X
5. Spatial efficiency	X	X				X			X				X	X
6. Equitable access to environmental resources			X	X	X	X							X	X
7. Equitable and effective participation of all stakeholders and forms of knowledge			X	X	X		X						X	X

8. Environmental integration and linkage				X	X	X	X	X			X	X	X	X
9. Protect the environment			X	X	X	X	X	X			X	X	X	X
10. Flexibility						X							X	X
11. Anticipatory planning						X	X	X	X				X	X
12. Transparent and inclusive decision-making			X	X	X		X		X				X	X
13. Empowering communities			X	X	X	X							X	X
14. Co-operative governance			X			X	X				X	X	X	X
15. Safety and security	X	X	X	X	X	X	X	X	X	X	X	X	X	X
16. Spatial legibility				X					X	X	X	X	X	X
17. Sharing of facilities				X										
18. Provide economic opportunities	X	X	X	X	X	X			X				X	

Note the terms employed in the spatial planning documents in Table 5-3 above differ somewhat from the principles found in the literature, as noted in Table 5-4 below.

(Source: adapted from Breed et al., 2023)

Chapter 2 Table 2-4 indicates the draft list of eighteen (18) GI spatial planning guiding principles extracted from the literature. The principles are listed in Table 5-4 below. The first four principles in Table 5-4 are planning principles. The next four are process principles categorised by Pauleit et al. (2017 and 2021). The remaining ten principles are not categorised in the literature.

Table 5-4. GI principles extracted from the literature

GI PLANNING PROPERTY PRINCIPLES
1. Urban ecological connectivity/networks (systems thinking)/ (physical and functional)
2. Multi-scale (communities = neighbourhood scale) / (cities = city-scale)
3. Multi-functionality (across scales)
4. Integration of green and grey elements
GI PLANNING PROCESS PRINCIPLES
5. Social Inclusion
6. Strategic spatial planning (focused on sustainability, integration, and developing contextually appropriate, affordable and effective forms of land-use management)
7. Interdisciplinary and transdisciplinary
8. Reflexive
GI PRINCIPLES UNCATEGORISED
9. Protection of biodiversity
10. Redundancy
11. Evidence-based
12. Adaptive and flexible design (temporal) – recognise the heterogeneity in evidence produced for policy and practice
13. Context-based planning / Applicability
14. Accessibility
15. Securing green space quality and quantity
16. Safety
17. Governance – including stakeholder participation
18. Continuity (long-term)

(Sources: Cilliers et al., 2014; Breed et al., 2015; Pauleit et al., 2017; Mell, 2016; Hansen et al., 2017; Cilliers, 2019; Lindley et al., 2018; Titz and Chiotha, 2019; Cilliers and Rohr, 2019; Monteiro et al. 2020; Pauleit et al. 2021; MacFarland et al. 2019; Du Toit et al. 2018).

During phase 2, the GI principles from the literature (Table 5-4) were aligned with the spatial and environmental development principles from the spatial documents (see Table 5-3), as illustrated in Figure 5-5.

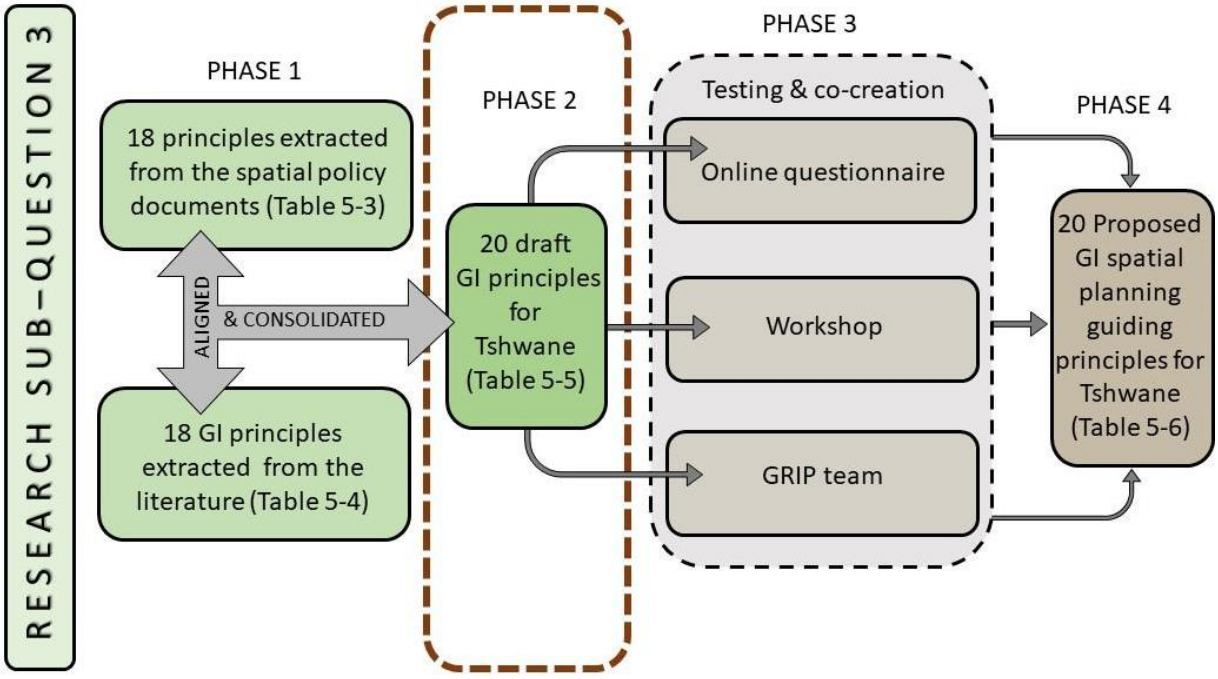


Figure 5-5. GI guiding principles co-development process: phase 2 aligning and consolidating the two sets of principles

During phase two, the researcher aligned the two sets of guiding principles listed in Table 5-3 and Table 5-4 above and amalgamated them into a draft list of twenty (20) guiding principles for the City of Tshwane (see Table 5-5). This step ensures that the proposed list of GI guiding principles addresses all the legislative aspects of GI planning in the South African spatial planning documents. Table 5-5 below indicates the alignment of the GI principles from the literature, spatial planning policy documents and stakeholder feedback during the semi-structured interview process.

Table 5-5. Alignment of GI principles from the literature, policy documents, and stakeholder interviews

20 Consolidated and aligned draft GI Principles		References from literature	References from policy documents and stakeholders
	GI PLANNING PROPERTY PRINCIPLES		
1	Connectivity of green spaces	Pauleit et al., 2017; Pauleit et al., 2021; Monteiro et al., 2020; Palmira, 2015; Cilliers and Cilliers, 2016.	Department of Human Settlements (2019); Republic of South Africa (1998c); Isikhungusethu Environmental Services, and Dewar (2017); City of Tshwane (2005); City of Tshwane (unpublished a and b); KH Landscape Architects (2008 and 2012); Interviews and workshop.

2	Accessibility of green space	Monteiro et al., 2020.	Isikhungusethu Environmental Services, Louw and Dewar (2017); Du Toit et al., 2018; GRIP WP1 workshop, (2022); Interviews and workshop.
3	Multi-functionality of green spaces	Pauleit et al., 2017; Du Toit, 2018; Monteiro et al., 2020; Pauleit et al., 2021.	City of Tshwane (2005); City of Tshwane (unpublished a and b); KH Landscape Architects (2008 and 2012); Isikhungusethu Environmental Services, Louw and Dewar (2017); Interviews and workshop.
4	Multi-scale planning for green spaces	Frischenbruder and Pellegrino, 2006; Pauleit et al., 2017; Monteiro et al., 2020; Pauleit et al., 2021.	Isikhungusethu Environmental Services, Louw and Dewar (2017); Department of Human Settlements (2019); Interviews and workshop.
5	Integration of “grey” and GI	Pauleit et al., 2017; Monteiro et al., 2020; Pauleit et al., 2021.	Department of Human Settlements (2019); Van Niekerk et al. (2019); Republic of South Africa (2012); City of Tshwane (2005); City of Tshwane (unpublished a and b); KH Landscape Architects (2008 and 2012); Interviews and workshop.
6	Adaptability/ flexibility over time	Cilliers et al., 2021.	Department of Human Settlements (2019); Interviews and workshop.
7	Diversity/ heterogeneity of green spaces	Monteiro et al., 2020.	GRIP WP1 workshop, March 2022; Interviews and workshop.
8	Contextual appropriate green spaces	Pauleit et al., 2017; Monteiro et al., 2020; Pauleit et al., 2021; Cilliers et al., 2021.	City of Tshwane (2005); City of Tshwane (unpublished a and b); KH Landscape Architects (2008 and 2012); Interviews and workshop.
9	Conserve and protect the natural environment (include biodiversity protection)		Republic of South Africa (1998c); Republic of South Africa (2004); Department of Human Settlements (2019); City of Tshwane (2005); City of Tshwane (unpublished a and b); KH Landscape Architects (2008 and 2012); South African National Botanical Institute (n.d) Gauteng Province (2014); Gauteng Province (2019); Interviews and workshop.
10	Quality of green space	Hansen et al., 2019.	Isikhungusethu Environmental Services, Louw and Dewar (2017); Department of Human Settlements (2019); City of Tshwane (2005); City of Tshwane (unpublished a and b); KH Landscape Architects (2008 and 2012);

			Interviews and workshop.
11	Safety and security inside green spaces	Cilliers, 2019.	Isikhungusethu Environmental Services, Louw and Dewar (2017); Department of Human Settlements (2019); Interviews and workshop.
12	Enhanced legibility/ orientation inside the city		Isikhungusethu Environmental Services, Louw and Dewar (2017); Department of Human Settlements (2019); City of Tshwane (2005); City of Tshwane (unpublished a and b); KH Landscape Architects (2008 and 2012); Interviews and workshop.
	GI PROCESS PRINCIPLES		
13	Strategic and anticipatory planning	Pauleit et al., 2017; Takyi et al., 2022; Pauleit et al., 2021.	Department of Human Settlements (2019); Interviews and workshop.
14	Cross-sectoral partnerships	Takyi et al., 2022; Ogu, 2000.	Interviews and workshop.
15	Socially inclusive planning	Pauleit et al., 2017; Monteiro et al., 2020; Cilliers et al., 2021; Pauleit et al., 2021.	Isikhungusethu Environmental Services, Louw and Dewar (2017); Van Niekerk et al. (2019); Interviews and workshop.
16	Interdisciplinary and transdisciplinary approach	Pauleit et al., 2017; Cilliers et al., 2014; Van Zyl et al., 2021; Roux et al., 2017.	Department of Human Settlements (2019); Interviews and workshop.
17	Co-operative governance and administration	Ogu, 2000; Takyi et al., 2022.	Isikhungusethu Environmental Services, Louw and Dewar (2017); Department of Human Settlements (2019); Interviews and workshop.
18	Co-ownership and sharing of facilities	Pauleit et al., 2017; Monteiro et al., 2020 Cilliers et al., 2021; Pauleit et al., 2021.	Isikhungusethu Environmental Services, Louw and Dewar (2017); Interviews and workshop.
19	Continuity (temporal)	Monteiro et al., 2020.	Interviews; workshop.
20	Green socio-economic opportunities	Pauleit et al., 2017.	Isikhungusethu Environmental Services, Louw and Dewar (2017); Interviews and workshop.

The 12 GI planning principles from Table 5-5 were selected for testing in phase 3 because they constitute generally accepted principles for planning green space. The researcher deemed the process (and management) principles less important to discuss, as these would be more context-

specific and would come out as a consequence of the discussion with stakeholders. As mentioned and described below, phase 3 of the process consists of three co-development and testing activities: the online survey, the participatory workshop, and written input from the GRIP research team, as illustrated in Figure 5-6.

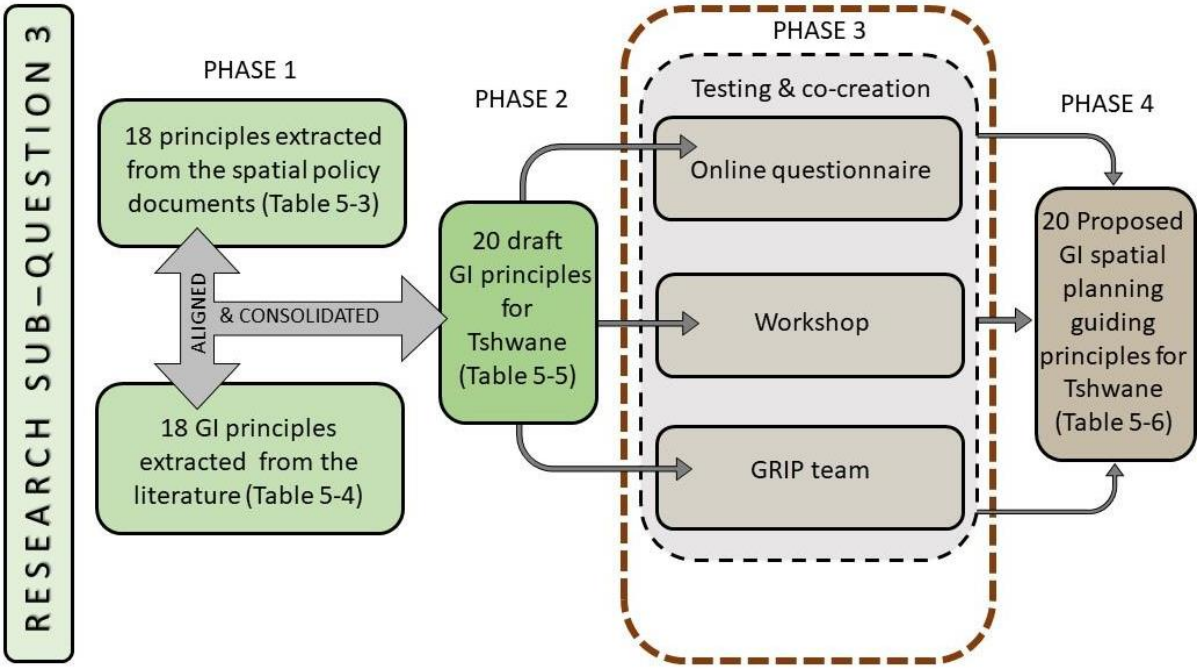


Figure 5-6. GI guiding principles co-development process: phase 3: testing and co-creation

Firstly, the pre-workshop online questionnaire included the 12 draft GI planning property principles from Table 5-5 in random order. The respondents were asked to assign a value indicating the importance of each principle for application in the City of Tshwane on a scale of one to ten (1 = not relevant to 10 = spot on).

The results of the ranking exercise from the online survey (see Table 5-6) indicate that “conservation and protection of green spaces” and “safety and security inside green spaces” are the most critical aspects regarding GI for the respondents. “Connectivity of green spaces” and different scales of green spaces” scored the lowest.

Table 5-6. Ranking results of GI core principles from the online questionnaire

Ranking	Core GI Principle	Assigned score 160
1	Conservation and protection of green spaces	148
2	Safety and security inside green spaces	146

3	Quality of green space	142
4	Adaptability/ flexibility over time Diversity of green spaces	141
6	Multi-functionality of green spaces Accessibility of green spaces	140
8	Integration of conventional and GI	138
9	Enhanced legibility/ orientation inside the city (green space contribution) Contextually appropriate green spaces	134
11	Connectivity of green spaces	132
12	Different scales of green spaces	130

Phase 3 Activity 2 consisted of the GI principle ranking process during the participatory workshop. As described in Chapter 3, the participants were divided into three small representative groups and tasked to rank the principles in order of importance to the City of Tshwane.

The workshop included three smaller representative focus groups engaging in robust debates regarding the ranking order of the draft principles. Participants were able to motivate the inclusion of new or omission of any principles tabled. The three groups then debated the individual group rankings to develop a final consolidated guideline ranking as presented in column 2 of Table 5-7.

The following are images of the participatory workshop that took place on 29 July 2022 and show the co-development nature of the event.

Figure 5-7. Photo documentation of workshop co-creation activities 1

Figure 5-8. Photo documentation of workshop co-creation activities 2

The priorities of GI planning principles allocated by workshop participants, ordered from a larger geographic scale (top) to site scale (bottom), are indicated in Table 5-7.

Table 5-7. Priorities of GI planning principles allocated by workshop participants. (Source: Breed et al., 2023).

Focus Group 1	Focus Group 2	Focus Group 3	Consolidated
Connectivity		Connectivity	Connectivity
Accessibility		Accessibility	Accessibility
	Conserve and protect	Conserve and protect	*Conserve and protect
		Diversity, adaptability	
Multi-functionality		Multi-functionality	*Multi-functionality
	Multi-scale	Multi-scale	*Multi-scale
Diversity, adaptability			Diversity, adaptability
		Safety, Quality	
Multi-scale			
	Multi-functionality		
	Green grey integration	Green grey integration	Green grey integration
Conserve and protect			
Safety, Quality			Safety, Quality

*principles prioritised by all three groups

Note: the colours highlight the same GI principle in each column only. The colour codes have no other significance.

Several themes recurred during the discussions, and some of the most important arguments raised during the workshop sessions were:

(i) Does *conserve and protect* come first or last?

Several participants believed that conserving and protecting the environment is a fundamental GI principle for the city and probably the most important, as supported by the online survey results (see Table 5-6).

> "*From my thinking, conserve and protect should be at the top of the list*". City Official 2
>
> "*Conserve and protect must be first*". City Official 19
>
> "*If you don't conserve and protect, you have nothing left*". Practitioner 5

Contrary to the above, some other participants argued that "Conserve and Protect" is implicit because numerous national and provincial legislation already regulate the natural environment, such

as the National Environmental Management Act 107 of 1998 (Republic of South Africa, 1998c) and the Gauteng Conservation Plan version 3-3 (Gauteng Province, 2014).

> "*But it is already underscored by legislation*". Practitioner 1
>
> "… *conserve and protect comes automatically if people take ownership of their open space network*" (Developer 1). City official 2 responded, "*And if they don't? Someone must do it* [take ownership]".

(ii) Safety and security are the most important principles

This principle ranked second highest in the online survey (see Table 5-6).

> *"I think in South Africa, this* [security] *is probably one of the most important ones"*.
>
> Practitioner 4
>
> *"I'd say the safety and security is a critical element…if you don't have this, everything is going to fall away".* Practitioner 5

Yet, some participants thought that safety and security were an outcome of GI, not a principle (Practitioner 5).

> "*Is safety and security a design issue? Because it's similar to legibility*". Practitioner 6
>
> "*I think you're right. Safety and security are again an outcome or an objective of a good environment*". Practitioner 5

(iii) Use open space to protect it

Some participants argued that the notion that the only way to protect and conserve natural areas is to fence them in and keep citizens out is outdated and has not worked in the past.

> "…*currently we put important areas in glass boxes, and one is not allowed to touch them, and people don't use them or value them"*. Practitioner 1

The participant argued that the natural environment must be used in order to protect it.

(iv) Re-establish open space connectivity linked to accessibility

Related to both arguments above is the idea that the fragmentation of private and public open space networks, which aims to protect or enhance safety within them, is achieving the opposite effect.

> *"If you look at Johannesburg, they opened up like Delta Park, you can ride into the CBD for 15km, but when you look at the east of Tshwane, the city has gated off its own open space … then you still have the estates further on that have totally blocked* [open space] *that you*

are breaking off your connectivity. It doesn't help you say connectivity, and then you have a lot of blocked areas". City Official 17

(v) Some of the principles could mean different things at different scales

"Accessibility at a larger scale means something different from what it means at a smaller scale. Context-specific means something different at a larger scale than at a smaller scale"; and, "*Like on a smaller scale, security if it's a neighbourhood space. Obviously, people are very concerned about that but larger ecological functions maybe not so much,"* (Practitioner 5).

(vi) GI principles versus outcomes

The participants argued that the outcomes (or objectives) were more important than the principles.

- Legibility is an outcome or objective of GI, not a principle (Practitioner 5)

  "For designers' legibility is the ease of understanding an environment, the ease of using it, it the classical Kevin Lynch thing, so it is maybe a broader thing where open space becomes part of that system... So, this is considered when you evaluate the design or the implementation. It should be legible. So, it's an outcome" (Practitioner 5).

- Sustainability: Where does it fit in?

  Some felt it was missing, while others thought it was an outcome of GI.

  "*Sustainability is missing*" (City Official 17)

  "*It becomes a big thing in sustainability that things are adaptable, so how important is it for GI and that one I am not sure I can answer"* (Practitioner 5)

  "*It's more of a product of GI"* (UP student observer) (to which Practitioner 5 agreed)

  - Some participants listed terms that they felt were missing:
    - Redundancy
    - Ownership
    - Robustness
    - Sustainability (mentioned in ii above)

  - All three focus groups mentioned that they believed all 12 principles are equally important in their internal discussions.

  - All three groups felt that some principles are very similar, such as green-grey integration and multi-functionality, and should be consolidated.

(vii) Missed opportunities offered by GI green-grey integration

City Official 13 mentioned that the City of Tshwane was not making the most of the many advantages offered by green-grey integration, such as:

- Rainwater and stormwater harvesting (Hennops River example, flooding, silting-up due to sediment, erosion of river system)
- Recycling of grey water not enforced

  "*It also saves you a lot on water use and water demands, but unfortunately, Tshwane is actually opposed to that* ." City Official 13
- The city does not enable or enforce the recycling of waste, and it lands on landfill sites and water courses (City Official 6).

"What the worth is of recycling, and I'm talking here about recycling the city as well. I mean, everything is going right into dumpsters. It's going right into the river systems."

City official 6

The third Phase 3 testing and co-creation activity involved the five members of the GRIP research team. The GRIP team were tasked to provide written input as follows:

1. Comment/edit to make the text clear and unambiguous.
2. If there are guidelines that could be combined.
3. If there are guidelines that should be separated.
4. If there are important guidelines you feel are missing.
5. If the guidelines are not well/ properly explained.
6. Any other considerations

The GRIP research team made various valuable contributions to refining the descriptions for the proposed GI principles and clarifying terms. Additional references were also provided. The input from the GRIP research team is incorporated into the final proposals.

The final phase involved collating all the input received and recommendations from the study participants during the testing and co-creation phase to compile the proposed 20 GI planning guiding principles for the City of Tshwane for incorporation at the SDP stage.

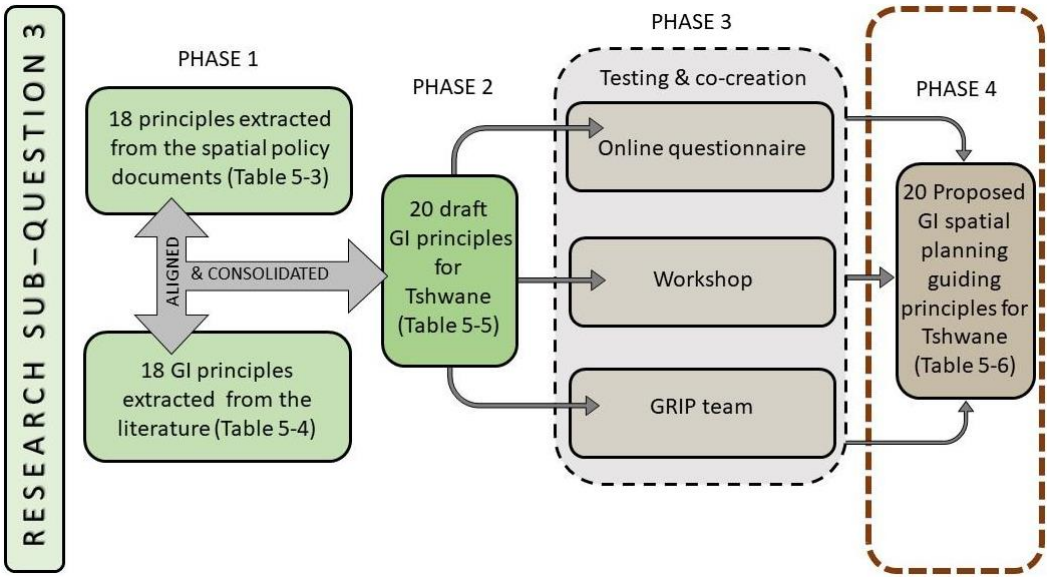


Figure 5-9. GI guiding principles co-development process: phase 4

Table 5-8 shows how the GI spatial planning guiding principles align with the spatial and environmental development principles extracted from SA spatial planning documents.

Table 5-8. Alignment of spatial development principles and proposed GI guiding principles from the literature, policy documents, and stakeholders

18 Spatial development and environmental principles from SA spatial documents and stakeholders (sources)	20 Proposed GI guiding principles from the literature, spatial documents and participants																			
	12 PLANNING PROPERTY PRINCIPLES												8 PLANNING PROCESS PRINCIPLES							
	Connectivity	Accessibility	Multi-functional	Multi-scale	Green-Grey integration	Context-based	Diversity	Adaptability/ Flexibility	Conserve and protect	Quality of green space	Legibility	Safe and secure	Strategically planned	Cross-sector partnership	Social inclusion	Inter-/ Transdisciplinary	Co-operative governance	Evidence-based	Green economic opportunities	Continuity
Spatial and Environmental justice (1-3,5,7-11,14-16)	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X		X
Spatial and Environmental sustainability (1-5,7-16)	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X
Spatial resilience (1,2,5,7-16)	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X			X
Spatial and Environmental quality (1,2,5,7-16)		X	X	X		X			X	X		X	X	X	X	X	X			X
Spatial efficiency (1,2,5,7,8,11,14-16)	X		X	X	X	X	X	X	X				X	X	X	X	X			X
Equitable access to environmental resources (3,5, 7-11,15,16)	X	X	X	X	X	X	X					X	X	X	X	X	X			X

Equitable and effective participation of all I&APs and all forms of knowledge (3,7-10,12,15,16)	X		X			X	X	X	X	X		X	X	X	X	X	X	X		X
Environmental integration and linkage (5, 7-13,15,16)	X			X		X	X		X		X	X	X	X	X	X	X	X		X
Protect the environment (3,7,8,9,10,11,12,13,15,16)	X				X	X	X	X	X	X		X	X	X	X	X	X	X		X
Flexibility (7,8,11,15,16)			X		X	X	X		X			X	X	X	X	X	X			X
Anticipatory planning (7,8,11,12,13,14-16)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Transparent and inclusive decision-making (3,7-10,12,14-16)	X	X	X			X		X		X		X	X	X	X	X	X	X		X
Empowering communities (3,5, 7-11,15,16)			X	X		X	X	X	X	X		X	X	X	X	X	X			X
Co-operative governance (3,7and8,11,12,15,16)	X		X	X	X	X			X	X	X	X	X	X	X	X	X			X
Safety and Security (1-16)	X	X	X		X			X	X	X	X	X	X	X	X	X	X			

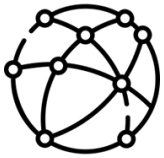
Sources for Column 1, Table 5-8 above:

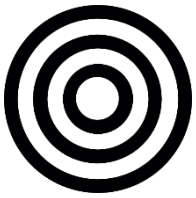
1.	National Development Plan 2030 (Republic of South Africa, 2012)	9.	*Draft Guidelines for the Provision of Open Space (Isikhungusethu Environmental Services, Louw and Dewar, 2017)
2.	Spatial Planning and Land Use Management Act 16 of 2013 (Republic of South Africa, 2013)	10.	Department of Human Settlements – Red Book (Department of Human Settlements, 2019)

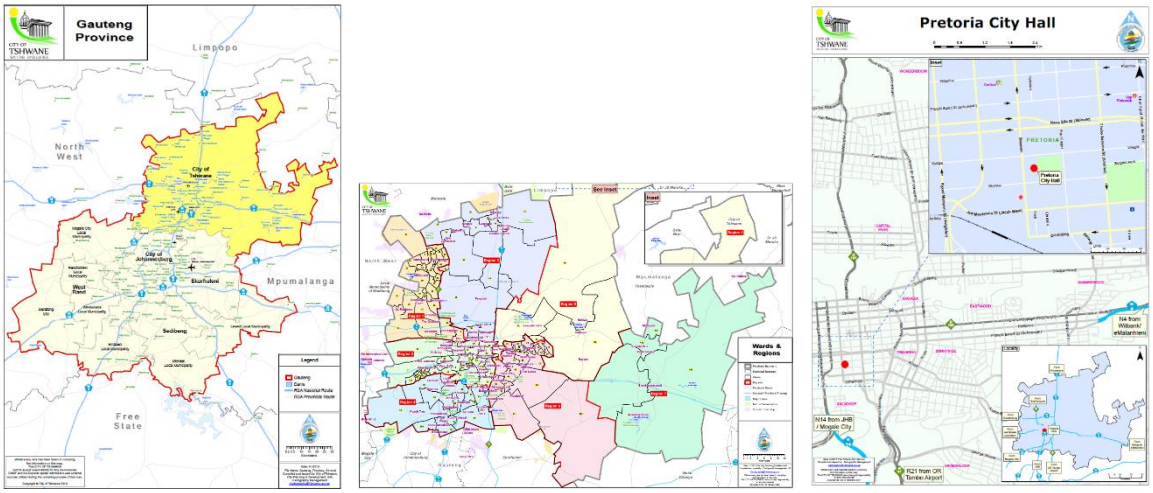
3.	National Environmental Management Act (NEMA), Act 107 of 1998 (Republic of South Africa, 1998c)	11.	CSIR Green Book: Adapting South African settlements to climate change (Van Niekerk et al., 2019)
4.	Tshwane Town Planning Scheme, 2008 (City of Tshwane, 2014).	12.	Gauteng Conservation Plan, 2014 v 3.3 (C-Plan-3) (Gauteng Province, 2014)
5.	Metropolitan Spatial Development Framework (City of Tshwane, 2021b)	13.	The Ridges Guideline (Gauteng Province, 2019)
6.	Regionalised Spatial Development Framework for Region 3 Draft 2023 (City of Tshwane, unpublished e)	14.	Gauteng Spatial Development Framework (Gauteng Province, 2022)
7.	Tshwane Open Space Framework (Tshwane Open Space Framework) 2015, 2020 draft (City of Tshwane, 2015; 2020)	15.	Interviews
8.	Regionalised Spatial Development Framework Regions 1–7, 2018 (City of Tshwane, 2018b)	16.	Workshop

Table 5-9 provides the final list of GI planning guiding principles with descriptions for the City of Tshwane.

Table 5-9. GI planning guiding principles and descriptions for the City of Tshwane

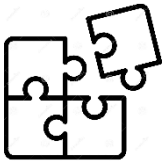
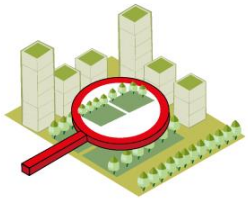
PLANNING PRINCIPLE	DESCRIPTION
1. CONNECTIVITY OF GREEN SPACES 	Connectivity refers to the physical and functional interlinking of open spaces and corridors across a broad range of scales in the city (Pauleit et al., 2017:16; City of Tshwane, unpublished b). If well planned, developed, maintained, and managed, these connected, open spaces form a GI network that supports ecological, spatial, social placemaking, and economic systems (Department of Human Settlements, 2019; City of Tshwane, unpublished b). Connectivity of open spaces in the urban landscape plays a vital role by: ● Increasing access to vital ecosystem services to the city, its inhabitants, and the broader environment (City of Tshwane, unpublished b) ● Sustaining species interaction (Monteiro et al., 2020); ● Providing wildlife corridors that enable species migration (Monteiro et al., 2020; Isikhungesethu Environmental Services, Louw and Dewar, 2017) and seed dispersion and thus promoting biodiversity (Isikhungesethu Environmental Services, Louw and Dewar, 2017; City of Tshwane, unpublished b) ● Giving spatial structure to the city (City of Tshwane, unpublished b); ● Serving as transit and recreation corridors for humans (Department of Human Settlements, 2019; Monteiro et al., 2020); ● Connecting different landscapes (Department of Human Settlements, 2019).
PLANNING PRINCIPLE	**DESCRIPTION**
2. ACCESSIBILITY OF GREEN SPACES 	Accessibility refers to both the equitable distribution of open space resources throughout the city (proximity to open space), as well as the permeability of open spaces that allow citizens to move freely and unobstructed through the urban environment (physically enter and move through open space) (Isikhungesethu Environmental Services, Louw and Dewar, 2017; City of Tshwane, unpublished b). This includes equitable access to a hierarchy of safe and quality open spaces and natural resources for all citizens (Isikhungesethu Environmental Services, Louw

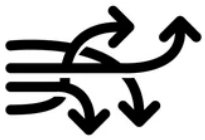
	and Dewar, 2017; Republic of South Africa, 2013; Republic of South Africa, 2012).
PLANNING PRINCIPLE	**DESCRIPTION**
3. MULTI-FUNCTIONAL GREEN SPACE 	The ability of green spaces to support and provide multiple functions, benefits, and services (ecological, engineering, spatial, social, placemaking and economic) (Pauleit et al., 2017; Isikhungesethu Environmental Services, Louw and Dewar, 2017; Du Toit et al., 2018; Monteiro et al., 2020; Department of Human Settlements, 2019).  Local example: Rietondale Park and Sports Grounds, 87 Van Der Merwe Street, Rietondale, City of Tshwane. (Image source: Google Earth Pro accessed 13 June 2022).
PLANNING PRINCIPLE	**DESCRIPTION**
4. MULTI-SCALE PLANNING OF GREEN SPACES 	The functioning of ecological systems across all spatial scales aims to link spaces from the metropolitan (macro) scale through regional and local (meso) scales down to the individual erf (micro) scale (Pauleit et al., 2017). The three spatial levels, according to scale and sphere of influence, are: "*Metropolitan Open Spaces: multi-functional open spaces that serve a metropolitan interest, with an influence sphere beyond the region"* (City of Tshwane, unpublished b). *"Regional Open Spaces: multi-functional spaces that serve a regional interest, with an influence sphere limited to a region"* (City of Tshwane, unpublished b). *"Local Open Spaces: multi-functional spaces that serve a local interest, with an influence sphere that seldomly stretches beyond the local area"* (City of Tshwane, unpublished b). The smallest spatial scale to consider is the individual development project at the township or individual erf size (Isikhungesethu Environmental Services, Louw and Dewar, 2017; Pauleit et al., 2017).

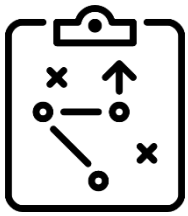


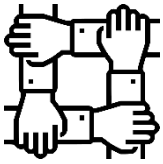
Different spatial planning scales from regional to site scale.

(Image source: City of Tshwane 2022)

PLANNING PRINCIPLE	DESCRIPTION
5. INTEGRATION OF 'GREY' AND GI 	Connections and synergies between GI and conventionally constructed engineering infrastructure (Pauleit et al., 2017; Monteiro et al., 2020). Landscape interaction with the built environment to achieve greater multi-functionality (Department of Human Settlements, 2019; Monteiro et al., 2020).
PLANNING PRINCIPLE	**DESCRIPTION**
6. CONTEXTUALLY APPROPRIATE GREEN SPACE 	GI plans and solutions must be context-specific and follow place-based approaches which are realistic and applicable to local spatial, ecological, and socio-economic conditions (Monteiro et al., 2020:8; City of Tshwane, unpublished b).
PLANNING PRINCIPLE	**DESCRIPTION**
7. DIVERSITY / HETEROGENEITY OF GREEN SPACES 	Diversity refers to a variety in the landscape (species, soils, climate, or typologies) that perform different functions in combination or perform the same function differently (Monteiro et al., 2020) and provide redundancy.

PLANNING PRINCIPLE	DESCRIPTION
8. ADAPTABILITY/ FLEXIBILITY OVER TIME 	The long-term success of GI plans and projects is determined by their ability to adapt to changes in the ecological cycle, such as climate and water availability (Monteiro et al., 2020:8; City of Tshwane, 2 unpublished b) and socio-economic circumstances and social use.
PLANNING PRINCIPLE	**DESCRIPTION**
9. CONSERVATION AND PROTECTION OF GREEN SPACES 	Protect areas of sensitive/ vulnerable ecosystems and high biodiversity. Protect unique agricultural land (Van Niekerk et al., 2019).
PLANNING PRINCIPLE	**DESCRIPTION**
10. QUALITY GREEN SPACES 	Quality spaces are inclusively designed, well-defined, comfortable to be in, offer shelter from the elements, and have basic amenities such as litter bins, seating, and trees for shade (Isikhungesethu Environmental Services, Louw and Dewar, 2017). Low-quality public spaces are degraded and are perceived as unwelcoming and unsafe by residents and encourage illegal activities such as dumping, anti-social behaviour, and acts of criminality (Interviews). *If communities can see the value of the space to them, they are more likely to protect it* (Isikhungesethu Environmental Services, Louw and Dewar, 2017:12).
PLANNING PRINCIPLE	**DESCRIPTION**
11. ENHANCE LEGIBILITY (Orientation inside the city) 	The ease with which the public can orientate themselves in the city (way-finding). People must recognise and organise green urban elements into a coherent pattern to provide an essential sense of emotional security (Lynch, 1960; (City of Tshwane, unpublished b).

PLANNING PRINCIPLE	DESCRIPTION
12. SAFETY & SECURITY 	Crime and anti-social behaviour mitigation measures should be considered in GI design. This includes aspects such as clear sight lines, clear access points, lighting and increased opportunities for surveillance. The safety and comfort of vulnerable people like children or the elderly should be considered (SaferSpaces, 2023; Isikhungesethu Environmental Services, Louw and Dewar, 2017).
PROCESS PRINCIPLE	**DESCRIPTION**
13. STRATEGICALLY PLANNED 	Careful consideration of the efficient use of existing resources, structures, processes, infrastructure, etc., within the city so as not to add additional burdens/ impacts to an already strained system (Republic of South Africa, 2013; Van Niekerk et al., 2019) and increase the social and ecological goods where they are most needed.
PROCESS PRINCIPLE	**DESCRIPTION**
14. CROSS-SECTORAL PARTNERSHIPS 	Effective partnerships between the city and the residents and businesses near GI assets create opportunities for the joint development, management, and upkeep of GI (Isikhungesethu Environmental Services, Louw and Dewar, 2017).
PROCESS PRINCIPLE	**DESCRIPTION**
15. PARTICIPATION, EQUITY & INCLUSIVITY 	Involving the local community and drawing on local knowledge throughout the project life cycle for GI to be sustainable, appreciated and owned (Van Niekerk et al., 2019; Monteiro et al., 2020; Interviews). Planning and design solutions developed by the community for the community (Van Niekerk et al., 2019).

PROCESS PRINCIPLE	DESCRIPTION
16. INTERDISCIPLINARY & TRANSDISCIPLINARY APPROACH 	The involvement of all disciplines and stakeholders from the start of a project and defining goals jointly. Benefits include the cross-pollination of ideas and points of view, which results in the co-production and synthesis of appropriate, innovative thinking, process and outcomes. (Interviews, Cilliers et al., 2014; Pauleit et al., 2017).  
PROCESS PRINCIPLE	**DESCRIPTION**
17. COLLABORATIVE GOVERNANCE and ADMINISTRATION (including co-ownership and sharing of facilities) 	Intergovernmental alignment, collaboration, and cooperation between the three spheres of government (Republic of South Africa, 1996; Republic of South Africa, 2013; Van Niekerk, 2019) and a shared vision in the city. A transparent, inclusive, and participatory process involving local communities to take ownership of the space (Monteiro et al., 2020; Interviews). Sharing of public spaces and facilities between user groups, regardless of ownership (Isikhungesethu Environmental Services, Louw and Dewar, 2017:12). This includes co-ownership through co-development and co-management of the facilities by the community and the private sector.
PROCESS PRINCIPLE	**DESCRIPTION**
18. EVIDENCE-BASED PLANNING $u = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $\int 3y^2 - 4y + 8$	"…GI planning must be based on robust scientific knowledge gained from a number of different fields" (Monteiro et al. (2020).

PROCESS PRINCIPLE	DESCRIPTION
19. GREEN-SOCIO ECONOMIC OPPORTUNITIES 	Contextually relevant activities that support the sustainable use of GI for meeting economic objectives are developed in partnership with local communities (Department of Human Settlements, 2019; City of Tshwane, unpublished a).
PROCESS PRINCIPLE	**DESCRIPTION**
20. CONTINUITY (MONITORING and MAINTENANCE) 	Ongoing care and upkeep of spaces are essential. This is ideally suited to government programs and community initiatives, particularly in the context of creating employment (Isikhungesethu Environmental Services, Louw and Dewar, 2017:11) and involving local communities to take ownership and care for spaces (Monteiro et al., 2020; Interviews). Periodic reports on the evolution of projects and successful/ unsuccessful outcomes create awareness and learning (Monteiro et al., 2020:8).

5.4 Discussion

5.4.1 GI Definition for the City of Tshwane

Several authors (Washbourne, 2022; Sussams et al., 2015; Mell, 2016) remind us why we need place-based definitions for GI when there are numerous definitions available in the literature. The authors contend that the GI term's strength and weakness lie in its malleability and intangibility. GI means different things to different audiences. The City of Tshwane requires a definition of GI that reflects its unique geo-political setting and socio-cultural context.

As described in Section 5.2, the recommended context-specific definition for GI for the City of Tshwane, developed through a rigorous co-creation process with input from all study participants, is:

In the City of Tshwane, we strive for safe GI that provides ecological, socio-cultural and economic benefits to all its citizens. GI is a connected system comprising green and blue, undeveloped and developed private and public open spaces. GI is equally important and can complement engineering infrastructure. GI must be accessible, walkable and multi-functional to enhance social justice and climate adaptation.

The first part of the above definition relates to most of the definitions for GI listed in Chapter 2, section 2.6, Table 2-4. The second half differentiates the proposed GI definition for the City of Tshwane from other definitions from the Global North or other parts of the GS. Here, the emphasis is on GI that is ***safe*****,** *accessible, walkable and multi-functional to enhance social justice and climate adaptation* that provides *ecological, socio-cultural and* ***economic benefits*** *to all its citizens.* This emphasis is contextually significant for various reasons. Firstly, because of the spatial planning legacies of colonialism and apartheid, greenbelts were used to enforce racial segregation between 'white' neighbourhoods and 'non-white' townships in South Africa and elsewhere on the continent (Arku et al., 2016; Cobbinah et al., 2019;). These green spaces did not benefit the surrounding residents and are mostly avoided (Landman, 2019; Dipeolu et al., 2021). Most citizens' lack of appreciation and value for green spaces (Guenat et al., 2020; Cilliers, 2019) can partly be attributed to these past injustices.

Climate change adaptation is also only mentioned in two of the 14 definitions listed in Table 2-4. Pauleit et al. (2021) confirm that most SSA countries focus on climate change adaptation regarding GI, not health benefits. In the City of Tshwane, this is similar to the city issuing its Climate Action Plan in 2021 (City of Tshwane, 2021a) and its Climate Response Strategy in 2023 (City of Tshwane, 2023a). Adapting to the effects of climate change has become increasingly relevant globally in the past years. In the City of Tshwane, climate change adaptation is critical as the rapid rate of urbanisation has increased the number of people settling illegally in environmentally vulnerable areas. This exposes people to life-threatening risks involving extreme weather events such as flooding. Emphasising the benefits of employing GI to mitigate these potential risks is vital in the context of the City of Tshwane.

The requirement for **safe** GI cannot be over-emphasised in South Africa and can be designated as the top priority for citizens. This aspect is supported by studies by Cilliers (2019)

and Combrinck et al. (2020), who disproved the proximity principle[13] in SSA countries. The authors of both studies contend that the green proximity principle applies in the Global North. Combrinck et al. (2020) highlight that security concerns created ecosystem disservices, resulting in unsafe green spaces often associated with criminal activities and substance abuse.

A difference between the general Global North (except for Monteiro et al., 2020) and GS definitions is the emphasis on promoting the economic benefits of GI for all the city's citizens. The excessively high unemployment and poverty levels in South Africa (Municipalities of South Africa, 2023) can be alleviated to some extent if citizens are enabled to benefit economically from GI, as seen in the D'MOSS programme (eThekwini Municipality, 2011). Pauleit et al. (2021) specifically mention how the economic value of GI and job opportunities are generally neglected in SSA. The Green Economy strategy emphasis in the City of Tshwane does not include GI but instead focuses on "renewables including solar and wind technologies, as well as green component manufacturing opportunities, related downstream services and generally speaking more greener production and transport practises, green agriculture and waste management opportunities" (City of Tshwane, 2023b).

5.4.2 GI Objectives for the City of Tshwane

GI principles include social, spatial, economic, and ecological considerations, as mentioned in Section 5.2.1. The objectives of GI are not explicitly mentioned in the Global North literature with the same emphasis as the guiding principles, except for Pauleit et al. (2017). There are many nuanced references to GI objectives, such as improving environmental quality (Hansen et al., 2017), conserving and protecting biodiversity (Cilliers et al., 2014), adapting cities to climate change (Du Toit et al., 2018; Cilliers et al., 2021; Pauleit et al., 2021); and promoting social cohesion (Cilliers et al., 2014).

Some study participants felt that some of the draft GI principles presented at the workshop were objectives, not principles, such as 'conserve and protect', 'safety and security', 'legibility' and the 'quality of open space'. Others included GI objectives in the proposed wording for the city's definition of GI, such as 'climate impact mitigation'.

[13] **Proximity principle** – property values increase as distance to urban green space decreases (Combrinck et al., 2020).

Based on the outcome of the co-creation process, the GS objectives have a shorter-term local emphasis, namely environmental protection, joint ownership and management, safety and cooperative governance.

5.4.3 GI Principles for the City of Tshwane

To establish what is unique about the identified City of Tshwane's GI guiding principles, a comparison with two studies from the Global North that discuss GI principles follows. The Global North studies containing lists of GI principles were selected, acknowledging that the Global North is not homogeneous since no known Global South studies were found that contain lists of context-specific GI principles.

Table 5-10 compares the GI planning principles extracted from the two Global North studies with the proposed GI principles for the City of Tshwane. The two Global North studies were selected for their specific focus on identifying and defining the most prominent GI principles applied in that region. The first Global North article referred to is by Pauleit et al. (2017). The authors divide seven core GI principles into four principles of planning *content* and three principles of planning *processes*. A research paper by Pauleit et al. (2021) added an additional process planning principle to the original seven principles. A second comprehensive study highlighting the most prominent GI principles extracted from Global North literature is by Monteiro et al. (2020), which identifies eight key GI principles. The last column in the table lists the 20 GI principles identified for the City of Tshwane through this study. The principles highlighted in green correspond with those commonly applied in the Global North. The principles highlighted in blue are specific to the City of Tshwane.

Table 5-10. Alignment between Global North-established GI planning principles and the City of Tshwane's proposed GI guidelines to illustrate unique principles

Global North Principles (Pauleit al., 2017 and 2021)	Global North Principles (Monteiro et al., 2020)	City of Tshwane GI Planning Principles (this study)
Network/Connectivity	Connectivity	Connectivity of green spaces
		Accessibility of green spaces
Multifunctionality	Multi-functionality	Multi-functionality of green spaces
Grey-green integration	Integration (or green-grey integration)	Integration of “grey” and GI
Multi-scale	Multi-scale	Multi-scale planning of green spaces

Reflective		Adaptability/ flexible overtime
	Diversity (or multi-object)	Diversity/heterogeneity of green spaces
	Applicability	Contextually-appropriate green spaces
		Conserve and protect the natural environment (including biodiversity protection)
		Quality of green space
		Safety and security inside green spaces
		Enhanced legibility/ orientation inside the city
Strategic		Strategic and anticipatory planning
		Cross-sectoral partnerships
Socially inclusive	Governance (which includes stakeholder engagement)	Socially inclusive planning
Interdisciplinary and transdisciplinary		Interdisciplinary and transdisciplinary approach
		Co-operative governance and sharing of facilities
	Continuity	Continuity (temporal)
		Green socio-economic opportunities

Blue highlight = guidelines unique to the City of Tshwane

Green highlight = guidelines applicable to both the Global North and the Global South

The main differences between the Global South and Global North regarding GI application found in the literature are listed in Table 5-11 below in order to illustrate which principles or aspects reveal contextual aspects or discourses of the Global South context that contrast with the Global North.

Table 5-11. Unique differences in GI application in the Global South and Global North

Global South	Global North (Europe, USA, Australia)
GI is not a priority and is viewed as a 'luxury' good in the face of 'more pressing' socio-economic problems.	GI is a mainstream concept with many examples of successful applications.
There is a shortage of context-based GI research or case studies (except in China).	Abundant research and physical case studies.
The proximity theory was disproved by Cilliers (2019) and Combrinck et al. (2020) due to safety concerns. The value of property adjacent to open spaces is negatively affected due to safety concerns.	Proximity theory proved that property values increase if adjacent to green space (Combrinck et al. 2020).
Cilliers (2019) and Combrinck et al. (2020) disproved the green compensation hypothesis.	The green compensation hypothesis proved that people in high-density areas who do not have access to private green space will compensate and seek out public green space elsewhere.
Social and cultural context: high levels of poverty, lack of access to basic services, housing backlogs.	Generally, there are much lower unemployment rates and low levels of poverty. Housing shortages and poor infrastructure delivery are also not prominent challenges.
Spatial challenges due to colonial and apartheid planning legacies.	Spatial planning has been culturally absorbed over millennia.

Table 5-10 indicates that all the GI planning principles identified by Pauleit et al. (2017), Pauleit et al. (2021) and Monteiro et al. (2020) were deemed applicable by the research participants and have been incorporated into the list of proposed GI planning principles for the City of Tshwane. Nine additional GI planning principles are also included in the City of Tshwane's list. The nine additional GI planning principles are significant and unique to the City of Tshwane. The city aims to address environmental and social equity and justice transgressions from the past as stipulated in the Constitution of South Africa (Republic of South Africa, 1996), the National Development Plan (Republic of South Africa, 2012), etc. Most importantly, the set of 20 GI guiding planning principles is context-based and was co-developed by city officials, built-environment practitioners, and developers who all reside in the City of Tshwane.

The main differences in the application of GI between the Global South and the Global North are noted in Table 5-11 above, and their importance is discussed in this section, for example, the impacts on spatial planning due to colonialism on SSA countries and apartheid in South Africa.

(i) Accessibility and evidence-based planning approach

The Monteiro et al. (2020) study deliberately excludes 'accessibility' and an 'evidence-based approach' as the Global North authors consider these two principles intrinsic to GI planning. However, 'accessibility' to green space is one of the most important principles for the city because of the historic apartheid and colonial planning legacies (Cilliers et al., 2014) that deliberately used open spaces as tools to enforce racial segregation between 'white' and 'non-white' neighbourhoods. Arku et al. (2016) also report on this method of implementing racial segregation in Accra, Ghana. However, more recently, unrestricted access to open space has become controversial in the Global South due to the high incidence of illegal land invasions. Undeveloped government land, specifically green open spaces, is seen as an easy target for encroachment. The informal settlers are often exposed to environmental and health risks such as flooding or polluted water, whilst vulnerable natural areas and ecosystems are degraded or destroyed. Access to GI in the Global South is also related to safety within GI. Even when citizens can access GI, they choose to avoid those spaces due to concerns for their safety (Landman, 2019). The perception (or reality) that green spaces are unsafe also adds to the lack of value of these spaces. Due to apartheid planning, the distribution of open space in the City of Tshwane is concentrated in previously 'white' neighbourhoods (Shand, 2023). In contrast, residents in previously 'non-white' neighbourhoods have fewer green open spaces close to home.

The 'evidence-based planning' principle for GI is required to motivate the importance and benefits of GI to decision-makers who allocate funding to city development projects (Cilliers 2019). Cilliers (2014:268) states, "Environmental concerns will always remain firmly on the back seat of a society where there are great disparities between science and the general concerns and basic needs of the public". Although more research on ecological systems in urban environments has been conducted in the past ten years, the Global South needs more research in this respect (Cilliers et al., 2021). Therefore, examples of best practices and pilot studies that are scientifically based and monitored and showcase GI benefits are required (Breed et al., 2015). Many such examples exist in the Global North (Breed et al., in review; Hansen et al., 2017).

(ii) Conserve and protect

Despite the robust debate among some workshop participants, 'conservation and protection' (of the natural environment) were maintained as a GI principle because it provides for biodiversity protection (viewed as a GI objective by Pauleit et al., 2017). In the local context, biodiversity protection is a critical aspect, as supported by Pfab et al. (2017), who highlight that the Gauteng Province is still very far from achieving its conservation targets as set by the Gauteng Conservation-Plan version 3.3 (Gauteng Province, 2014). Also, due to indiscriminate land invasion of vulnerable ecological spaces, some form of conservation and protection of endangered habitats is unavoidable. Amoako and Adom-Asamoah (2019) report that up to 60% of the original green areas and community parks in Kumasi (Ghana), formally known as the "Garden City of West Africa", have been lost since 1980 to encroachment. In their study of 15 parks and green spaces in Kumasi, the authors found that only one (the Kumasi Golf Course) was operational and protected from encroachment. However, it is important to understand that conserving and protecting natural and open green spaces is also controversial in South Africa. Under apartheid, the conservation and protection of GI restricted access and excluded adjacent indigenous communities from sharing in the benefits gained from the GI. An important outcome of the interviews and participatory workshop supports this view and advocates for protecting and conserving open space by using it (Practitioner 1, City Officials 8, 9 and 10). Cilliers et al. (2021) state that although Global North cities also face challenges with protecting natural resources, they rarely experience the same priority challenges created by the unique socio-economic conditions in the GS.

(iii) Legibility, quality and safety

'Quality,' 'safe and secure open spaces', and 'enhanced legibility' are all principles that impact the **lack of value** society and political stakeholders attach to open space. As discussed in (a) above, this lack of value can be traced back to discrimination against native people in colonial and apartheid planning, where open space was used as a tool to enforce racial segregation. Poorly maintained and neglected open spaces with poor or no amenities encourage antisocial behaviour, such as illegal dumping of litter and building rubble, worsen pollution, attract criminals, and are not used by residents (Landman, 2019; Cilliers, 2019; Combrinck et al., 2020). In light of the multiple challenges the city needs to overcome to provide its service delivery mandate and improve the quality of GI, it seems unrealistic to think that the quality of spaces will improve should the status quo remain. This highlights the importance of other unique GI principles proposed for the city, such as promoting cross-sectoral partnerships,

sharing facilities by the different spheres of government and enabling green socio-economic opportunities in green spaces.

(iv) Partnerships

Cross-sectoral partnerships, cooperative governance and sharing of facilities are principles that encourage a new approach to empowering communities and improving institutional ability (Cilliers et al., 2014). Mechanisms are needed to enable businesses, built environment professionals and citizens to collaborate with local government and become more involved and invested in the planning and custodianship of the city's GI to benefit all its citizens. The example of Ibadan, Nigeria, shows that such an approach could render benefits to all if all city stakeholders are prepared to work together towards a long-term goal (Ogu, 2000). How these partnerships come together and need to be managed is an aspect that needs more insight and investigation.

(v) Green-socio economic opportunities

GI can potentially increase the sustainability of livelihoods in SSA by creating green-socio economic opportunities (Breed et al., in review; Pauleit et al., 2017; Shin and Mabon, 2018). This principal links to access to open space, which can be increased through small-scale economic opportunities whilst conserving and protecting vulnerable ecosystems through levels of co-ownership and cross-sectoral partnerships. When citizens become the beneficiaries of the provisioning, regulating, cultural and supporting services provided by GI, a change in their value perception thereof may follow in the long term.

5.5 Chapter Summary

This chapter describes the process undertaken to co-develop a GI definition and set of spatial planning guiding principles suited to the unique geopolitical context of the City of Tshwane.

Three definitions of GI were selected and used to initiate the co-development process to produce a customised GI definition explicitly suited to the City of Tshwane conditions. A draft GI definition which combined components of the above three options was presented to the workshop participants. The participants' edits and suggestions were collected, and the researcher compiled a final draft of the proposed GI definition for the City of Tshwane. The 20 GI spatial planning guiding principles assembled from the four-phased process for the City of Tshwane are illustrated in Figure 5-7.

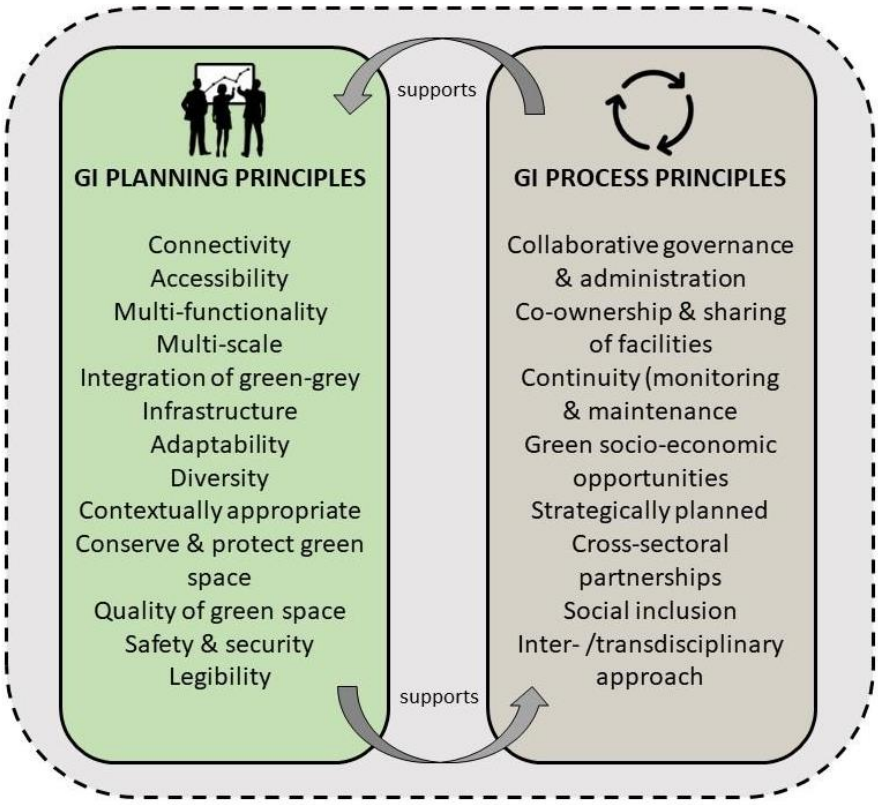


Figure 5-10. Proposed GI planning guiding principles for the City of Tshwane

The GI definition and 20 GI spatial planning guiding principles are firmly grounded in the literature, local spatial planning regulatory documents and co-creation activities by cross-sectoral participants.

The legacies of colonialism on the African continent and apartheid in South Africa have impacted spatial planning. Thus, the emphasis on accessibility, safety, and reaping the economic benefits provided by GI is vital for all the people of the City of Tshwane, South Africa and the SSA region. These aspects are significant and emphasised in both the definition and the GI planning principles proposed for the city.

Chapter 6 Study Findings: Opportunities for GI planning in the local policy documents

6.1 Chapter Introduction

This chapter seeks to answer research sub-questions 4 and 5. Research sub-question 4 asks: "*Where are the **gaps** in the city's policy documents that weaken the inclusion and evaluation of GI at the SDP stage? Where are possible **entry points** for including GI guiding principles in the policy documents? Which entity in the city should take **ownership** of GI application across the City of Tshwane?"* Research sub-question 5 asks: "*Based on the findings from sub-questions 1 to 4, what **recommendations** can be made for the improved application of GI in the City of Tshwane at the SDP stage?"*

This chapter is presented in four sections. Firstly, the results of the gaps identified and the proposed entry points for incorporating GI guiding principles into the city's policy documents, where they will make an impact, are presented. The next section seeks to show where in the city structure the responsibility should lie to improve the performance of GI by all city departments. Then, a discussion of the findings follows together with some recommendations. Figure 6-1 illustrates the structure of the chapter.

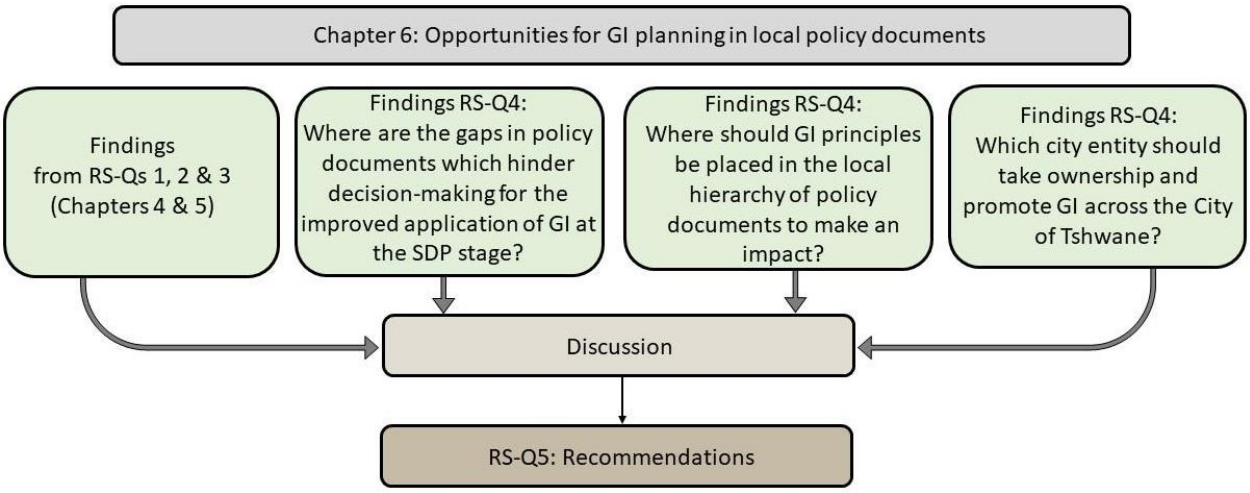


Figure 6-1. Structure of Chapter 6

6.2 Which city policy documents contain GI guidelines

Chapter 2, Section 2.8 identifies the following City of Tshwane policies, by-laws and spatial frameworks as the most pertinent affecting and governing GI and relevant to this study:

- City of Tshwane Land Use Management By-law, 2016 (City of Tshwane, 2016);
- City of Tshwane Town Planning Scheme 2008 (Revised 2014) (City of Tshwane, 2014);
- City of Tshwane Metropolitan Spatial Development Framework, 2030 (City of Tshwane, 2021b);
- Regionalized Municipal Spatial Development Frameworks 2018, Region 1-7 (City of Tshwane, 2018b);
- City of Tshwane Open Space Framework 2005 (City of Tshwane, 2005);
- City of Tshwane Open Space Framework Reviewed June 2015 (City of Tshwane, unpublished a);
- Review of the Open Space Framework 2020 (City of Tshwane, unpublished b);
- Local Open Space Plans (KH Landscape Architects, 2008 and 2012);
- Development Application Requirements Letter (City of Tshwane, 2019) issued by the City of Tshwane Environment and Agriculture Management Department Environment and Agriculture Management Department; and,
- Draft Development Application Requirements Letter 2022 (City of Tshwane, unpublished c).

Table 2-10 in Chapter 2 indicates the GI principles currently appearing in the documents listed above to identify gaps in the city's policy documents, resulting in the poor implementation of GI. Notably, the Integrated Development Plan (refer to Chapter 3, Section 3.3.3) does not feature in the above list of documents containing GI guidelines. The Integrated Development Plan maps the city's future planning over the short, medium and long term and informs the City of Tshwane's annual budget (City Official 17). It is seen by some as the City of Tshwane's 'super plan' (Practitioner 3). The fact that the Integrated Development Plan does not speak about GI and how it should be planned and implemented is, therefore, problematic.

6.3 Identifying the Entry Points

This section presents the findings on the appropriate entry points to incorporate GI planning guiding principles into the City of Tshwane's hierarchy of policy documents. The workshop and post-workshop clarification meetings were the primary data-capturing methods that shed light on research sub-question 4.

6.3.1 Workshop

The workshop participants agreed that including GI principles at the SDP stage was appropriate. However, this stage is too late for budgeting in the land development application process if it is the first time the guidelines are introduced. (Practitioners 3 and 5; City Officials 2, 15 and 17; Developer 1).

> "…*with regards to your focus point on the SDP, I'm of the opinion… it's too late. You need to start where the application is submitted."* Practitioner 3

> "*So, just see the SDP as the final product of a bigger system… it can't work on its own."* City Official 17

Including GI guiding principles in the city's policy documents, referred to by developers and built-environment practitioners at the start of the land development process, is critical. The recommended documents where guidelines must be included are the Metropolitan Spatial Development Framework and the Regional Spatial Development Frameworks. The most emphasis was placed on the value of having the principles in the Regional Spatial Development Frameworks alongside the Tshwane Open Space Framework.

> "[The] *RSDF* [Regional Spatial Development Framework] *… is what developers work on when they buy a property…It is important to understand that when you want to make a change, you must make a change here, in the RSDF, and then it goes down at the end to the SDP."* City Official 17

> "*Because all developers…plan according to the RSDF [*Regional Spatial Development Framework] *…If you don't have the impact at the beginning, it is too late."* Practitioner 15

However, City Official 15 argued that GI guidelines should be included even earlier than the land development application stage, namely at the bulk engineering master planning stage of the city.

> "*I will start before the application stage…The guidelines must impact the master planning of* [grey infrastructure] *…sewer, electrical master planning because the master planning has an impact on the IDPs* [Integrated Development Plans (see 6.2)], *the RSDF* [Regionalised Spatial Development Framework] *is an outflow from that. And*

the IDP is guiding all the developments that are happening on the ground."

City Official 15

This view was confirmed by City Official 17, who explained that the Economic Development and Spatial Planning Department analyses all the submitted land development applications. The department then projects the expected future growth patterns of the city. This data is given to the utility departments that model the information and prepare their long-term development master plans accordingly. These master plans are costed, and the utility departments feed this information into the city's Integrated Development Plan, which allocates budgets for capital expenditure. The city council must facilitate public involvement at all stages of the Integrated Development Plan process, from assessing and prioritising needs to developing strategies, goals and objectives (Republic of South Africa, 2000). The master plan information is also included in the Regional Spatial Development Frameworks, which informs the developer on the conditions and budgetary requirements when deciding to buy and develop property in a specific city area. The official recommended that the Environment and Agriculture Management Department follow the same process for open space provisioning as the Economic Development and Spatial Planning Department follows for other infrastructure so that open space is also budgeted for within the Integrated Development Plan and Regional Spatial Development Frameworks. Official 15 added that this process would ensure GI is elevated to the same importance as other city engineering infrastructure.

Developers refer to City Planning's Regional Spatial Development Frameworks and e-GIS layer, which is the geographic information system available on the city's official webpage (City of Tshwane, 2023f), to determine the feasibility of a proposed development against city planning and zoning information. The City of Tshwane's open space information and requirements should also be projected and made available on these platforms. Figure 6-2 illustrates the proposed process.

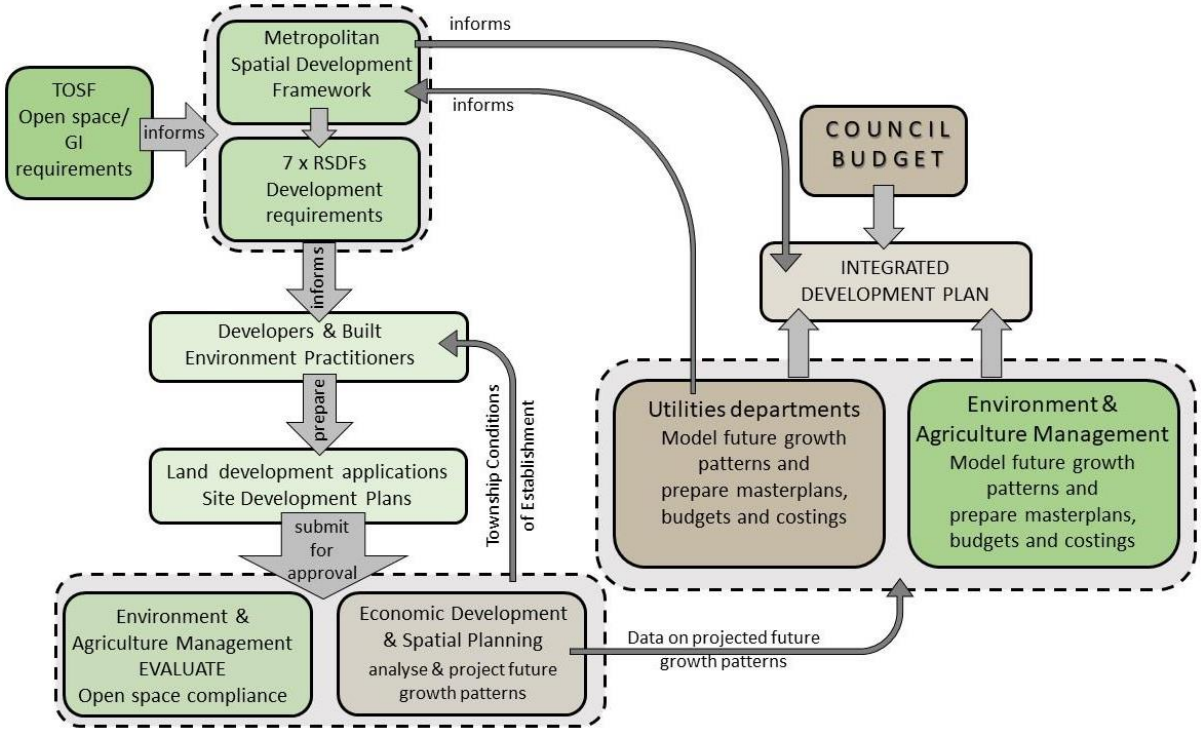


Figure 6-2. The Influence of master plans on the Regional Spatial Development Frameworks, Integrated Development Plan and Council Budget

During the workshop, the following question was asked:

> "*What is the main objective of including GI (public open space) in land development applications at the SDP stage?"*

City official 13 responded that the main purpose was to ensure that the residents within a development had access to functional, centrally located recreational space, which would entice them out of their residential units into the green spaces. Due to the lack of safe, accessible, good-quality green spaces in the city within proximity to residential neighbourhoods, well-designed, functional recreational private open spaces are critically important to the health and well-being of people living in those developments.

City official 13 argued that the content of the City of Tshwane's Development Application Requirements letter (City of Tshwane, 2019) was the most thorough and detailed document, including information regarding the environmental and town planning requirements. However, he added that the document was being updated as the department had become aware of gaps in the information presented through developer engagement.

6.3.2 Post-workshop clarification meetings

The post-workshop clarification sessions confirmed that multiple entry points are appropriate for GI guiding principles in the City of Tshwane's policy documents. The city officials concurred that there is an opportunity for the principles to be included or supplemented in the following city documents:

- The Tshwane Open Space Framework;
- The Regional Development Frameworks that will be updated during 2023;
- The Metropolitan Spatial Development Framework;
- The Human Settlements Plan which was almost finalised at the time of the workshop (2022).

Officials from the Environment and Agriculture Management Department concurred with the above proposals and emphasised that GI guidelines must remain a prominent component of the Tshwane Open Space Framework. Figure 6-3 indicates the agreed entry points for the GI guidelines in the city's spatial planning documents.

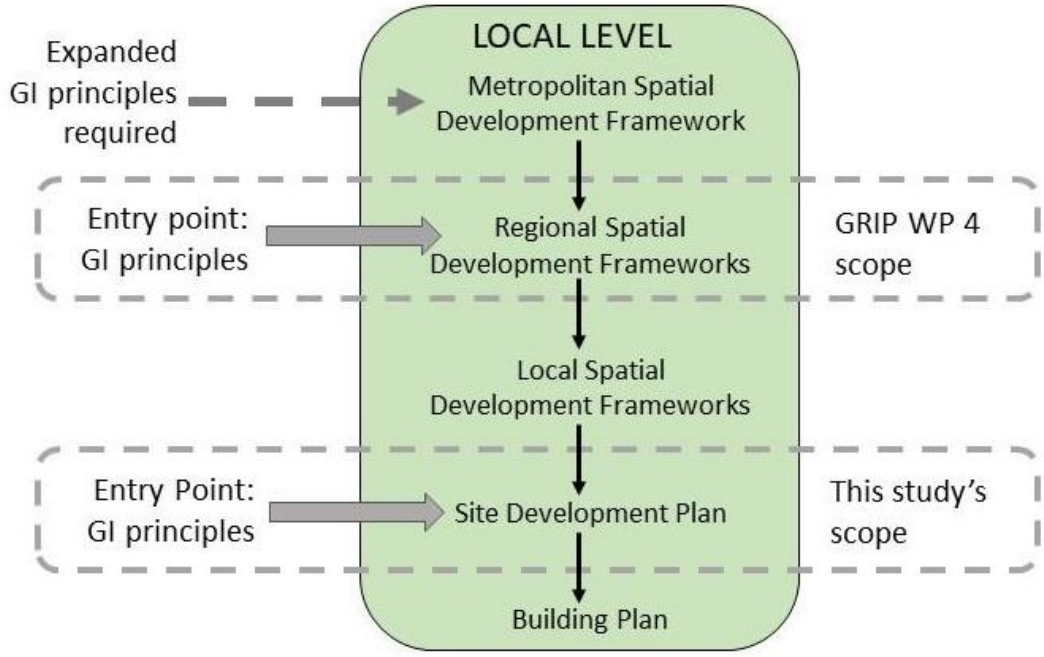


Figure 6-3. Identified entry points for the inclusion of GI principles in the City of Tshwane spatial planning policies

The above section presented the findings regarding the appropriate entry points for GI guiding principles in the hierarchy of spatial planning policy documents in the city. The next section presents the findings on which entity should own and actively promote GI across the city.

6.4 Responsible entity for GI in the City of Tshwane

During the interviews, the study participants offered several suggestions on which city entity should take ownership of promoting GI application in the city. Some officials suggested GI should be under the auspices of the Executive Mayor, the City Manager's Office, or even the Member of the Mayoral Committee for Environment and Agriculture Management (City Officials 3, 4, 11, 12 and 14). City Official 11 contended that a high-level GI task team with the necessary jurisdiction, represented by all city departments, should be established in the City Manager's office to promote GI.

City Official 15 argued that a different approach was necessary to ensure that GI is applied throughout the city and incorporated by all city departments. As mentioned previously, the official put forward the view that by including the GI guiding principles in the Regional Spatial Development Framework, GI would be integrated into all land development applications. City Official 17 added that developing a long-term Open Space Master Plan at the same level as the engineering master plans, which feeds into the Integrated Development Framework and thereby accesses the City of Tshwane's funding, would elevate GI to the same level as grey infrastructure.

6.5 Discussion

The findings show that no current City of Tshwane policy document prioritises or promotes GI conservation or application. A similar situation exists in Kwabre East Municipality in Ghana, as Takyi et al. (2022) found in their study. Takyi et al. (2022:1) argue that "the absence of a single policy document with clear-cut regulations to guide green space management and development… gives less priority to green spaces". The Tshwane Open Space Framework (City of Tshwane, 2005) is the only approved planning document promoting open space and its protection and guiding GI development. However, this document is currently outdated, not consulted amongst developers and town planners, and not easily accessible. The Takyi et al. (2022) study highlights that Ghana has legislation in place that stipulates that "structure plans" must be updated every five years or less to "conform to current aspirations", yet this does not happen. The Tshwane Open Space Framework (2005) case is similar. Consultants have been commissioned to review and update the Tshwane Open Space Framework (2005) twice, once in 2015 and again in 2020. Both revised Tshwane Open Space Framework versions are still in draft format and have not been ratified by the City of Tshwane's Council.

The city officials agree that the proposed GI planning guidelines should also be included in the Regional Spatial Development Framework because developers and built-environment practitioners consult this document for guidance before starting a project. Similarly, the Regional Spatial Development Framework is an integrated, cross-departmental document that governs the land development process in the city.

Further to the specific spatial policy documents that should include GI principles mentioned above, the eThekwini Municipality has incorporated the D'MOSS (equivalent to the Tshwane Open Space Framework) into their Integrated Development Plan and the city's Town Planning Schemes (eThekwini Municipality, 2010). The D'MOSS is accessible via the eThekwini Municipality website as a spatial layer on its city maps facility. Similarly, the City of Cape Town has mapped their GI network (GINet), which is accessible as a geographic information system layer on the CityMap Viewer (City of Cape Town, 2022a). The Tshwane Open Space Framework is not currently available from or integrated into the City of Tshwane's eGis Viewer (City of Tshwane, 2023f).

One of the most pertinent challenges mentioned by the city officials interviewed and by some of the workshop participants (see Chapter 4) was the lack of a joint inter-departmental vision for GI. The literature supports these findings, as mentioned by Takyi et al. (2022) in Ghana, Zakka et al. (2017) in Nigeria, and other authors of SSA studies (Du Toit et al., 2018; Cilliers et al., 2021). This returns the conversation to the question of which city entity should take full responsibility and ownership of promoting the application of GI in the city. The successful local examples of the eThekwini Municipality and the City of Cape Town show that an effective integrated home for GI is within the environmental planning departments. As mentioned, this is the eThekwini Municipality's Environmental Planning and Climate Protection Department (EPCPD) and the Environment Management and Recreation and Parks Department at the City of Cape Town.

The success of the D'MOSS has been discussed in previous chapters and can be attributed to several aspects. The first is that the Municipality's Environmental Planning and Climate Protection Department persistently advocates for GI application to politicians and other city departments. Another is that the staff are skilled and knowledgeable about GI and encouraged to continue their tertiary academic studies in related fields. A third aspect mentioned by Shin and Mabon (2018) is that local experts, such as academics from the University of Kwa-Zulu Natal and private-sector practitioners, all work together to apply local knowledge to co-create GI solutions. A last aspect worth mentioning is that GI has a champion in eThekwini in Dr

Debra Roberts, who has headed the Environmental Planning and Climate Protection Department and the GI programme since the early 1990s and has become internationally recognised in her efforts.

It is worth noting that in both the City of Cape Town and the eThekwini Municipality, the promotion of GI is driven by the Environmental departments with strong leadership and technical skills and, consequently, a team that actively advocates the application of GI into the urban fabric.

6.6 Recommendations

Based on the findings and discussion of this chapter, this section contains recommendations that are presented in four sections, namely GI application, changing negative perceptions towards GI, identifying entry points for GI guiding principles into policy documents, and identifying the city entity where the responsibility for GI promotion within the city should lie.

6.6.1 Opportunities for improved GI application

This section contains recommendations to capitalise on the opportunities to overcome city officials' challenges with applying GI at the SDP stage. They are:

- Institutions must be empowered to provide adequate service delivery, including providing and protecting GI in the city. One way to enable institutional capacity for city officials is to support them with the time, training and skills development opportunities to meet their mandates.
- In addition, clearly defined roles and shared responsibilities by city departments are needed. The polarisation of groupings and viewpoints within and between city departments needs to be addressed and improved.
- The co-development of a shared, long-term vision throughout the city for the quality of the urban environment may assist with breaking down the existing silo operations within departments.
- An effective, high-level GI task team represented by all city departments should be established in the City Manager's Office.
- Environmental and Spatial Planning functions should be placed in the same directorate, enabling the adoption of a shared vision for land development.
- A champion who has influence in the top management Council structures, who will advocate for green issues and GI, is critical, as learnt from the D'MOSS programme.

- Partnerships with community-based organisations, such as “Friends” groups (see 4.3.1f-ii), that can support city departments in achieving their mandates must be strengthened.
- The endowments developers pay as penalties in lieu of providing public open space should be ring-fenced for green space development and GI provision. The by-laws that currently do not make this possible should be challenged and amended.
- Bylaws such as "Adopt-a-spot" (see 4.2.1m-iii) should be expanded to allow for additional GI benefits such as urban farming or planting of medicinal plant species, for instance, that can contribute to food security, poverty alleviation and protection of vulnerable species being over-harvested in natural areas. This could incentivise greater co-management of GI by residents.
- Engagement with the provincial and national government to resolve points of conflict (either in legislation or mandates) and create an enabling political environment for the city to apply GI whilst imploring national and provincial governments to perform their functions regarding poverty alleviation and job creation is crucial.
- Creative incentives encouraging developers to include GI in their developments should be co-developed in consultation with all stakeholders.

6.6.2 Changing negative perceptions towards GI

Several recommendations for changing negative perceptions towards the value of GI, related to study objective 1 (see Chapter 1, Section 1.4), were found in the literature and offered by the study participants. These are:

- Environmental education programmes that are presented by local youth, schools and tertiary institutions that emphasise the ecosystem services provided by GI.
- GI planners should understand the different values users attach to green spaces and their preferences for different types of GI.
- GI planners should improve the quality and quantity of accessible green space in neighbourhoods.
- The city should lead by example by applying GI guidelines to all its new projects and retrofitting old infrastructure to incorporate GI, such as harvesting and attenuating rainwater and stormwater.
- The city should encourage and enable small-scale pilot studies that promote GI and its benefits to communities and then branch out to larger scales to obtain buy-in.

- Planning professionals should sharpen their knowledge of all land development requirements, including GI, and fully advise their clients when starting a development project.
- All actors and citizens should be informed and educated on the negative impact for future generations on the social, economic, and cultural benefits of lost irreplaceable green space.
- Citizens should be enabled to participate in the development of and benefit from civic resources. The city should facilitate GI spatial co-planning, co-design, co-management, and co-ownership approaches to expand the resource pool and contribute to environmental justice for its residents.

6.6.3 Entry points for GI guiding principles into policy documents

This section summarises the recommendations on the proposed entry points in the City of Tshwane's hierarchy of policy documents where GI principles are lacking. The inclusion thereof can impact and significantly improve the land development application process.

- **Integrated Development Plan stage**: Capitalise GI by developing an Open Space Master Plan at the same level as the engineering services' long-term master plans. The Open Space Master Plan should form part of the city's integrated spatial planning layers (like the D'MOSS) and feed into the Integrated Development Plan (see Figure 7-5).
- **Metropolitan Spatial Development Plan stage:** should include the complete set of GI principles, not just a passing reference to multi-functionality, connectivity, and multi-scale approach.
- **Regional Spatial Development Plan stage:** should include generic open space (GI) principles with illustrations in the Regional Spatial Development Frameworks. This will ensure developers and their professional teams know up-front what is required and can plan for the GI in their proposed development as per the city's open space requirements. The additional cost incurred by the developers for the open space provisioning can be recovered from the selling price per unit in the same way that bulk contributions for the upgrade of engineering services are recovered from the purchaser by the developer.
- **Tshwane Open Space Framework:** needs to have an updated version ratified urgently and made readily available on the city's official website. The GI guidelines belong here and must be located in this document.

- **Precinct Plan stage:** develop a costed open space masterplan at the Precinct Plan stage for areas where future growth is predicted. The City Planning and Development Division predicts the trends by analysing the incoming land development applications. That Division recommends investigating the new Bus Rapid Transport routes as the national government provides large budgets for Bus Rapid Transport routes, including open space development, which is an opportunity for GI planning.
- **Site Development Plan stage:** develop the Environmental Planning and Open Space Management Division's "Letter of Requirements" into a visually appealing format with graphic illustrations like that of the City Planning and Development Division's Site Development Plan Evaluation Forms (evaluation criteria checklist) and City of Cape Town's SDP booklet.
- The inclusion of minimum GI application requirements should be inserted into the city's tender documentation as part of the qualifying criteria for the tender award.

6.6.4 Responsible entity

GI must remain and be confirmed as the responsibility of the Environment and Agriculture Management Department by the Executive Mayor and City Manager's Offices. The City Manager should institute a high-level GI task team representing all city departments. The Environment and Agriculture Management Department must take full responsibility for actively promoting the conservation and development of GI in the city. All city departments involved in urban planning matters, the professional bodies and councils in the built environment, the public and high-level arenas such as the city's mayoral committees must be targeted. The City Manager should elect a designated 'GI champion' who is passionate about GI. All city departments should be tasked to collaborate and contribute to the successful application of GI in the city.

6.6.5 Format

The format of the proposed SDP GI planning guiding principles should take on a visually appealing appearance to make them accessible and easy to understand. The content should be written in accessible language and illustrated graphically for clarity. Overtly technical and legal tones and terms should be avoided since this writing style tends to obscure and mystify the essence of the planning objectives and guidelines. Existing guideline documents prepared by the City of Cape Town are considered good examples of visual appeal that can serve as examples. At the same time, the content of the City of Tshwane's Development Application Requirements Letter can be presented in a more accessible language style.

Chapter 7 Conclusions and Recommendations

7.1 Chapter Introduction

Chapter 7 is the final chapter of the document and focuses on summarising the findings and concluding the study. The first section of the chapter considers all the research questions for the study and the related findings. The second section focuses on the study's contributions and the implications on current theory and practice and makes recommendations for future research. Figure 7.1 illustrates the structure of this chapter.

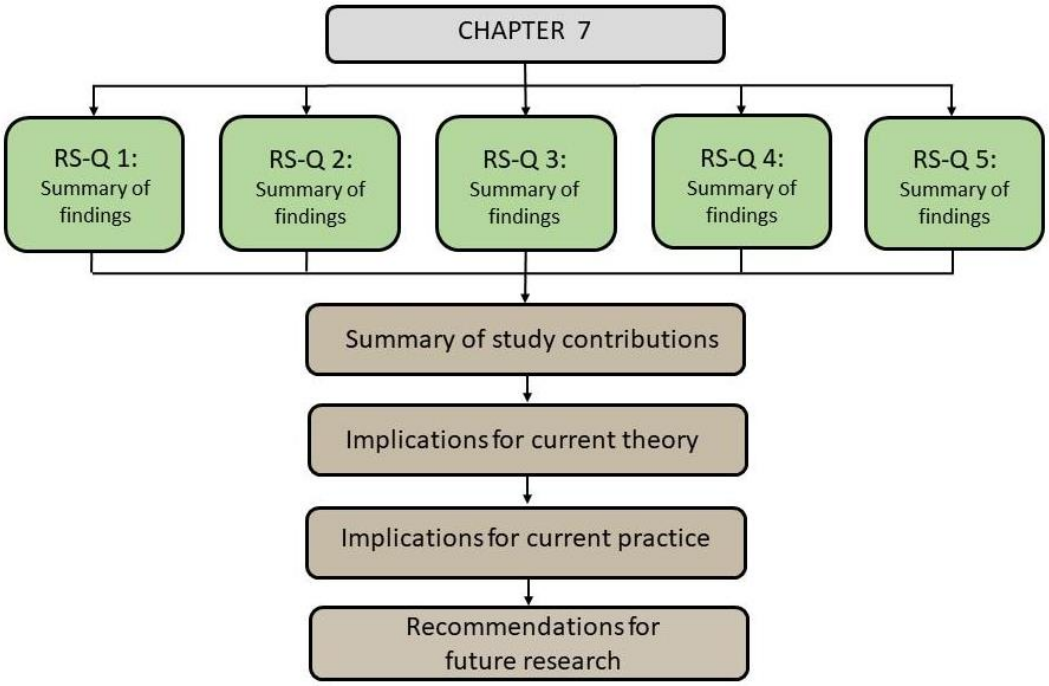


Figure 7-1. Structure of Chapter 7

7.2 Summary of the findings related to the research questions

The research design moved through four phases of research: (1) understanding the challenges and opportunities with the application of GI at the SDP stage of the land development approval process; (2) co-development of a definition for GI in the context of the City of Tshwane; (3) co-creating GI guiding principles for incorporation in the SDP approval documentation; and (4) identifying where the guidelines should be placed in the city's spatial planning documents and, where in the city structure the responsible entity is situated that should advocate for GI application throughout the city. The following section highlights each research question and summarises the findings.

7.2.1 Findings: Research Sub-Question 1

Research sub-question 1 asks: *What are the institutional challenges, and what opportunities exist regarding incorporating GI as part of the SDP process at the City of Tshwane?*

The study found numerous challenges which are fully described in Chapter 4, Section 4.2. They are rapid urbanisation and population growth, limited institutional capacity, conflicting spatial planning systems (internally and between the three spheres of government), failed bureaucracy, compromised enforcement, compliance, and post-construction monitoring, poor work ethics, green-value gap, development pressures from competing heterogeneous actors, land invasion, lack of knowledge about the benefits of GI and skills to apply GI, disservices associated with GI and the quality of existing GI, other aspects, such as inaccessible and unevenly distributed GI, adverse geotechnical conditions, and historically unregulated planning.

The study found numerous opportunities which are fully described in Chapter 4, Section 4.3. They are addressing the green-value gap and promote GI buy-in, empowering the institution and promoting cooperative governance, entrenching guidelines into spatial policies and by-laws, promoting cross-sectoral partnerships, active citizen participation, transdisciplinary approaches, communicating the benefits of GI, updated technical databases, generating funding to develop and maintain GI, incentives and further research.

Conclusions: Research Sub-Question 1

The research shows that the City of Tshwane, like most urban areas in SSA countries, faces serious challenges concerning service delivery. The pressing socio-economic needs, versus the city's ever-declining resources and capacity, place an increasing burden on GI. Spatial planning and environmental policies and frameworks are not aligned to promote the application of GI. The heterogeneous competing actors in the urban development arena promote their agendas and priorities, often at the cost of urban green space. In addition, climate change is creating unprecedented environmental challenges in African cities. A new approach is needed. The city departments involved with land development applications should develop a shared vision, values, and strategies. Educating all stakeholders on the value of GI and its benefits is essential. Incorporating GI guiding principles into the city's spatial policies, specifically the SDP stage, but in higher-level policy documents, too, is

critical for successful integration. The research shows that the City of Tshwane should embrace an inclusive approach to planning, protecting, developing, and managing its green spaces to ensure a healthy, functional urban environment for future generations.

7.2.2 Findings: Research Sub-Question 2

Research sub-question 2 asks: *"What is a contextually appropriate definition for urban GI for SSA and South African cities, particularly the City of Tshwane?"*

- Numerous interchangeable terms are used for GI, such as public open space, green spaces, ecosystem services, and nature-based solutions. Studies show that the term GI is well-known in the Global North but not commonly used in SSA or South Africa.
- Numerous definitions for GI originate from both the Global North and the Global South, the most well-known being the definition by the European Union (European Union, 2013).
- The term GI is flexible and malleable, which some authors perceive as a positive characteristic and others as a negative characteristic.
- The City of Tshwane requires a place-specific definition for GI that responds to its unique political and socio-economic context.

Based on the co-creation activities with the study participants, the recommended definition for GI for the City of Tshwane is:

> In the City of Tshwane, we strive for safe GI that provides ecological, socio-cultural, and economic benefits to all its citizens. GI is a connected system comprising green and blue, undeveloped and developed, and private and public open spaces. GI is equally important and can complement engineering infrastructure. GI must be accessible, walkable, and multi-functional to enhance social justice and climate adaptation.

7.2.3 Findings: Research Sub-Question 3

Research sub-question 3 asks: *"What contextually appropriate GI planning principles will enhance the City of Tshwane's SDP process?"*

The study found that all the GI principles identified in the Global North literature apply to the City of Tshwane. However, additional GI planning guiding principles require inclusion and

emphasis for the City of Tshwane due to its unique geo-political and socio-economic context. Specifically, the equitable access to GI regarding proximity to residential areas and even distribution must be addressed because of the city's colonial and apartheid planning legacies. Equally important is the emphasis on developing solid cross-sectoral partnerships to empower citizens to participate in the development and management of GI and benefit from GI services. The alignment of the proposed GI guiding principles with the spatial and environmental management principles that occur in the South African policy documents lends rigour to the process.

The study identified 20 context-specific GI planning principles for the City of Tshwane. Their full descriptions are in Chapter 5, Table 5-9. They are connectivity of green spaces, accessibility of green spaces, multi-functionality of green spaces, integration of 'grey' and green infrastructure, multi-scale planning of green spaces, adaptability/ flexibility over time, diversity/ heterogeneity of green spaces, contextually-appropriate green spaces, conserving and protecting the natural environment (including biodiversity protection), quality of green space, safety and security inside green spaces, enhanced legibility/ orientation inside the city, collaborative governance and administration, co-ownership and sharing of facilities, continuity (temporal), green socio-economic opportunities, strategic and anticip[atory planning, cross-sectoral partnerships, socially inclusive planning, and an interdisciplinary and transdisciplinary approach.

7.2.4 Findings: Research Sub-Question 4

Research sub-question 4 asks: ***"*** *Where are the gaps in the policy documents that weaken the inclusion and evaluation of GI at the SDP stage? Where are possible entry points for including GI guiding principles in these policy documents? Which entity in the city should take ownership of GI application across the CoT?"*

The Tshwane Open Space Framework is the appropriate home for the proposed GI guiding principles. However, the guidelines must also be included and emphasised in the City of Tshwane's suite of spatial planning policy documents to elevate the importance of GI to the same level as that of the city's grey infrastructure. A high-level, long-term Open Space Master Plan and entries into the Regional Spatial Development Frameworks are recommended. Furthermore, the GI information in the Metropolitan Spatial Development Framework should be supplemented. Other interventions, such as Open Space Precinct Plans at the intermediate

stage between the Regional Spatial Development Frameworks and SDP stages and including GI guiding principles into the Human Settlements Plan, will add value (see Figure 6-3).

7.2.5 Findings: Research Sub-Question 5

Research sub-question 5 asks: ***"****Based on the findings from sub-questions 1 to 4, what recommendations can be made for the improved application of GI in the City of Tshwane at the SDP stage?".*

Opportunities exist that will enable institutional capacity through co-development by the city departments involved in land use planning of a shared, long-term vision for the quality of the urban environment envisioned for the city. Ongoing skills development and support for city officials to effectively execute their mandates regarding GI application is needed. Environmental and Spatial Planning functions should be placed in the same directorate, enabling the adoption of a shared vision for land development. Partnerships should be formed and strengthened with community-based organisations that can support city departments in achieving their mandates. Current by-laws not allowing the ring-fencing of endowments paid instead of providing open space should be amended to enable this. The provincial and national governments should be engaged to align conflicting policies and promote collaboration. Finally, incentivising developers to include GI in their developments should be initiated.

The green-value gap could be addressed through ongoing environmental education programmes aimed at different stakeholders that emphasise the beneficial ecosystem services provided by GI, understanding the values users attach to green spaces, and improving the quality and quantity of accessible green space in neighbourhoods. All actors and citizens should be informed and educated on the negative impact for future generations on the social, economic, and cultural benefits of lost irreplaceable green space.

The city should lead by example by applying GI guidelines to all its new projects and retrofitting old infrastructure to incorporate GI. Furthermore, small-scale pilot studies that promote GI and its benefits should be developed in the city to provide physical evidence. GI spatial co-planning, co-design, co-management, and co-ownership approaches are required between the city and all stakeholders. The city should facilitate the co-creation of processes that enable residents to participate in the development of and to benefit from civic resources such as GI.

GI has the potential to be elevated to the same status as grey infrastructure through the development of a high-level master plan that informs the Integrated Development Plan and, in so doing, accesses City of Tshwane Council funding. The GI guiding principles should be included at the Regional Spatial Development Framework and SDP stages, although they are still an integral part of the Tshwane Open Space Framework. The updating of the Tshwane Open Space Framework is critical, and it must be made more accessible to the public by placing it on the city's official website and promoting it to the built environment professional councils and developers.

The Environment and Agriculture Management Department should take ownership of the promotion of GI in the city, with all city departments tasked to collaborate and contribute to the successful application of GI through a GI task team supported by the Executive Mayor and the City Manager.

An SDP GI planning guiding document that is visually appealing and written in accessible language should be developed and disseminated by the Environment and Agriculture Management Department.

7.3 Summary of study contributions

The present study attempts to address multiple gaps in GI research in the City of Tshwane and makes the following contributions.

First, this study unpacks how GI relates to the land development application process in the City of Tshwane.

Second, this study has identified and documented the opportunities for incorporating GI into the city's land development application process.

Third, the study illustrates a novel co-development and co-creation process, including testing and verifying definitions, principles and entry points for GI principles into the City of Tshwane's policy documents.

Fourth, the study is novel and made a contribution in that it undertook an in-depth review of national, provincial, and local spatial planning policy documents to identify existing guidelines and see how they align with GI planning guidelines extracted from Global North and Global South literature.

Fifth, this study further contributes by proposing a unique set of context-specific GI planning guiding principles specifically applicable to the City of Tshwane, which have been tested and verified through the study's co-development process. In this, the study is the first to propose GI guidelines specifically for a Global South and SSA context.

Sixth, this study identifies entry points in the local spatial planning documents where GI planning guiding principles should also be included, such as the Regional Spatial Development Frameworks of the city, the Integrated Development Plan and the City Planning SDP Annexure A.

Finally, the study further identified the need and made recommendations for a high-level Open Space Master Plan with a budget estimate at the same level as the engineering master plans, elevating GI to the same level as grey infrastructure.

7.4 Implications for current theory

The City of Tshwane case study contributes to the current theory by identifying the challenges and opportunities associated with GI as part of the land development application process. This study draws on and contributes to the valuable work of Du Toit et al. (2018), who identified seven challenges in SAA facing local authorities with applying GI.

This study proposes a tangible GI definition for the City of Tshwane. This study draws on and contributes to the valuable work of Washbourne (2022), who identified the different emphasis other South African cities, namely Johannesburg, Cape Town and eThekwini (Durban), place on GI in their spatial documents.

The study identified policy documents that influence the planning and management of GI in the national, provincial, and local governments. Building on the former work of Cilliers et al. (2014).

No GI planning principles have been developed explicitly for a Global South and SSA context. There are no guidelines in the literature for applying GI to the land development application process at the SDP stage in the City of Tshwane. This study draws on and contributes to the work by Pauleit et al. (2017), Pauleit et al. (2021) and Monteiro et al. (2020) by proposing a customised set of GI guiding principles for the City of Tshwane's SDP stage and process. The

study proposes unique GI guidelines for the City of Tshwane that might be applicable to other SSA countries.

The study's proposals regarding the entry points for GI guiding principles at different levels of the City of Tshwane's hierarchy of planning policy documents draw on and expand recommendations by Cilliers (2019) and Takyi et al. (2022) for similar actions to promote GI in urban areas in SSA.

The study furthers conversations about GI and provides local insight into alternative contexts to the Global North with uniquely contextual responses.

7.5 Implications for current practice

This study proposes a context-specific definition for GI for the City of Tshwane, which may be developed further.

If applied, the proposed GI guiding principles for the SDP stage could assist with demystifying the concept of GI and streaming the land development application process. This will save applicants time, money, and frustration. The GI guiding principles could provide developers and built-environment practitioners with an accessible GI framework that can be applied to all future developments. In addition, the GI guidelines could provide the city officials involved with evaluating and approving SDPs with clear strategies to justify their comments on SDP applications. Furthermore, identifying other entry points for the guiding principles in the hierarchy of the city's spatial planning policy documents could ensure that the application of GI becomes mainstream. Based on this study's foundational work and findings, the researcher and her study leader have been invited to make recommendations for the City of Tshwane's Regional Spatial Development Frameworks under review and possibly other city spatial planning policy documents.

Similarly, there is currently no Global South literature or planning guidelines for the application of GI specific to the land development application process at the SDP stage in the City of Tshwane.

7.6 Recommendations for future research

- The continued densification trend within the city's urban edge requires creative alternative processes to the "pay or provide" options for providing open space in urban developments.

Research participants believe that the city needs to reassess the payment of endowments by developers. Research into alternative processes and applications that will contribute to the increase of open space provision would be valuable.

- Research that develops examples and options to calculate and apply the minimum public open space ratios for different development scenarios and densities other than the current blanket m²/ unit method currently applied by the City of Tshwane. This would be valuable and helpful by providing a fair and reasonable system to calculate the minimum open space to be provided by a development and, in turn, solicit less resistance from developers. Since many examples come from the Global North, comparative studies for Global South countries are required.
- Research into achieving equitable access to GI will contribute to environmental and social justice within the City of Tshwane. This recommendation links to (ii) above. By finding mechanisms to ensure that sufficient open space is provided by new developments (either within the development or in the nearby surrounding neighbourhoods), more accessible green spaces will become available to citizens. This will also add to the valuable work done by Shand (2023).
- Research into feasible and attractive incentives for developers to incorporate GI into developments would be valuable for the Global South context.
- Research into GI principles for rural areas beyond the urban edge to support anticipatory planning pursuits already pre-empted in the current spatial planning policy documents, such as the Regionalised Spatial Development Frameworks.
- Research to better understand the perceptions, values and preferences of local users for the design of GI and that enable co-development and co-ownership by the community.
- Research on how to incorporate transdisciplinary, institutional, business, and local citizens' resources to create and mobilize effective cross-sectoral partnerships to build on the valuable work done in Ibadan, Nigeria, documented by Ogu (2000) and the Durban Metropolitan Open Space System (Shin and Mabon, 2018).
- Although previous research has been conducted to attach a monetary value to GI and its ecosystem services, specific context-specific research supported by case-study evidence in the City of Tshwane (Practitioner 3; Mngumi, 2020) will assist in bridging the green-value gap amongst the different role players and stakeholders in the city.
- Research to incorporate GI guiding principles into the draft Green Building Development and Net-zero Carbon Building By-law for the City of Tshwane, 2021 (City of Tshwane, unpublished c) was not mentioned during any of the data collection methods but should be investigated.

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Appendices

APPENDIX A:	Ethics Approval Letter from the University of Pretoria EBIT faculty
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APPENDIX A:
Ethics Approval Letters from the University of Pretoria EBIT faculty

Faculty of Engineering, Built Environment and Information Technology

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

2 February 2022

Reference number: EBIT/45/2021 Line 1

Dr CA Breed
Department: Architecture
University of Pretoria
Pretoria
0083

Dear Dr CA Breed,

This is to notify you that the amendments to your application entitled "Integrative Green Infrastructure Planning (GRIP)", have been approved by the EBIT Ethics Committee.

Kind regards

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

Faculty of Engineering, Built Environment and Information Technology

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

Reference number: EBIT/45/2021

Dr CA Breed
Department: Architecture
University of Pretoria
Pretoria
0083

Dear Dr CA Breed

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 "Integrative Green Infrastructure Planning (GRIP)" is approved under the strict conditions indicated below. If these conditions are not met, approval is withdrawn automatically.

Conditions for approval
Motivation for asking personal questions as provided as a comment by the applicant on the portal is acceptable under the condition that no comparison amongst these factors (e.g. male vs female) can be made without a representative sample of the population.

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:
Signed Declaration of Originality

DECLARATION OF ORIGINALITY

UNIVERSITY OF PRETORIA

The Department of ARCHITECTURE places great emphasis upon integrity and ethical conduct in the preparation of all written work submitted for academic evaluation.

While academic staff teach you about referencing techniques and how to avoid plagiarism, you too have a responsibility in this regard. If you are at any stage uncertain as to what is required, you should speak to your lecturer before any written work is submitted.

You are guilty of plagiarism if you copy something from another author's work (eg a book, an article or a website) without acknowledging the source and pass it off as your own. In effect you are stealing something that belongs to someone else. This is not only the case when you copy work word-for-word (verbatim), but also when you submit someone else's work in a slightly altered form (paraphrase) or use a line of argument without acknowledging it. You are not allowed to use work previously produced by another student. You are also not allowed to let anybody copy your work with the intention of passing if off as his/her work.

Students who commit plagiarism will not be given any credit for plagiarised work. The matter may also be referred to the Disciplinary Committee (Students) for a ruling. Plagiarism is regarded as a serious contravention of the University's rules and can lead to expulsion from the University.

The declaration which follows must accompany all written work submitted while you are a student of the Department of ARCHITECTURE No written work will be accepted unless the declaration has been completed and attached.

Full names of student: TANIA DU PLESSIS

Student number: 85463559

Topic of work: GREEN INFRASTRUCTURE

Declaration

1. I understand what plagiarism is and am aware of the University's policy in this regard.
2. I declare that this dissertation (eg essay, report, project, assignment, dissertation, thesis, etc) is my own original work. Where other people's work has been used (either from a printed source, Internet or any other source), this has been properly acknowledged and referenced in accordance with departmental requirements.
3. I have not used work previously produced by another student or any other person to hand in as my own.
4. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.

SIGNATURE T duPlessis

APPENDIX C:
Letter from the City of Tshwane granting permission to access data and carry out research

CITY OF TSHWANE
IGNITING EXCELLENCE

City Strategy and Organisational Performance

Room D2EO01 | 2nd Floor, Block D | Tshwane House | 320 Madiba Street | Pretoria | 0002
PO Box 440 | Pretoria | 0001
Tel: 012 358 4749/0478 | Fax: 086 651 9999
Email: nosiphoh@tshwane.gov.za | www.tshwane.gov.za | www.facebook.com/CityOfTshwane

My Ref:	**Research Permission Letter\Dr C.Breed**	Tel:	(012) 358 4559
Contact Person:	**Pearl Maponya**	Email:	PearlMap3@tshwane.gov.za
Section/Unit:	**Knowledge Management**	Date:	28 June 2021

Dr Christina Breed (Principal Investigator: GRIP)
Department of Architecture
University of Pretoria
Private Bag X20
Hatfield, 0028

Dear Dr Breed,

RE: PERMISSION TO CONDUCT INTEGRATIVE GREEN INFRASTRUCTURE PLANNING PROJECT IN THE CITY OF TSHWANE

Permission is hereby granted to Dr Christina Breed, Principal Investigator, and the Green Infrastructure Planning (GRIP) Research Team, from the University of Pretoria (UP), South Africa and Aarhus University (AU), Denmark to conduct a DANIDA funded GRIP research in the City of Tshwane Metropolitan Municipality in the following thematic areas:

- Guidelines for policy and bylaw review on Green Infrastructure.
- Mapping and modelling of Green Infrastructure using GIS and Remote Sensing
- Perceptions, planning and management of Green Infrastructure that assess. access, livelihood needs, and human-nature relationships.
- Development of planning and design guidelines

It is noted that the GRIP collaborative research project will be conducted for a period of two (2) years until March 2023 involving post-graduate and post-doctoral student researchers. The GRIP project aims at facilitating a strategic transformation of the inherited social and urban landscape in CoT, through improved GI management, multi-functionality, and planning. The City of Tshwane further notes that all ethical aspects of the research will be covered within the provisions of the UP and AU Research Ethics Policy. You will be required to sign a confidentiality agreement form with the City of Tshwane prior to conducting research.

Relevant information required for the purpose of the research project will be made available as per applicable laws and regulations. The City of Tshwane is not liable to cover the costs of the research. Upon completion of the research study, it would be appreciated that the findings in the form of a report and or presentation be shared with the City of Tshwane.

Yours faithfully,

Pearl Maponya (Ms.)
DIRECTOR: KNOWLEDGE MANAGEMENT

Tania du Plessis

From: Pearl Maponya <PearlMap3@TSHWANE.GOV.ZA>
Sent: Tuesday, 01 February 2022 11:13
To: Dr C A Breed
Cc: tania@bpla.co.za; Malebo Moatshe; Chueu M. Wilheminah
Subject: RE: CoT Research Permission - GRIP Research Project UP

Importance: High

Dear Dr Breed,

The content of your email is noted with thanks. There is no problem, Ms du Plessis can go ahead to collect data. In her communication with CoT Officials, she just need to attach the Permission Letter granted for GRIP Project and to state the exact title of her Master's study. Once her Master's has been examined and completed, she can share the research report with the CoT KM Unit.

Trusting you will find the above in order.

Regards,

CITY OF TSHWANE
IGNITING EXCELLENCE

Pearl Maponya
Director: Knowledge Management

Office No C0EO46|Tshwane House – West Wing D|City Strategy and Organisational Performance| Cnr Madiba and Lillian Ngoyi Streets|Pretoria| 0001
PO Box 440 | Pretoria | 0001 | www.tshwane.gov.za |
Tel: 012 358 4559 | Mobile: 0760284430 | Email: pearlmap3@tshwane.gov.za

From: Dr C A Breed <ida.breed@up.ac.za>
Sent: Monday, January 31, 2022 10:23 AM
To: Pearl Maponya <PearlMap3@TSHWANE.GOV.ZA>
Cc: tania@bpla.co.za
Subject: CoT Research Permission - GRIP Research Project UP

Dear Pearl,

I hope you are doing well. Compliments for the new year.

As part of our GRIP research project on Green Infrastructure that runs 2021-2023, we would like to notify the knowledge management unit of a Master's study that will be conducted this year under the GRIP project by Tania du Plessis (cc).

Tania will be interviewing CoT green space officials this year.
I attach our letter with an overview as well as Tania's questionnaire that she proposes to use for your consideration and information.
We have also updated these details to our ethics application at the University of Pretoria.

We trust that it falls under our existing approval and confidentiality agreement with knowledge management (also attached)
Best wishes
Ida

Dr C A Breed

BLArch PhD (Pretoria) MDes (Mex) PrLArch

Senior Lecturer • Coordinator Honours: Biodiversity Studio and Research Methodology

Department of Architecture, University of Pretoria

Tel +27 (0)12 420 4536

Cell +27 (083) 309 5606

Email ida.breed@up.ac.za

www.up.ac.za

Faculty of Engineering, Built Environment and Information Technology

Room 4-9, Boukunde Building, Hatfield Campus, University of Pretoria

Private Bag X20, Hatfield 0028, South Africa

On Mon, 28 Jun 2021 at 10:25, Pearl Maponya <PearlMap3@tshwane.gov.za> wrote:

Dear Dr Breed,

As discussed, herewith the revised permission letter.

Regards,

Pearl

APPENDIX D:
Interview Questionnaire

FOCUS GROUP QUESTIONS & DISCUSSION POINTS

Research topic: Incorporating Green Infrastructure design principles for Site Development Plans at the City of Tshwane

18 February 2022

Name of respondent:
Designation:
Period of employment with the City of Tshwane:
Period in current position:
Previous position/s:
Training:
Other relevant background information:

SECTION 1: THE TERM '*GREEN INFRASTRUCTURE* – (UGI)

1a. What is your understanding of the term Green Infrastructure?

The European Union 2013, defines GI as follows: ''*Green infrastructure is a strategically planned network of natural and semi-natural areas designed and managed to deliver a wide range of ecosystem services*".

Monterio et al. 2020, "*Apart from ecological functions, green infrastructure can also contribute to social, cultural and economic benefits which in turn support the establishment of sustainable, resilient, inclusive and competitive urban areas."*

1b. Do you think the above definitions apply to the South African context or would you define GI differently, and if so, how?

1c. Are you of the opinion that GI can make a positive contribution to the overall social, cultural, economic, and ecological health of the CoT? Please elaborate on your view.

SECTION 2: UGI – BARRIERS & OPPORTUNITIES

2a. In your experience, what Challenges/ Barriers/ Limitations are faced with the PLANNING for and PROVISION of GI as part of local greenfield or brownfield developments AND/OR the PROTECTION of natural GI systems to allow for ecological/social functions?

2b. Please list the actual/ potential Challenges, Barriers, and Limitations for the MANAGEMENT (either POST DEVELOPMENT or NATURAL/ PROTECTED AREAS) of GI in the CoT, based on your experience/ frame of reference.

2c. Please list POTENTIAL OPPORTUNITIES for the PROVISION of and PLANNING for GI as part of local greenfield or brownfield developments AND/OR the PROTECTION of natural GI systems to allow for ecological/social functions.

SECTION 3: CoT LAND DEVELOPMENT APPLICATION PROCESS

3a. Please briefly explain the objectives of your department.

3b. If applicable, please explain the CoT Land Development Application (LDA) process and the role & responsibilities, and objectives of your specific division/ department in that process.

3c. Please expand on the challenges your division faces with the LDA process, specifically in terms of green infrastructure/ open space provision and planning/ design.

3d. Are there any other legislative, policy, or framework documents that should be reviewed that concern the LDA process or GI, for the focus of the study? Do you agree that the documents listed below are all relevant?

SPLUMA, 16 of 2013	Tshwane Town Planning Scheme, 2008 (revised 2014)
NEMA, 107 of 1998	CoT Land Use Management By-Law, 2016
NEMBA, 10 of 2004	CoT Metropolitan SDF, 2021
NWA, 36 of 1998	CoT Regionalised SDF Regions 1-7, 2018
NFA, 84 of 1998	Draft Green Building By-law, 2021
NHRS, 25 of 1994	TIEP (Tshwane Integrated Environmental Policy), 2006
CARA, 43 of 83	Bioregional Plan for the City of Tshwane, 2016
	Tshwane Open Space Framework (TOSF, 2005, 2015, 2020 – draft)
Gauteng Ridges Policy	Local Open Space Plans (LOSPs)
Gauteng Conservation Plan v 3.3	Development Application Requirements Letter, 2019

3e. Can you suggest any amendments to the LDA process that would make the achievement of your department's objectives easier?

3f. How would these objectives influence or challenge the provision of GI?

SECTION 4: POTENTIAL GI BEST PRACTICE GUIDELINES

4a. How would the city be able to uphold a priority to connect UGI as a system that provides social and ecological support and that is preserved and maintained to do so (in terms of best practice guidelines).

4b. Please provide recommendations on how the proposed guidelines can be incorporated into the city's policies, by-laws, and/or SDP requirements, concerning specific documents and bylaws.

SECTION 5: UGI – CASE STUDIES

5a. Please list known local, national, and/ or Sub Sahara African case studies which can be researched and from which lessons can be learned regarding the implementation and management of GI in urban city developments.

APPENDIX E:
Informed consent document

Consent Form

1. Project Information:	
Title of Research Project	Incorporating Green Infrastructure design principles that impact on Site Development Plans at the City of Tshwane.
1.2 Researcher Details:	
Researcher's Name	Tania du Plessis
Researcher's Mobile Number	082 805 8655555
Researcher's Email	tania@bpla.co.za
1.3 Research Study Description:	
The Project	To develop a set of practical, Green Infrastructure (GI) planning and design guidelines which will serve as a design-support tool and assist developers and practitioners with the implementation of GI in their urban development projects. The guidelines will also serve as a decision-making tool which will assist city officials with the assessment of proposed city development projects in terms of the implementation of green infrastructure.
Research Objectives	• Conduct a policy and framework gap analysis of existing of relevant CoT planning polices, frameworks and by-laws, which create a challenge for effective decision making by city officials at SDP level • Develop a set of practical, design guidelines for the implementation of green infrastructure which will enable both city official and urban design practitioners to ensure the inclusion of robust green infrastructure in urban planning projects in the City of Tshwane
What's Required of Participants	Participants (city officials, private practice practitioners, experts in the field, interested and affected citizens and developers) will be consulted and their input requested regarding a proposed set of planning and design guidelines for the implementation of green infrastructure in city development projects.
Possible Risks to Participants	The only possible risk to participants would be if they shared opinions regarding council processes which could be of a sensitive or confidential nature. However, this risk will be mitigated as all information shared with the researcher will be used with utmost discretion for the research objectives stated above. All inputs will be kept anonymous.

2. Informed Consent:

2.1 Name of participant: . . . . . hereby voluntarily grant my permission for participation in the project as explained to me by Tania du Plessis.

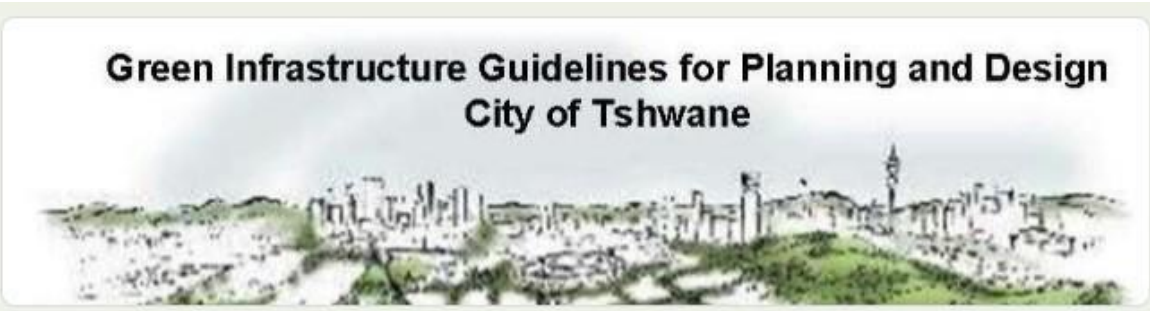
2.2 The nature, objective, possible safety and health implications have been explained to me and I understand them.

2.3 I understand my right to choose whether to participate in the project and that the information furnished will be handled confidentially. I am aware that the results of the investigation may be used for the purposes of publication.

2.4 Upon signature of this form, the participant will be provided with a copy.

Signed (Participant)	Date:
Signed (Witness)	Date:
Signed (Researcher)	Date:

APPENDIX F:
Online Survey Questionnaire



City of Tshwane Green Infrastructure Workshop

To clarify expectations regarding the contents and format of a workable GI guideline document

July, 2022, GRIP, University of Pretoria

tania.bpla@gmail.com (not shared) Switch account

* Required

Pre-workshop participation

This form prompts and gathers ideas from workshop participants on Urban Green Infrastructure

A_ GI Planning & Design Principles

Please select on a scale of 1 to 10 the importance (or not) of the green space principle in terms of improving Green Infrastructure functionality and benefits in the City of Tshwane

1. Connectivity of green spaces *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

2. Multi-functionality of green spaces *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

3. Contextually appropriate green spaces *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

4. Adaptability/ flexibility over time *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

5. Integration of conventional and green infrastructure *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

6. Diversity of green spaces *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

7. Different scales of green spaces *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

8. Accessibility of green spaces *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

9. Enhanced legibility/ orientation inside the city (green space contribution) *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

10. Quality of green space *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

11. Safety & security inside green spaces *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

12. Conservation & protection of green spaces *

	1	2	3	4	5	6	7	8	9	10	
not relevant	○	○	○	○	○	○	○	○	○	○	spot on

B_ Green Infrastructure local definition

13. Having considered the GI principles above, pick a definition below that you feel is most appropriate for the City of Tshwane *

- ○ "Green infrastructure is a strategically planned network of natural and semi-natural areas designed and managed to deliver a wide range of ecosystem services".
- ○ "Green infrastructure contributes to ecological functioning, but also to social, cultural and economic benefits which in turn support the establishment of sustainable, resilient, inclusive and competitive urban areas."
- ○ "Green Infrastructure refers to open spaces, with both social and ecological functions, that are seen as infrastructure equal to roads, water, electricity, and the other traditional municipal services that have long taken precedence over open space."
- ○ Other: _____

C_ Green Infrastructure

C_ Green Infrastructure

14. Which of the three categories listed below, in your opinion, is currently functioning well in the CoT *

- [ ] GI Management (e.g. governance, maintenance and monitoring)
- [ ] GI Planning & Design (e.g. connectivity, multi-functionality, quality)
- [ ] GI Decision-making Process (e.g. partnerships, participation, inclusivity)
- [ ] None
- [ ] Other: _____

15. Which of the three categories listed below, in your opinion, is currently problematic in the CoT *

- [ ] GI Management (e.g. governance, maintenance and monitoring)
- [ ] GI Planning & Design (e.g. connectivity, multi-functionality, quality)
- [ ] GI Decision-making Process (e.g. partnerships, participation, inclusivity)
- [ ] None
- [ ] Other: _____

I hereby state that I provide consent for my answers to be used as part of a research project. I participate voluntary and will remain anonymous *

- ◯ I approve and give consent
- ◯ I disapprove and do not wish to participate

I hereby state that I provide consent for my answers to be used as part of a research project. I participate voluntary and will remain anonymous *

- ◯ I approve and give consent
- ◯ I disapprove and do not wish to participate

Thank you for your participation and input

Dr Ida Breed & Tania du Plessis, GRIP, Department of Architecture, University of Pretoria
email: ida.breed@up.ac.za; tania@bpla.co.za

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APPENDIX G:
Workshop Agenda

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

GRIP

AGENDA

Green infrastructure Planning & Design Guidelines for the City of Tshwane [GRIP WP4]

Date: Friday 29 July 2022
Time: 8:30-12:30 plus lunch (optional)
Venue: University of Pretoria, Future Africa Campus, South Street, (on the grounds of the university's experimental farm/ Hillcrest campus)

8:30		ARRIVAL AND COFFEE	
First session		**Introduction**	
9:00	9:30	Welcome & Introductions Workshop objective and status quo of GI research	IB & TdP
Second session		**Draft Green Infrastructure Principles**	
9:30	10:00	List of draft GI Principles Small group discussions on draft list of GI Principles	TdP Participants
10:30	10:50	TEA BREAK	
Third session		**Draft GI Planning & Design Guidelines for SDP applications**	
10:55		Key Objectives for provision of GI Contents and Format of Guideline document	All participants
11:00	11:15	COMFORT BREAK	
Final Session		**GI Decision-making process**	
11:20		The decision-making - stream-lining the process	All participants
		Wrap up and way forward	IB
12:35	13:30	LUNCH	

PURPOSE OF THE WORKSHOP

To co-develop green infrastructure guidelines for the CoT

with private- and public sector input

- To share and test the relevance of draft research findings on Green Infrastructure Planning Principles with selected key stakeholders from industry, the built environment professions and the city officials
- To co-develop a joint vision for the provision of Green Infrastructure at a city-wide level
- To clarify expectations regarding the contents and format of a workable GI guideline document
- To gain input on a) the current decision-making process and b) how it can be improved

Kind regards
Dr Ida Breed and Tania du Plessis

University of Pretoria, Integrative Green Infrastructure Research Project

REBUTTAL TO OCTOBER 6th, 2023 EXTERNAL EXAMINER COMMENTS AFTER THESIS EXAMINATION

EXTERNAL EXAMINER: Dr. S. GUENAT

CANDIDATE/STUDENT: TANIA DU PLESSIS

MLArch IN LANDSCAPE ARCHITECTURE (DEPARTMENT OF ARCHITECTURE).

	EXAMINER COMMENT	CORRECTION DONE (Highlighted in yellow in the thesis document)
General points	1. In general, the subject of the thesis is very interesting and the results lead to very interesting practical applications. There is clearly a lot of work behind it, for which I congratulate you.	1. Thank you very much, your positive comments are appreciated.
	2. There are however some aspects that need improving, the main ones being: -	2. Noted, thank you. These aspects are responded to in more detail by specific comments below.
	(1) the conciseness of the writing, which would help keep the thesis within a normal length (I could not find the regulations of the University of Pretoria regarding length, but it is higher than others I have seen) and the readability;	(1) The general guideline provided by my supervisor for the length of a master's thesis is 100-120 pages. In the case with my thesis a lot of data is captured from different sources to be analysed and discussed. However, I definitely take note of your concerns in this regard and will endeavour to hone my writing to be more concise and less repetitive in future.
	(2) having more clarity as to your role and that of the supervisor/ colleagues; and	(2) My thesis aligned with the GRIP research project (see page 3), therefore the workshop had logistical support from GRIP team members. My supervisor gave input into the workshop preparation, and she facilitated the workshop. Dr Breed developed Table 5-7 (page 135) from her own analysis of the workshop proceedings, which I included in my thesis and referenced. These aspects were mentioned clearly in the thesis for the sake of

		transparency. All other work (which is not referenced) was executed independently by myself.
	(3) more details on the methods	(3) Answered below in *b. Methodology* items 4.1, 4.2 and 4.3.
Scientific and academic standard of research	*a. Research procedures and techniques* 3. The methods selected were relevant for answering the research questions, and their selection was well justified within the text. I particularly appreciated the mix of different methods.	3. Noted, thank you.
	b. Methodology 4. Though the methods were appropriate, more details are needed on some aspects, namely:	4. Noted, thank you.
	4.1 The literature and policy reviews. As those were presented quantitively and discussed as one of the result, there should be a whole protocol on how the literature review was conducted including which keywords were used, which were the inclusion/ exclusion criteria for each article, and how many article was found at each step.	**4.1 Literature and policy review** <u>Literature review</u> A systematic literature review process was not followed, but rather a scoping and conceptual review. This has been altered to read more clearly as follows in the text on page 14, 2nd paragraph: *"A scoping review process was followed. The literature review included scientific literature concentrating on the past ten years. Key words that were used to search for papers that included*: *green infrastructure; guidelines; guiding principles; definition, challenges, barriers, opportunities, enablers, Sub-Saharan Africa, Global South, City of Tshwane, landscape design, co-development, green space. A snowball process was followed accumulating papers referred to by other papers and recommended by the GRIP team. Some selected older yet still relevant*

		published studies are also included to follow the development of the concept of GI". <u>Policy document review</u> Pages 42-43 explain the policy document identification process and how the policy documents were included/ excluded: 2.9.1 Policy document Identification process *"The policy document identification process comprised two stages. The first stage produced an initial list of policy documents to be reviewed as part of this study and was compiled on 31 January 2022 with the assistance of Ms Annelise Grobler, director at Landscape Dynamics Environmental Consultants and a registered practitioner with the Environmental Assessment Practitioners Association of South Africa (EAPASA). Secondly, additional policy documents were sourced by conducting an internet search using the Google search engine on official webpages of* ***South African*** *metropolitan municipalities and national institutions involved in environmental and spatial planning and research. The City of Tshwane's official website (City of Tshwane, 2023f) was accessed as shown in the box below. Scoping interviews were conducted with public officials and private sector environmental practitioners involved with spatial planning at the City of Tshwane. Volume 2: Contextual Framework of the draft City of Tshwane Review of the Open Space Framework 2020 (City of Tshwane, unpublished b) was also considered, and policy documents cited in Chapter 3 of that volume are included. A draft list of policy documents was compiled and tested with the participants of the semi-structured interviews. The initial list of policy*

		*documents reviewed is shown in Table 2-6. The **final** policy documents **reviewed** are listed in Tables 2-7 to 2-10 below…".* (Text in bold has been added for clarity). Page 76-77 describes the policy document analysis method in detail (amendments for clarification are highlighted in yellow): 3.4.2(i) Policy document analysis method *"Each policy document was reviewed deductively (with reference to* a preliminary list compiled from *the literature, specifically Monteiro et al., 2020; Pauleit et al., 2017 and Pauleit et al., 2021) and inductively (Saldaña and Omasta, 2018), and the content (words, phrases, clauses, parts of sentences or complete sentences, paragraphs) (Mayring, 2014; McCombes, 2022) of each was analysed in search for GI planning principles, which were identified and copied into an excel spreadsheet. The content analysis process involved ~~the identification of recurring principles into themes~~* matching the wording and concepts of GI principles encountered in the literature *by searching for the interrelations between coded terms and phrases (Creswell, 2014) to develop a list of recurring environmental and spatial planning principles in the national, provincial and local policy documents. The spatial and environmental planning principles extracted and consolidated from the policy documents are illustrated in Chapter 5, Table 5.2".*
	4.2 There are very few details of the content of the survey in the text. You should explain how you used Likert scales to assess all the GI planning and design principles, how respondents had to select the GI definition they thought the	4.2 Thank you for this comment. The online survey was merely used to stimulate thinking for the workshop – which was the main method for gathering focus group discussions that provided the rationale and reasons (root causes) along with proposed solutions. This was stated on page 67 and on page 121. However, based on the

	most appropriate and how they had to assess what they thought worked. I am aware the survey is available in the appendix; however, appendixes are support if the readers want to further explore an aspect of the thesis. They should not be the only place where information is given.	examiner's comment, I have provided further clarity below and included the text in the thesis on pages 67 and 68. <u>Online survey section A:</u> The survey participants were asked to indicate on a scale of 1 to 10 (where 1 = not relevant and 10 = spot on), which green space principles they believed are important for improving GI functionality and benefits in the City of Tshwane. The participants merely indicated their preference and were not asked to give a numeric value to the principle they preferred as with a Likert scale-type survey. The purpose of the information illustrated in Table 5-6 on pages 132 & 133 is to show how the ranking of the GI principles changed quite substantially from the survey to the workshop focus groups. <u>Online survey section B:</u> The survey participants were provided with three GI definitions and asked to select the one that they felt was the most appropriate for the City of Tshwane. They could also provide their preferred definition. <u>Online survey section C:</u> The final two questions were formulated around whether GI management, GI planning and/or the GI decision-making process was functioning well or was problematic in the City of Tshwane. The rationale behind these two questions was to establish where the greatest institutional challenges and opportunities occurred with the application of GI, according to the participants. Only 17 of 23 people participated in the survey.
	4.3 It is mentioned in the workshop description that	4.3 I coordinated the planning of the workshop and compiled a draft agenda

	"The workshop format and content were co-developed between the researcher and her supervisor. Dr Christina Breed facilitated the workshop". Similarly, in the result section from the workshop, you present a table with Breed. et al. (under review) as a source. Please be precise on exactly what was your role in the workshop preparation and data analysis.	based on the desired outcomes for my thesis. I discussed it with my supervisor for input and guidance, we then had an advisory session with a GRIP team member (Dr Kristine Engemann Jensen) and amended the agenda and activities to be more precise in purpose and outcome. Because of my research alignment with the GRIP project, the team members could provide advice in terms of the process and assist with the logistics, such as booking the venue and assisting with the recording. On the advice of the team members, I selected to remain neutral during the workshop and rather spend my time observing the participants and their interactions, taking notes, making audio recordings and taking photographs (all with consent). At the same time, my supervisor facilitated some of the announcements and timing of the activities. Other UP students assisted with handing out materials and making backup recordings. I analysed all the data collected from the workshop independently. I am the second author of the article Breed et al., now published, since the interviews and policy review data were from my thesis project. Dr Breed wrote the first draft of the article based on the data and findings of my thesis. The literature review, discussion and conclusion of the article are all unique and different from my thesis. Dr Breed drew up a specific table from the workshop data transcriptions, which I included and referenced (Table 5-7, page 133). I therefore dealt transparently with all aspects that were not 100% solely my own work. <u>Reference:</u> Breed, C. A., Du Plessis, T., Engemann, K., Pauleit, S. and Pasgaard, M. 2023. Moving green infrastructure planning from theory to practice in Sub-Saharan

		African cities requires collaborative operationalisation. Urban Forestry & Urban Greening, 128085.https://doi.org/10.1016/j.ufug.2023.128085
	c. Exploration of the literature 5. There is a good overall exploration of the literature on green infrastructure. However, I had a feeling there is a lot of repetition of the literature (which can happen when there is not too much of it, as is the case with GI in SSA), and that some aspects were missing.	5. Noted, thank you.
	6. For instance, though you discuss the place of SSA in regards to GI in your introduction, you don't mention anything about the scope and scale of urban growth in SSA as compared to the rest of the world, and how that impacts greenspaces. See for instance (UN-Habitat, 2016; Yao et al., 2019).	6. Thank you for the valuable input, I have added text and references that elaborate on the scope and scale of urban growth in SSA as suggested on page 1 of the thesis. The added text is highlighted in yellow below. "Africa is undergoing a significant demographic and economic growth phase (Cilliers et al., 2021; United Nations, 2019; Gulati & Scholtz, 2020). The United Nations World Population Prospects 2019 (United Nations, 2019) predicts that by the end of this century, Africa's global population will increase from its current share of 16.7% (1,3 billion) to about 39.5% (4,3 billion) of approximately 11 billion people on the planet. Conversely, Global North cities have seen a steady decline in growth, with cities in Europe growing the least (UN-Habitat, 2016). The UN-Habitat (2016) study reports that the African urban growth rate is 11 times faster than Europe's. Rapid urbanisation can also result in a significant loss of vegetation cover due to changes in land cover to make place for built-up areas (Guenat et al., 2019; Yao et al., 2019). Benefits for humans and the environment derived from vegetation cover, such as absorbing atmospheric CO_2 and alleviating

		the urban heat island effect, are diminished by such actions (Yao et al., 2019). Simultaneously, climate change adds to the continent's risks and challenges (Du Toit et al., 2018; Cilliers et al., 2021; Pasquini and Enqvist, 2019) by causing life-threatening weather conditions such as severe flooding, extended droughts, and extreme fluctuations in temperature. The region is reportedly warming up 1.5 times faster than the global average (Gulati and Scholtz, 2020)".
	7. Other subjects are touched upon in the discussion and not referenced with appropriate literature such as the perception of urban greenspaces (Guenat et al., 2019; C. Shackelton et al. et al., 2017; S. Shackelton et al., 2015).	7. Thank you. I have added references about perception-based studies of urban green spaces, as suggested on page 23. References have also been added on page 14 of the thesis.
	d. Bibliography and reference list 8. There are several references with dates missing. Though that happened from time to time, the one I checked (EEA; biodiversity.europa.eu/green-infrastructure) clearly states when it was created and modified.	8. Noted, thank you I have corrected and updated these references. -European Environmental Agency. 2020. Biodiversity Information System for Europe. GI. Available on: https://biodiversity.europa.eu/green-infrastructure. [Date viewed: 11 November 2021]. - Association for Qualitative Research. (2022). The hub for qualitative excellence. Available from: https://www.aqr.org.uk/. [Date viewed: 10 April 2023]. -City of London. (2023). GI. Available from: https://www.london.gov.uk/programmes-and-strategies/environment-and-climate-change/parks-green-spaces-and-biodiversity/green-infrastructure [Date viewed: 15 February 2023) -Delve. (2022). The Essential Guide to Coding Qualitative Data. Available on: https://delvetool.com/guide. [Date viewed: 16 May 2023]. -University of Copenhagen. (n.d.). The GREEN

		SURGE Handbook. Available from: https://ign.ku.dk/english/green- surge/. [Date viewed: 27 March 2023]. -Wildlife and Environment Society of South Africa. (n.d.). The power of public participation. Available from: https://wessa.org.za/. [Date viewed: 09 April 2023].
	9. There are also a few errors in the in-text references (e.g., Guenat et al., 2000 instead of 2020; p. 151). For future reference, I would recommend using a reference manager.	9. Noted, thank you. I have gone through the text carefully and corrected inconsistent dates in the references. For example: - Guenat et al., 2000 on p. 150 has been corrected to Guenat et al., 2020.
Scientific and academic quality of processing and presentation	*e. Structure and logical development/ arrangement of content (internal coherence)* 10. My main comments are mostly about the structure/ writing. Though I find the subject and conclusions very interesting, the thesis was relatively hard to read because very long and repetitive. Below are a few aspects that need to be improved: 10.1 The structure needs to be clarified:	10. Noted, thank you.
	10.1.1 There are aspects of the methods (literature review) in the introduction paragraph.	10.1.1 The literature review was not considered part of the methodology; the introduction therefore states what was included in the literature review section.
	10.1.2 The results should all be together and discussed at the end, not starting with a method, then a discussion, etc.	10.1.2 It is not clear to which chapter or section(s) in the thesis are referred to here. Therefore, no changes were made.
	10.1.3 Some aspects of the results are also included in the other sections (e.g.,	10.1.3 It is not clear to which chapter or section(s) in the thesis are referred to here. Therefore, no changes were made.

	participants believe…, p. 184).	Note that the thesis submitted for examination ended on page 178. However, I take note of the comment for future publications, thank you.
	10.1.4 The last section about future research needs to be written out in full text.	10.1.4 It is not clear to which chapter or section(s) in the thesis are referred to here. Perhaps the examiner is referring to the summary of the findings related to the challenges and opportunities (7.2.1., page 172) and the findings for research sub-question 3 (7.2.3, page 174) that were presented in bullet-point format. The comment is noted, thank you. I have written these sections as full text (please see pages 172 and 174).
	10.1.5 There is no need to start each chapter by explaining exactly what it is about, including with a figure. Just an introductory sentence is sufficient.	10.1.5 Noted, thank you. This structuring of the chapters has been done at the discretion and preference of my supervisor. I will consider this advice in future publications/writings.
	10.2 If this is allowed by your university, I would recommend using the first person (I) for two reasons: (1) It makes it much easier to read and (2) you have done this work, it is good work, you can take credit for it!	10.2 Noted, thank you. I am more comfortable writing in the third person voice for academic writing, this is also still an institutional tradition for our department. However, I am aware that writing in the first-person singular voice is acceptable, and I will consider it in the future. Thank you for the compliment.
	10.3 You mention many different definitions of GI but do not explain which you use. Though the context-dependent definition of GI comes later in the text, explaining why you don't use a specific one would be needed.	10.3. Perhaps the examiner expected a more explicit approach, but my use and selection of definitions were indicated. Please refer to (Chapter 2 - literature review) sections 2.6, page 33: Defining urban GI and 2.6.1, page 34: UGI interchangeable terms that explain my preference of not selecting a definition from the outset but rather searched for a place-specific one as I did not believe that the GN definitions in the literature apply to the SSA and SA context. This was explained in

		Section 2.7, p. 36-37 (GI definition for SSA) and supports my approach: *"Cilliers (2019) echoes the sentiment of others, such as Sussams et al. (2015) and Washbourne (2022),* ***that no uniform understanding or definition of the term GI exists in the African context.*** *Cilliers (2019)* ***argues that deliberate efforts are required to define and capture the value of GI for African countries.***
	10.4 In the literature review, the way you put City of Tshwane in relation to the literature is confusing. Sometimes it is linked to the subject, and sometimes does not appear at all.	10.4 . It is not clear to which section(s) in the thesis are referred to here. Therefore, no changes were made.
	f. Presentation and analysis of data 11. The qualitative data was presented in a rich manner, supported by many direct quotes, thank you. However, the presentation of the results in-between the quotes was sometimes unclear as to whether it was direct transcription or your own data analysis.	11. Noted, thank you. The results are presented as an outcome of the data analyses, which identified themes and presented and supported some of these by quotes from the respondents. It is all my own analysis.
	12. You tend to present results from different data sources (initial interviews, workshop and consolidation focus groups). However, I would rather recommend grouping results thematically, potentially highlighting how the diversity of methods allowed for richer data.	12. Noted, thank you. The structuring of the results according to methods instead of thematically was decided upon after much consideration. I will consider thematic groupings of results in future publications, as suggested.
	13. I also personally think that it might not be necessary to cite the participants by their codes, as they may be identifiable given the few	13. Noted, thank you. I have amended Table 3-5, column 2 on page 74 to avoid the possibility of participants being identifiable.

	number of people they could include.	
	g. Critical findings 14. Your data was very rich. Though all sections were interesting, I particularly liked the re-definition of GI and I really appreciate your GI planning principles. There is however a need to be clearer as to where they come from: is it only a result from the interviews and workshop, or from the literature and policy documents?	14. Noted, thank you. The results are from ALL those sources and were explicitly indicated in Table 5-5, page 129, regarding their origins and relations to the interviews, workshops, literature and policy documents.
	h. Discussion/ conclusion/ recommendations 15. This was clearly the highlight of your thesis for me! Though there is always room for improvement, you made a few very interesting points, e.g., on how the colonisation and apartheid history concretely influences the current understanding of GI in South Africa. Some of these points could however be made a bit more explicit.	15. Thank you, much appreciated. Noted, thank you. I will be more explicit about this in future publications on these results.
	16. The recommendations are also very practical, and I really appreciate how you explained the outreach/ how you then transmitted them to city officials.	16. Thank you very much. The compliment is highly appreciated.
Language and editing	17. In general, the English is well-written. There are, however, quite a few repetitions. Some details could be improved, as follows:	17. Thank you, noted.
	17.1 I would recommend not including any abbreviations in the abstract, as it makes it	17.1 Noted, thank you. I have replaced the two abbreviations in the abstract. In-text

	much less readable. And as much as possible, not in the text either (though that's less problematic).	abbreviations are limited. I will apply your advice to future writing, thank you.
	17.2 If this is allowed by your university, I would recommend using the first person (I) for two reasons: (1) It makes it much easier to read and (2) you have done this work, it is good work, you can take credit for it!	17.2 Thank you, your advice is noted. Please see my response to the same comment above (10.2).
	17.3 You use a lot of direct quotes from articles in the introduction. I would recommend reformulating more.	17.3 Noted, thank you. I will take this advice towards future publications. Some direct quotes are mainly definitions of green infrastructure but I note the convention.
	17.4 Be careful about typos in uncommon names. Unluckily for you, I did some work in Ghana, and one of the cities was misspelt.	17.4 Noted, thank you. I appreciate the spelling mistake pointed out. I have corrected the spelling of Sunyani on page 17 and in Figure 2-2.
	18. A few more detailed feedback on the abstract, as this is one of the key parts of the thesis:	18. Thank you for this detailed feedback on my abstract, it is appreciated.
	18.1 Within the abstract, the study aims are clearly enunciated. Well done.	18.1. Thank you.
	18.2 The aims are, however, repeated between the end of the first paragraph and the beginning of the second one, which is not needed. The first paragraph is well structured in describing the background and leading to the aims. The second is about methods, and there is no need to repeat the aims.	18.2 Noted, I have removed the repetition of the aims. <u>Proposed revisions to Abstract:</u> Globally, researchers advocate the potential of infrastructure green infrastructure (GI) applications to contribute to inclusive, safe and sustainable cities as captured by the United Nations Sustainable Development Goal number 11. Socio-economic urgencies and political agendas often overshadow GI opportunities in Sub-Saharan Africa (SSA). The development and incorporation of

		implementable, context-based GI planning principles in spatial planning policies and frameworks are scant in many SSA cities, and so is research on GI. This study considers the challenges and opportunities city officials face with GI planning when enforcing minimum public open space requirements in the City of Tshwane, South Africa. ~~A literature review, policy document review and semi-structured interviews were conducted to (1) identify the challenges faced by city officials and opportunities that exist to improve the decision-making process at the site-level stage with the application of GI and (2) identify and collate GI planning principles for the City of Tshwane.~~ ~~The literature review focused mainly on SSA, and papers focused on GI guidelines~~. A literature review that focused mainly on GI guidelines in SSA was conducted. The researcher reviewed 28 South African policy documents at national, provincial and local level. The review considered the alignment of the GI principles identified in the literature with existing spatial and environmental development principles in spatial policy documents. In parallel with the literature and policy review process, 16 semi-structured interviews with 18 interviewees involved in GI planning at the City of Tshwane were conducted. The researcher followed a co-development process that commenced with the interviews and continued through a participatory workshop with 23 participants, including a pre-workshop online survey and five post-workshop feedback and clarification discussions. Participants included city officials, property developers and built-environment practitioners, all with many years of

		experience in the land development application process in the city. The findings illustrate that city officials face many complex challenges with the application of GI, such as poor intergovernmental collaboration; conflicting policies, regulations and frameworks; scarce resources; urbanisation resulting in land invasions due to a housing shortage; and a lack of appreciation of the value and benefits that GI can provide. The findings further illustrate that local spatial policies have many national, provincial and city planning principles but are not carried through to the site development planning stage. Many v opportunities were identified for improved GI planning, such as streamlining the land development application process, incentivising developers, enabling cross-sectoral partnerships to open up new resource pools to fund GI applications, and promoting the long-term benefits of GI. Based on the findings, 20 planning principles are proposed for the city's site development planning phase that overlap with 18 principles in the literature but emphasise aspects of access, safety, quality and cross-sectoral partnerships to co-develop and co-manage green space. These are unique requirements in an SSA context that can assist with the increased sustainability, protection and local benefits that GI offer and represents in the city. The study demonstrates the value of local cross-sectoral input in GI planning by following co-design, co-development, co-management, and co-ownership approaches that enable residents to benefit from civic resources and contribute to environmental justice whilst ascertaining the contextual application of research outcomes.

	18.3 The methods paragraph needs to be clarified a bit.	18.3 I am unclear on how to clarify this paragraph further.
	18.4 Really nice results/ discussion paragraph.	18.4 Thank you very much.
Technical presentation and layout	19. The figures in your introduction need to be reconsidered, as they should not be text. Fig. 1-1 and 1-2 could, for instance, be a table (two to three columns, one for research sub-question, one for objective, one for outcome), which could make it more readable. In their current format, it is very difficult to understand where to look. If text is included in a figure, it should really be 1-2 words per panel.	19. Noted, thank you for the suggestion. I will apply this suggestion to future work and publications.
	20. Additionally, if I am not mistaken, the content of both the figures cited above are the same, except for the addition of the outcome. Consequently, one table would be enough.	20. Noted, thank you. Yes, you are correct. This was done to give the reader a complete picture of how each research sub-question aligns with its objectives and outcomes.
	21. In general, figures and tables should be readable without the text: please be clearer in your legends, explaining, for instance, the colour code.	21. Thank you, noted. If this comment refers to Table 5-7 on page 135. Here, the same GI principle was allocated a colour to assist with readability, the colours themselves have no other meaning. However, I will review all my figures and check that they are readable and have clear legends or add colour codes.
	21.1 The table presenting the results from the Likert-scales in the questionnaires could be transformed into figures (bar-plots with average score and standard error, ranking scores), which would make it much more clear and visual.	21.1 The findings from the online survey were not considered significant enough to warrant additional figures. However, the suggestion to make data visually clearer will be taken forward in future work, thank you.
	21.2 Some tables and figures are also redundant, e.g., those comparing the challenges	21.2 Noted, thank you. Coming from a visual profession, we prefer tables as a summary, and this was at the request of my supervisor. However, I appreciate and take

	identified in the literature and by your interviews – this should be discussed in the text.	note of the remark for future work for conciseness.
Examiners should also indicate whether they regard parts and/ or the substance of the dissertation/ thesis as publishable.	22. There would need some work to streamline it, but the co-creation of South African GI definitions and planning principles is definitely publishable. The challenges and opportunities are probably as well.	22. Thank you very much, noted with appreciation.

REBUTTAL TO SEPTEMBER 26th, 2023 EXTERNAL EXAMINER COMMENTS AFTER THESIS EXAMINATION

EXTERNAL EXAMINER: Dr. L. Herslund

CANDIDATE/STUDENT: TANIA DU PLESSIS

MLArch IN LANDSCAPE ARCHITECTURE (DEPARTMENT OF ARCHITECTURE).

EXAMINER COMMENT	CORRECTION DONE (Highlighted in yellow in the thesis document)
23. The thesis on the challenges and opportunities of city officials when planning GI in the City of Tshwane is a very ambitious thesis on a highly relevant topic. The candidate shows great independence, overview and ability to dig deep into a subject, identifying the	23. Thank you; your positive comments are highly appreciated.

key challenges and perspectives in literature and applying them in reality while reflecting on the limitations.	
24. The thesis contributes new knowledge on Green Infrastructure planning in the Global South, in the City of Tshwane and at the SDP scale.	24. Thank you. I am pleased that the desired objectives of this thesis were realised.
25. The thesis rests on a large base of relevant GI literature in the Global North and South. The candidate has made a thorough and systematic literature search and built up an analytical framework to guide the methodological research design and data analysis. The candidate has identified the key GI literature from the Global South and Sub-Saharan Africa.	25. Thank you. A systematic literature review process was not followed, but rather a scoping and conceptual review. This has been stated more clearly in the text on page 14, 2nd paragraph as follows: *"A scoping review process was followed. The literature review included scientific literature concentrating on the past ten years. Keywords that were used to search for papers included*: *green infrastructure; guidelines; guiding principles; definition, challenges, barriers, opportunities, enablers, Sub-Saharan Africa, Global South, City of Tshwane, landscape design, co-development, green space. A snowball process was followed accumulating papers referred to by other papers and recommended by the GRIP team. Some selected older yet still relevant published studies are also included to follow the development of the concept of GI*".
26. One question of curiosity; - do SSA and SA always compare? Some reflections could possibly have been made on whether SSA literature is always relevant or how SA and SSA differentiate. But no matter what, the candidate mainly applies very relevant SA literature.	26. Du Toit et al. (2018) conducted a systematic literature review on the current state of research on GI and ES in SSA. In their search, only 38% of all SSA countries were represented. Of the 68 studies, 37 originated from SA (68%). With this in mind, one cannot state unequivocally that all studies originating from SSA apply to SA and visa versa.

	However, when comparing the findings regarding the challenges and opportunities, it can be deduced that SA experiences similar challenges caused by socio-economic and political pressures, which result in a lack of appreciation of the benefits that GI can offer a city and threaten the retention of green space in urban areas. Also, as a practitioner that practiced and worked with council projects for over 35 years, I believe that every community has specific needs and preferences, and every location has its own unique contextual aspects. Exceptions do exist even within one country, such as the cities of Durban and Cape Town versus the City of Tshwane (Shin & Mabon, 2018). So I believe, it is imperative to take cognisance of the context in every case (environmental & socio-economic aspects). <u>Reference:</u> Shih, W.-Y. and Mabon, L. 2018. Land-use planning as a tool for balancing the scientific and the social in biodiversity and ecosystem services mainstreaming? The case of Durban, South Africa. Journal of environmental planning and management, 61**,** 2338-2357.
27. The thesis rests on a dense empirical base. The thesis contains a literature review, policy document review and semi-structured interviews and a co-development process, and the candidate shows great ability in designing a qualitative case study, collecting and facilitating data collection and generation and finally analysing it. The candidate applies several qualitative methods and reflects on how limitations	27. Thank you. Your comments are highly appreciated.

such as different stakeholders not responding can skew the results. The candidate gives a very detailed and systematic account of the methods used and the whole data collection process.	
28. The analysis of the data is very detailed and thorough. It presents the activities that contributed to the objectives and research questions; it quotes participants, sums up and reflects on the findings in relation to the literature and how it is done elsewhere.	28. Thank you. Your comments are highly appreciated.
29. The thesis is well written with a clear structure and layout. At times, it can be difficult to read as a coherent text as there are many tables and citations; however, this is also what makes it trustworthy and novel;- as a reader, you get close to the reality and everyday governance of GI.	29. Thank you, noted. I will keep your comments about the readability of the thesis in mind for future work. I tend to lean towards the graphic representation of data due to my profession as a landscape architect. I appreciate the comment.
30. The thesis or parts thereof is definitely publishable. The process and results of adapting GI to the city of Tshwane are very interesting and could be relevant both as a scientific journal paper but also as an approach to be used in other cities;- and published to international organisations. The reflections and comparisons between the North and South GI challenges could also be interesting as a paper.	30. Thank you very much. Your suggestions on possible topics for publication in scientific journals and international organisations are appreciated, and I will undoubtedly pursue them.
31. Minor comment: The thesis is done within landscape architecture. It could be interesting with some more reflections on the role of landscape architects in the promotion of GI in South African cities and in the various offices, which we get acquainted with in the thesis.	31. Thank you for this comment. The role of landscape architects in the promotion of GI was not part of the objectives of this thesis and has been taken up in other studies such as Breed (2015) and Shand (2023). Breed (2015) points out that landscape architects in South Africa are trained with a strong environmental background and social conscience

	and are well-positioned to promote environmentally sustainable practices with their clients. <u>References:</u> Breed, C. A. 2015. Social production of ecosystem services through the articulation of values in landscape design practice in South Africa. PhD thesis, University of Pretoria. Shand, D. 2023. Nature-based Park making: interpreting nearby nature narratives to promote environmental justice in City of Tshwane community parks. PhD thesis, University of Pretoria.
32. Possibly also what motivated the candidate to study the topic;- what is the background of the candidate to do so, etc.	32. In my own professional practice as a landscape architect in Gauteng for the past 35 years, it became apparent that there were no guiding principles for applying GI in the city and that green space was under pressure. My thesis is an (ambitious) attempt to bridge this gap and, in so doing, assist in streamlining the SDP approval process while developing clear guidelines for providing GI in property developments. I believe that as a landscape architect, I am well-positioned to conduct this study and will build further upon this in future publications.