

**Planning for the protection of the natural resource  
base within an urban biodiversity hotspot (Durban,  
South Africa)**

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**in the Discipline of Ecological Sciences**

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## **ABSTRACT**

This thesis responds to the global call for local government to play an active role in responding to the global biodiversity crisis. The study focused on Durban, South Africa, which has four decades of experience in biodiversity conservation. The purpose of the thesis was to determine, using Durban as a case study, the role a local government can play in contributing towards improved biodiversity outcomes. Through new case-study research, in the context of biodiversity conservation, the thesis aimed to contribute to addressing the global policy to local implementation gap, research-implementation gap, and the Global South research gap. Using analytical frameworks, spatial analyses, and local spatial data, the thesis investigated three key areas.

Chapter two analysed Durban's evolution in open space planning, identifying crucial elements in advancing biodiversity mainstreaming. Evidence was provided in the mainstreaming of biodiversity concerns within local government processes, institutional functions, and land-use decision-making. This has been achieved through effective and sustained leadership; the use of science and scientific information in advancing the policy and legislative environment; and building political support by responding to shifting governance contexts; investment in institutional scientific capacity; and generating scale-appropriate biodiversity information.

The third chapter examined the effectiveness of local government tools in protecting, managing, and restoring biodiversity. Successes included town planning tools contributing to avoided biodiversity loss and protection of key sites, and effective land management and restoration efforts with socio-economic co-benefits. Challenges persisted that hampered progress, including unequal protection and investment based on socio-economic status; cross sectorial barriers and governance fragmentation; and inappropriate incentives to promote conservation.

Future priorities include scaling successful models, improving incentives for landowners, and adopting a more community-centred approach.

The fourth chapter explored opportunities to increase terrestrial area-based biodiversity conservation in Durban. Traditional authority areas and private landholdings harbour most biodiversity features outside existing conservation areas. Inclusion of complementary land-use zones and unrealised conservation servitudes represent short-term interventions to increase the conservation estate. Aligning critical biodiversity areas with biophysically contained areas offers significant potential conservation and sustainable development co-benefits. Developing tools and incentives for area-based conservation in traditional authority areas, and targeted rezoning to protect threatened vegetation, represent important required interventions. Building on the learnings from the previous chapter, these opportunities were assessed in terms of feasibility, effectiveness, and co-benefits for climate change resilience.

This thesis demonstrated the important role that a local government can play in contributing towards broader biodiversity goals, identifying investment areas that may shorten the time required for effective mainstreaming; challenges and opportunities to advance biodiversity outcomes; and provided innovative mechanisms to advance biodiversity and urban sustainability outcomes.

## PREFACE

The data described in this thesis were collected in Durban, Republic of South Africa from May 2018 to December 2024. Experimental work was carried out while registered at the School of Life Sciences, University of KwaZulu-Natal, Pietermaritzburg, under the supervision of Professor Rob Slotow and Professor Debra Roberts.

This thesis, submitted for the degree of Doctor of Philosophy in the College of Agriculture, Engineering and Science, University of KwaZulu-Natal, School of Life Sciences, Pietermaritzburg campus, represents original work by the author and has not otherwise been submitted in any form for any degree or diploma to any University. Where use has been made of the work of others, it is duly acknowledged in the text.

[Redacted]

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March 2025

I certify that the above statement is correct and as the candidate's supervisor I have approved this thesis for submission.

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March 2025

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**DECLARATION 1 - PLAGIARISM**

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#### **PUBLICATION 1: Formatted for Sustainability (published)**

##### **The Evolution of Open Space Planning within a Developing, Biodiverse City (Durban, South Africa)**

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##### **Local Government Response to Urban Biodiversity Conservation Challenges within a Global Biodiversity Hotspot**

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##### **Identifying Opportunities for Terrestrial Area-Based Conservation within an Urban Global Biodiversity Hotspot (Durban, South Africa)**

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# CHAPTER 1

## INTRODUCTION

### 1.1 The biodiversity crisis and cities

The anthropogenic-driven biodiversity crisis represents one of the world's most significant challenges (UNEP, 2024). Rates of extinction are occurring at tens to hundreds times greater than prehuman times (Richardson et al., 2023). Since 1500, it is estimated that 30% of species have been threatened or driven to extinction (Isbell et al., 2023), equating to 1 million known animal and plant species (IPBES, 2019a; WWF, 2020).

Land-use change represents the most significant driver of biodiversity loss (Jaureguiberry et al., 2022), with conversion of land to urban areas an increasingly important contributor (Simkin et al., 2022). Urbanisation is a defining megatrend of the 21<sup>st</sup> century, where the majority of the world's population now live (UN Habitat, 2022), and, by 2050, close on 70% of people will reside in cities (IPCC, 2022). The majority of this growth is anticipated to occur in the Global South, emphasising that the 'urban world is increasingly a 'southern urban World' (Shackleton et al., 2021).

Predicted urban expansion is expected to lead to the loss of 11-33 million hectares of natural land, with more rapid land-use change associated with the world's most biodiverse regions (Li et al., 2022). By 2030, it is predicted that 40% of protected areas will be situated within 50 km of urban areas (McDonald et al., 2020). Future urban growth within Sub-Saharan Africa represents a particular threat to biodiversity, and without careful planning will lead to significant biodiversity losses (Simkin et al., 2022).

Biosphere integrity, one of the nine Earth system boundaries that are critical to the stability and resilience of the Earth System, has long been transgressed (Gupta et al., 2024; Rockström et al., 2023). The concern is that continual biodiversity loss may result in nonlinear and irreversible changes to the Earth system, with direct impacts on society, and particularly those that are most vulnerable (Gupta et al., 2024; Rockström et al., 2023). The loss of biodiversity due to land-use change has severe negative implications for people and cities (Hasan et al., 2020; IPBES, 2019a). The contribution of ecosystems to human wellbeing (IPBES, 2019a; Summers et al., 2018) is now well established in literature and includes ecosystem services (conceptually replaced by *Nature's Contribution to People* (IPBES, 2019a)) relating to provisioning services (such as production of food, timber or other resources), regulating services (such as air quality or water regulation, pollination and storm protection), cultural services (such as natural assets for recreation, cultural identity and direct health benefits), and supporting services (such as soil formation, biogeochemistry and primary productivity) (IPBES, 2019b).

The loss of these critical services represents a particular challenge to cities of the Global South where citizens are often directly reliant on ecosystems services to meet basic needs (Shackleton, 2021). Compounded by structural spatial and economic inequities, the continual loss of these critical services increases the vulnerability of these citizens (Davoren & Shackleton, 2021; Kumar & Yashiro, 2014). This is particularly important when considering triple planetary crisis of biodiversity loss, climate change and pollution (UNEP, 2024). The now almost certain inevitability of a 1.5<sup>0</sup> C overshoot means that cities will increasingly be subjected to climate change impacts, with impacts being disproportionately associated with cities of the Global South (IPCC, 2023). Increasing coastal storms, droughts, extreme heat and flooding will require adaptation, and generate losses and damages; but again due to the inherent inequalities of the Global South the capacity to address these issues is limited (Sitas et al.,

2021). Ensuring the protection of biodiversity, and the associated urban regulating ecosystem services, within cities of the Global South, represents critical pathways to improving resilience (Pauleit et al., 2021) .

## **1.2 Global response**

Global reviews, policy development and international agreements have increasingly sought to address the biodiversity crisis. Global reports such as the *Global Assessment Report on Biodiversity and Ecosystem Services* (IPBES, 2019a) and the *Living Planet Report(s)* (WWF, 2020, 2022) have served to illustrate the extent of the problem and provide policy guidelines. The interconnection between climate change and biodiversity, both in terms of impact of a changing climate change on biodiversity, and biodiversity as an adaptation and mitigation response, means that biodiversity features prominently in the work of the Intergovernmental Panel on Climate Change (IPCC, 2022; Pörtner et al., 2021, 2022). Similarly, the Development of Sustainability Development Goals, developed as part of the United Nations 2030 Agenda for Sustainable Development, have included specific biodiversity goals ‘life below water’ (Goal 14) and ‘life on land’(Goal 15) UNGA, 2015).

The Convention on Biological Diversity (CBD), however, represents the primary global body responsible for addressing the biodiversity crisis through the development of the strategic plan for biodiversity and associated targets. The Aichi targets, as part of the UN Strategic Plan for Biodiversity (2011-2020), were largely not met (Maxwell et al., 2020). Following on from this, the Kunming-Montreal Global Biodiversity Framework (GBF), established by the 15th Conference of Parties to the UN Convention on Biological Diversity, ambitiously calls for, *inter alia*, the effective conservation of 30 percent of ecologically representative and connected terrestrial systems by 2030 (UN, 2022).

The adoption of a ‘Whole of Government, whole of society’ approach recognises that curbing biodiversity loss cannot follow a business as usual approach (UNEP, 2024). Importantly, inclusivity and equity, in the achievement of goals are evident in the framework. An important example includes recognition of the importance of indigenous peoples and communities through, *inter alia*, Target 22, which aims to *Ensure Participation in Decision-Making and Access to Justice and Information Related to Biodiversity for all* (Watson et al., 2023). Greater inclusivity and recognition of conserving areas outside of strictly protected areas would seemingly provide confidence in moving from area-based terrestrial target of 17% (Aichi Target 11) to 30% in the current GBF. A key enabler for this are Other Effective Conservation Measures (OECMS) (Gurney et al., 2021). Although, OECMS were referenced in the Aichi targets, it wasn’t until 2018 that they were defined (Donald et al., 2019) as *a geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio economic, and other locally relevant values* (CBD, 2018).

Facilitated by the implementation gap between global goals and local realities, subnational actors, including local governments and cities, have been recognised by the CBD since 2010 (Smallwood et al., 2022). Local government’s role in contributing towards biodiversity outcomes and sustainability is receiving increasing global attention (Acuto et al., 2020; McDonald et al., 2018). This is particularly evident in the expression of urban-focused sustainable development goals, particularly SDG 11 of the 2030 Agenda for Sustainable Development that aims to *Make cities and human settlements inclusive, resilient and sustainable* (UNGA, 2015) and Target 12 of the post 2020 GBF that aims to *Enhance Green Spaces and Urban Planning for Human Well-Being and Biodiversity* (UN, 2022). Similarly,

the importance of biodiversity protection in enabling climate change adaptation represents a central element of the GBF with clear links to urban areas (Targets 8, 11 and 12) (UN, 2022).

### **1.3 Biodiversity outcomes in cities and local governments**

Given this expanding mandate, and direct links between biodiversity, urban sustainability, and human wellbeing, cities and local governments have a vital role to play to drive transformative change through local policy and legislative mainstreaming and coordination (Gupta et al., 2024; Kok, 2022). A central mechanism by which local governments are seen to contribute to biodiversity is through one of their core mandates, the mainstreaming of biodiversity concerns in land-use and spatial planning (Allred et al., 2021; Knight et al., 2006; Miller et al., 2009; Parris et al., 2018; Shih & Mabon, 2018). Effectiveness of biodiversity mainstreaming has differed substantially across cities (Shih & Mabon, 2018) emphasising the significant implementation gap that persists in conservation planning and environmental governance (Ferraro & Failler, 2024; Knight et al., 2008)

Another core issue relates to perceptions of the biodiversity value of urban areas by conservation agencies, as urban is often viewed as the antithesis of natural (Soanes & Lentini, 2019). This undervalues the importance of local governments' contributions to area based conservation (Soanes et al., 2019; Xie & Bulkeley, 2020) , and evident in the avoidance of urban area by conservation agencies undertaking area-based conservation expansion (Tulloch et al., 2016). Importantly, however, cities often harbour critical biodiversity that are essential for meeting representativity targets (Ives et al., 2016; Soanes & Lentini, 2019; Wintle et al., 2019). The fragmented nature of urban landscapes does mean that active management of areas is required to ensure mitigating of threats and maintenance of ecological processes (Potgieter et al., 2022). Despite challenges with the protection and management of urban biodiversity,

these areas often represent ideal places to undertake conservation activities offering significant co-benefits in the protection of ecosystem services, including fostering connectivity with nature, and enhancing well-being (Dearborn & Kark, 2010; MacKinnon et al., 2019; Shanahan et al., 2018).

#### **1.4 The need to address the Global South research gap**

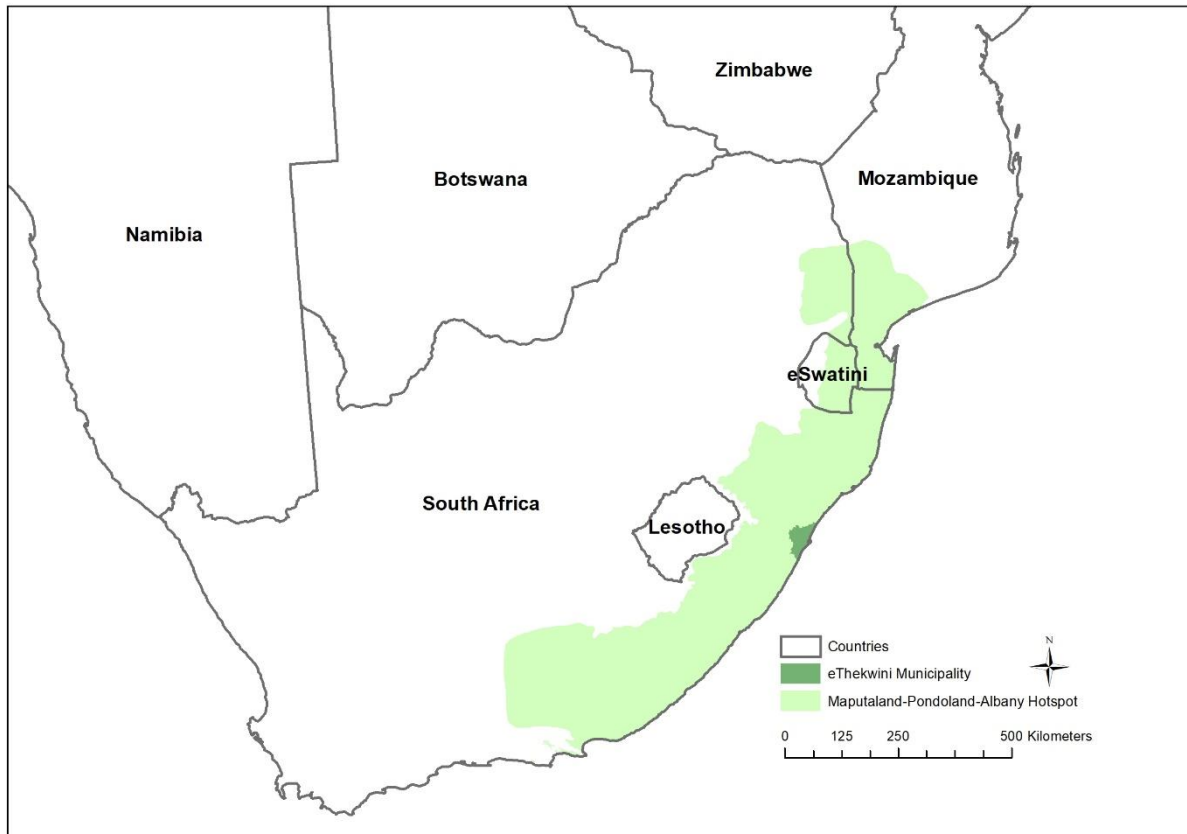
Urbanisation over the next decades will not resemble that of the past; it will be distinctly southern (Schindler, 2017). Sprawling informal settlements in small- to medium-sized cities will likely be a more prominent urban form, and associated with biodiverse regions of the world (Anderson et al., 2021; McDonald et al., 2018; Samper et al., 2020; Seto et al., 2012). Biodiversity loss will increase vulnerability of cities and their citizens that already face significant structural inequalities and limited governance capacity to respond to challenges and provide services (Pauleit et al., 2021; Shackleton et al., 2021). When considering the additional impacts of climate change, opportunities for a healthy and equitable future for citizens appears limited (Sitas et al., 2021). Nature Based solutions (definition as per Resolution 5 of the Fifth United Nations Environment Assembly (UNEP, 2022)), including the integration of biodiversity within land-use planning, however, offers opportunities to create more resilient systems with multiples co-benefits of ecosystem service provision and climate adaptation (Pauleit et al., 2021).

Global South cities are contextually different to those of the Global North in terms of, *inter alia*, levels of inequality and vulnerability, development history, and urban form (Shackleton et al., 2021). This has led researchers to call for more active participation of cities in academic literature from cities of the Global South toward a more relevant Global South urban agenda (Nagendra et al., 2018; Shackleton et al., 2021). The research gap is evident across the urban

biodiversity and governance space (du Toit et al., 2021; McDonald et al., 2020; Nagendra et al., 2018; Rega-Brodsky et al., 2022). Understanding unique Global South perspectives is essential so as to avoid past mistakes and develop a transformative pathway that promotes sustainability and equity (Lwasa et al., 2018).

### **1.5 Motivation for a Durban case study**

The preceding subsections highlight three gaps in understanding that form the motivation for this thesis, including the: (1) global policy to local implementation gap; (2) research-implementation gap; and (3) Global South research gap. The City of Durban, administered by the eThekweni Municipality, located in middle of the Maputaland-Pondoland-Albany biodiversity hotspot (Figure 1.1) (Boon et al., 2016), has been actively involved in the protection, management and restoration of biodiversity for the past four decades (EThekweni Municipality, 2007, 2024; McLean et al., 2020). This longstanding engagement provides an opportunity to analyse and develop a deeper understanding of these interventions, their efficacy in contributing towards broader biodiversity goals, and contributions to addressing the aforementioned gaps in understanding. Importantly, this research provides an opportunity to determine what opportunities exist to improve biodiversity outcomes and provide baseline information to assess future changes in local biodiversity, planning and management in response to climate change and urbanisation impacts.



**Figure 1.1:** The location of the eThekweni Municipality within the Maputaland-Pondoland-Albany Biodiversity Hotspot (McLean et al., 2024).

Durban’s socio-economic environment presents challenges that are common in cities of the Global South. These include high levels of poverty, unemployment, economic and spatial inequality, growing informality, and civil unrest (Sutherland et al., 2024). Increasing urbanisation has resulted in the considerable impacts on the natural resources base, which, in combination with basic service delivery backlogs and budget constraints, present a considerable challenge for the municipality and its citizens (EThekweni Municipality, 2020). The presence of a dual governance system within Durban, a common feature across African cities, adds additional complexity to the land governance system (Sutherland et al., 2024). Traditional authority areas account for over 40% of the total municipal area (Figure 1.2), and are sites where customary law and recognition of custodial rights of traditional leadership

intersect with municipal planning (Sutherland et al., 2024). These areas are also harbour significant biodiversity, thereby offering the opportunity to further explore achieving conservation outcomes in such areas. Given the increasing global recognition of the importance of indigenous lands (also largely under customary law) for biodiversity (Garnett et al., 2018; O'Bryan et al., 2021), as evident in the GBF, the motivation for Durban as a case study is further enhanced.



**Figure 1.2:** The distribution of Traditional Authority Areas within the eThekweni Municipality (McLean et al., 2020).

## **1.6 Thesis outline and broad methodology**

The overall purpose of the thesis is to determine, using Durban as a case study, the role a local government can play in contributing towards improved biodiversity outcomes. Through new case-study research, the thesis aims to contribute to addressing the gaps identified in Section 1.5, including: 1) the global policy to local implementation gap; (2) research-implementation gap; and (3) Global South research gap.

This thesis is composed of five chapters, with the body of the thesis (chapters 2-4) containing one published manuscript and two others that have been prepared for publication in appropriate international journals. A brief description of the three manuscripts has been included below.

*Chapter Two: The Evolution of Open Space Planning within a Developing, Biodiverse City (Durban, South Africa)*

Land-use and spatial planning represents a primary local government function, and envisioned mainstreaming tool aimed at preventing biodiversity loss (Shih et al., 2020). Globally, the mainstreaming of biodiversity considerations into land-use and spatial planning has been poor (McDonald et al., 2018). Durban has been actively engaged in biodiversity focused open space planning for the past 40 years (McLean et al., 2020). Through the use of analytical frameworks (using historical, thematic, and content analysis) and local government development application data, the chapter aims to demonstrate how open space planning has evolved and to identify enablers in advancing biodiversity mainstreaming, through:

- 1) The analysis of the approaches taken in response to shifting urbanisation, governance and policy/legislative contexts;
- 2) Identification of the role of science and scientific information informing planning, as well as the champions required, and key institutional changes undertaken, to improve

biodiversity outcomes by embedding an explicit biodiversity mandate within local government; and

- 3) Analysis of how biodiversity concerns have been integral in land-use planning decision-making via the City's environmental planning function.

*Chapter Three: A Local Government Response to Urban Biodiversity Conservation within a Global Biodiversity Hotspot (Durban, South Africa)*

Despite increasing calls for local governments and cities to play a more active role in biodiversity conservation, they are rarely seen as significant contributors. Durban and its partners have been actively engaging with tools focusing on the protection, management, and restoration of biodiversity for several decades. Through the use of analytical frameworks (using thematic, content and comparative analysis) and local government spatial data this chapter aims to:

- 1) Illustrate how a local government can contribute to broader conservation goals;
- 2) Assess the efficacy of the biodiversity protection tools, management models, and restoration activities applied; and
- 3) Identify priority future action and enablers required to improve conservation outcomes.

*Chapter Four: Identifying Opportunities for Terrestrial Area-Based Conservation within an Urban Global Biodiversity Hotspot (Durban, South Africa)*

Building on from the outcomes of Chapter 3, this chapter aims to provide an overview of potential opportunities for increased biodiversity protection, that, if realised, would advance area-based conservation in the city, and the multiple co-benefits associated with it. Using fine-scale biodiversity and local government data this chapter aims to:

- 1) Spatially identify the extent of terrestrial biodiversity features outside of the current conservation area network, and across land tenure types.
- 2) Identify opportunities to increase the conservation area estate using existing local government conservation mechanisms across land tenure and biodiversity feature types.
- 3) Identify priority areas where existing mechanisms are less suited to achieve conservation outcomes and would require alternate mechanisms to promote area-based conservation.
- 4) Assess the feasibility of these opportunities/mechanisms. potential effectiveness, policy and practice requirements to advance these opportunities/mechanisms and co-benefits for building climate change resilience.

In the final chapter (chapter 5) I provide (1) a summary of key findings from each chapter; (2) gaps and limitations; (3) implications of achieving biodiversity outcomes at the local government level; (4) recommendations for policy and practise; (5) recommendations for future research; and (6) the conclusion.

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## CHAPTER 2

### **The Evolution of Open Space Planning within a Developing, Biodiverse City (Durban, South Africa)**

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## 2.1 Abstract

Conserving and restoring biodiversity is central to the achievement of the Sustainable Development Goals. The need to curb biodiversity loss through mainstreaming of biodiversity considerations within land-use planning is consistently highlighted in global biodiversity assessments intended for policy makers and practitioners. We present a Global South local government led examination of the mainstreaming of biodiversity issues within a biodiversity hotspot area. Here, we evaluated the four-decade long evolution in open space planning in Durban, South Africa, in response to shifting urbanisation, governance and policy/legislative contexts. We assessed the role of science in responding to contextual changes, the need for champions, and key institutional interventions undertaken to embed a biodiversity function within local government. In addition, we investigated how biodiversity concerns have been incorporated into land-use planning applications via the city's environmental planning function. We provide evidence of the advancement of mainstreaming biodiversity concerns within local government processes, institutional functions, and land-use decision making. This has been achieved through effective and sustained leadership; the use of science and scientific information in advancing the policy and legislative environment and building political support by responding to shifting governance contexts; investment in institutional scientific capacity and generating scale appropriate biodiversity information. Learnings from this paper may be useful for other local governments addressing biodiversity loss through land-use planning processes, by identifying critical investment areas that may shorten the time required for effective mainstreaming.

Keywords: biodiversity mainstreaming; urban biodiversity; local government; land-use planning; eThekweni

## 2.2 Introduction

The process of urbanisation is a defining mega trend of the 21<sup>st</sup> Century (Gerten et al., 2019), and over half of the global population already live in cities, rising to 68 % by 2050, growing mostly in the continents of Africa and Asia (United Nations, 2022b). Creating more sustainable cities and conserving and restoring biodiversity are key to achieving the Sustainable Development Goals (UNGA, 2015). Developing cities, particularly those of the Global South, can leap-frog past unsustainable development patterns, by focussing on transformative pathways that prioritise sustainability, equity and, particularly, the socio-ecological system (Lwasa et al., 2018)

The global wave of unprecedented urban growth has also been recognised as one of the major drivers of biodiversity loss (IPBES, 2019; WWF, 2020), with growing concern regarding the impact of urban growth in global biodiversity priority areas (McDonald et al., 2018; Nhamo et al., 2021). Urbanisation in its current form will hasten the biodiversity crisis, further compromising an already strained system, and risk non-linear and irreversible changes to the Earth system that will have a direct impact on society (Richardson et al., 2023). Africa is the most rapidly urbanising continent, where the majority are poor and approximately 60% of sub-Saharan Africa's urban population live in informal IPCC, 2022), often poorly-serviced, settlements, and are directly dependent on local natural systems to meet many of their basic needs (O'Farrell et al., 2019). Improvement in ecosystem health through the implementation of nature-based solutions (definition as per Resolution 5 of the Fifth United Nations Environment Assembly (UNEP, 2022)) has the potential to directly improve human wellbeing, and is increasingly viewed as an important tool in for urban areas to adapt to climate change (Pörtner et al., 2022).

The role of cities and local governments in addressing sustainability challenges is also receiving increasing global support, and is most evident in the expression of urban focused sustainable development goals, particularly SDG 11 of the 2030 Agenda for Sustainable Development that aims to *Make cities and human settlements inclusive, resilient and sustainable* (UNGA, 2015). Similarly, there is growing literature pointing to the importance of biodiversity in ensuring urban sustainability and human wellbeing (Elmqvist et al., 2013; IPBES, 2019). Drawing these imperatives together is the responsibility of local government working with their local stakeholders, and this has been further emphasised following the adoption of the Kunming-Montreal Global Biodiversity Framework (GBF) by the 15<sup>th</sup> Conference of Parties to the UN Convention on Biological Diversity, which *inter alia* advocates for a ‘whole-of-society’ approach in order to reach ambitious biodiversity targets, and an emphasis on ecosystem based approaches to minimizing the impacts of climate change on biodiversity (UN, 2022a). Central to this approach is increasing recognition that sub-national and local governments can be the best place to drive transformative change through co-ordination of initiatives and local policy mainstreaming (Visseren-Hamakers & Kok, 2022)

This call to action is particularly relevant to those cities that are within biodiversity priority areas, as failure to effectively deal with the threats of urbanisation in these areas will increase extinction rates, and directly impact ambitious global biodiversity goals (McDonald et al., 2018). This is especially relevant to the 36 global biodiversity hotspots that encompass more than half of endemic plant and terrestrial vertebrate species within just 2.5% of the Earth’s land surface area (Habel et al., 2019). The City of Durban is one of 33 hotspot cities across the global biodiversity hotspots that, given their relative size and rate of expansion, have a particular responsibility in ensuring the protection of globally significant and threatened components of biodiversity (Weller et al., 2017).

Globally, biodiversity considerations are poorly integrated into urban planning, often linked to lack of supporting policy and associated planning tools (McDonald et al., 2018). Recognition of this mainstreaming gap is evident in the GBF and particularly target 12 in the urban context, which aims to ‘Significantly increase the area and quality and connectivity of, access to, and benefits from green and blue spaces in urban and densely populated areas sustainably, by mainstreaming the conservation and sustainable use of biodiversity, and ensure biodiversity-inclusive urban planning...’(UN, 2022). Similarly, the White Paper on the Conservation and Sustainable Use of South Africa’s Biodiversity identifies the importance of biodiversity mainstreaming as a key enabler in achieving conservation objects and promoting sustainable development (DFFE, 2023).

The City of Durban, with four decades of experience in the fields of urban open space planning (used interchangeably with biodiversity planning in this chapter) (Boon et al., 2016), provides a useful case study in mainstreaming biodiversity through a local government lens. Over this period there has been ongoing engagement by local government, and the lessons learnt, and approaches taken, provide useful insights for local governments of both developing and developed cities, and particularly for the network of cities that fall within biodiversity hotspots.

Therefore, we aim to demonstrate how Durban’s work in open space planning has evolved over the past 40 years and to identify the key elements involved in advancing biodiversity focused open space planning, through:

- (1) The analysis of the approaches taken in response to shifting urbanisation, governance and policy/legislative contexts.
- (2) Identification of the role of science and scientific information informing planning, as well as the champions required, and key institutional changes undertaken, to improve

biodiversity outcomes by embedding an explicit biodiversity mandate within local government.

- (3) Analysis of how biodiversity concerns have been integral in land-use planning decision making via the City's environmental planning function (referred to as the "Department").

To address these questions, we make use of two analytical frameworks which assess the factors influencing the different open space planning iterations, and the role and influence of the Department in land-use planning processes, which is supplemented by local level development application data.

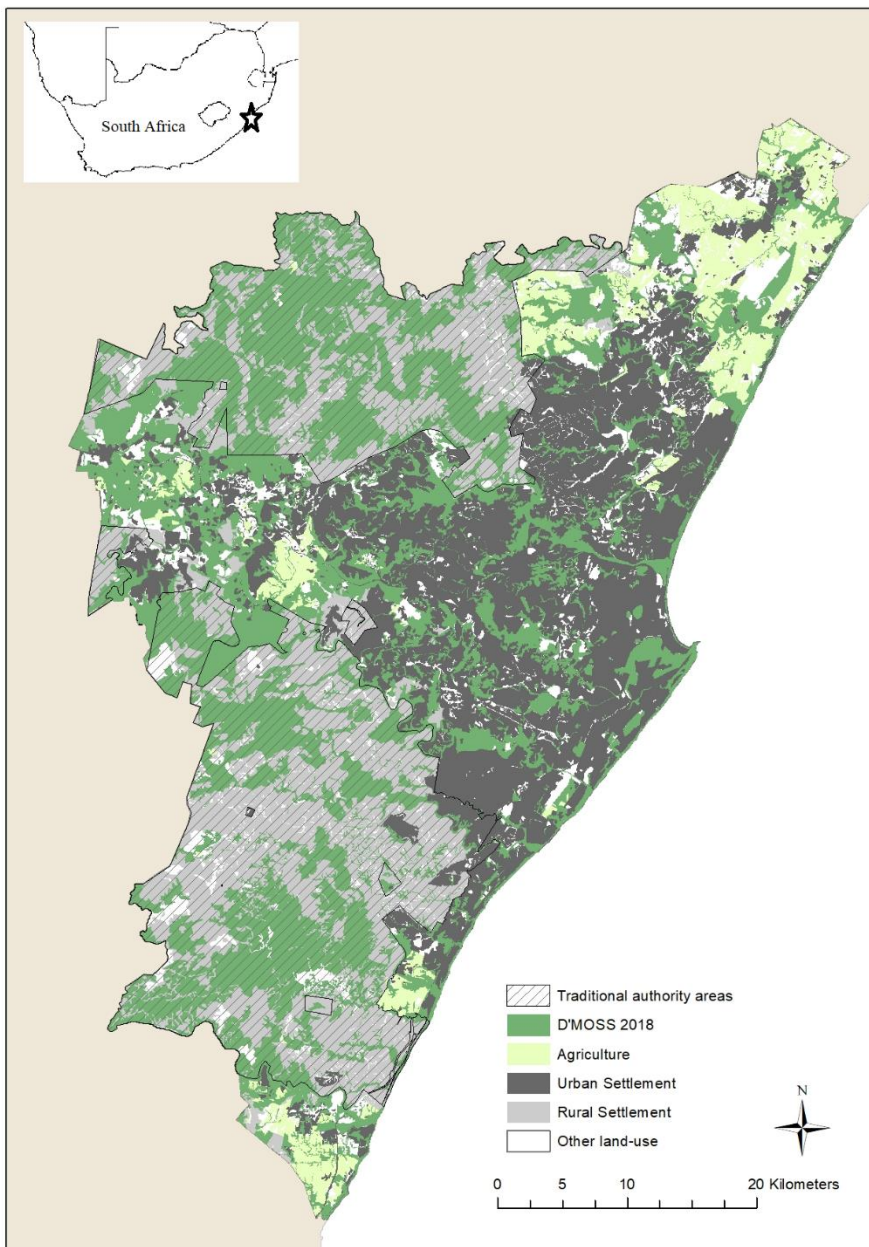
This study serves to generate understanding, and the understanding is generalised, noting that *'force of example' is underestimated* in the role of case studies and the ability to generalise, which can allow for natural extension of findings beyond the boundaries of an individual study (Flyvbjerg, 2011).

## **2.3 Methods**

### **2.3.1 Location and context**

The 2 566 km<sup>2</sup> City of Durban is administered by the eThekweni Municipality in the province of KwaZulu-Natal (KZN), South Africa (McLean et al., 2020) (Figure 2.1). The variety of landforms and climatic conditions in the eThekweni Municipal Area (EMA), as well as its unique biogeographical position, in the centre of the Maputaland-Pondoland-Albany global biodiversity hotspot (Mittermeier et al., 2005), has resulted in a wide range of terrestrial and aquatic ecosystems that are home to a rich diversity of organisms (Boon et al., 2016). The EMA

contains three of the country's nine terrestrial biomes viz, savanna, forest, and Indian Ocean Coastal Belt, and includes several threatened vegetation types. In Durban alone, there are approximately 2267 plant species, 82 terrestrial mammal species and 526 species of birds. There are also 69 species of reptiles, 25 endemic invertebrates (e.g. butterflies, millipedes and snails) and 37 frog species (McLean et al., 2020).



**Figure 2.1:** The eThekweni Municipal Area with main land-uses, indicating the area administered by the Ingonyama Trust Board, with the balance falling under the formal municipal scheme and the 2018 Durban Metropolitan Open Space System (McLean et al., 2020)

Durban is the third largest metropolitan area in South Africa, with a population of approximately 4.1 million people (EThekweni Municipality, 2022), representing more than a

third of the provincial population in an area that is less than 3% of the provincial total. The result is that Durban's rich natural resource base has been under significant pressure and negatively impacted over the past 150 years, initially by extensive agriculture, and then increasingly by rapid urbanisation, resulting in the cover of the original vegetation types being reduced to approximately one-third of the original extent (Boon et al., 2016). Rates of loss of natural habitat are particularly high in KwaZulu-Natal, averaging 1.2% per annum between 1994 and 2011, and likely to be substantially higher in the more densely populated Durban (Jewitt et al., 2015).

The socio-economic context of Durban, with a high degree inequality (Gini co-efficient = 0.62) and more than a third of the population living below the poverty line (EThekwini Municipality, 2022), further exacerbates pressure through growing informality and the increasing reliance on natural resources (EThekwini Municipality, 2020). In addition, the availability of land to support the economic activities associated with one of sub-Saharan Africa's busiest ports (Mthembu & Chasomeris, 2023) is limited by *inter alia* the steep topography that characterises the city, placing additional pressure on threatened habitats types (e.g. grassland systems) that are typically associated with the flatter more 'developable' areas (EThekwini Municipality, 2020). An additional complexity in Durban is the presence of dual governance system for the administration of land-use viz, formal municipal scheme areas that are administered by the eThekwini Municipality, and traditional authority areas administered by the Ingonyama Trust Board (ITB) (EThekwini Municipality, 2020)(Figure 2.1). The latter, reflective of the legacy of spatial segregation, represents land held in trust for the former KwaZulu homeland area, with the Zulu King as the sole trustee (Nel, 2021).

### 2.3.2 Approach

This paper is based on 40 years of experience in the field of local government open space planning. This case study, and the associated analytical frameworks, have been used to generate understanding, and then this understanding is then generalised. This approach is supported by literature (Flyvbjerg, 2011; Steinberg, 2015; Tsang, 2014), with process tracing representing an important approach in providing evidence to support assertions, with theoretical implications that may extend beyond the boundaries of the case study and be comparable to large N-methodologies in generalisability (Steinberg, 2015) The City's flagship environmental planning product viz., Durban Metropolitan Open Space System (D'MOSS) (Shih & Mabon, 2018), through historical and thematic analysis, was evaluated using an analytical framework for each of the major iterations of the product since 1982. For each iteration, the framework incorporated aspects relating to: (1) the urbanisation context of the time; (2) specific governance context that necessitated an appropriate planning response; (3) approach taken in response to contextual changes; (4) science/action nexus; (5) areas of innovation; (6) area of D'MOSS and year of approval; and (7) important champions or institutional structural changes.

A primary way in which D'MOSS is used in the municipality is through the triggering of development assessment processes linked to land-use change proposals (development applications). A second analytical framework, based on thematic and contentment analysis, was used to analyse the role of local government in the assessment of the environmental elements of these applications from a legislative and process context through a biodiversity lens, including: (1) applicable legislation; (2) role of the municipality in decision making; (3) applicability of D'MOSS; (4) potential constraints to development; (5) mechanisms for mainstreaming biodiversity consideration and/or protection; (6) Science/ Action nexus; and (7)

how the biodiversity functions of the municipality contribute towards facilitation of this mainstreaming. In addition, data were collated from the Department's application database to provide the number and type of applications received, per year.

Important to note is that this paper focuses on a particular aspect of Durban's response to the protection of biodiversity. There are several programmes within the city that respond to other aspects such as conservation area expansion, land management (e.g. the management of invasive alien species) and ecosystem restoration (Boon et al., 2016; Mugwedi et al., 2018; Roberts et al., 2012)

## **2.4 Results**

### **2.4.1 Durban Metropolitan Open Space System**

Table 2.1 provides an analysis of the seven major iterations of D'MOSS using the analytical framework. The patterns are summarised below.

**Table 2.1:** An analysis of factors influencing the seven open space plan iterations for Durban.

ITERATION	URBANISATION CONTEXT	GOVERNANCE CONTEXT THAT PROMPTED A SUITABLE RESPONSE	APPROACH TAKEN IN ADDRESSING THE ISSUE	INNOVATION	FOOTPRINT (HA)	SCIENCE ACTION NEXUS	CHAMPIONS AND KEY INSTITUTIONAL STRUCTURAL CHANGES
<b>1982 Metropolitan Open Space System</b>	The Durban Functional Region comprised several local councils with limited integration of open space planning across administrative boundaries	Concern over loss of key environmental assets, identification of imbalance in open spaces within the greater Durban area, and lack of trail systems	Mapping of existing conservation areas, areas of conservation potential and potential trail system	First attempt at mapping ecological assets within the greater Durban areas,	8 295	Although there is little evidence that the map was informed by ecological theory it represented a critical spatial product that land-use planning authorities could engage with., while also highlighting important natural spaces.	Wildlife Society (now Wildlife and Environmental Society of Southern Africa) and the Natal Town and regional Planning Commission
<b>1989 Durban Metropolitan Open Space System</b>	The municipal area at this point was restricted largely to the current CBD and suburbs immediately adjacent to the urban core.	Change in town planning legislation <sup>1</sup> prompted a relook at the roles of open spaces in urban planning, with a greater focus on the role of natural areas.	Mapped network of open spaces, including nine nature reserves	Inclusion of managed and disturbed landscapes Economic analysis of proposed open space in terms of required capital and operational budget.	2 193	Partnership with the university led to the development of a PhD researcher applying ecological theory in the development of an ecologically viable open space system.	Town Planning Branch, Durban; Head: Parks Department; Durban; and PhD researcher from UKZN.
<b>1999 Durban Metropolitan Open Space System Framework Plan</b>	New democracy and the amalgamation of 40 local municipalities substantially increased the municipal footprint.	The significant change in context placed a responsibility on government to rollout services to citizens, and a particular requirement to balance this rollout within the framework of sustainable development.	Expert based mapping approach in the identification of sensitive areas. Recognition of open spaces as an asset that is part of the City's service delivery response.	Valuation of services delivered by open spaces and Digitized using ArcGIS. Analysis of land included in the footprint that was considered undevelopable for	45 090	(Costanza et al., 1997) provided the theoretical framing to map and value open spaces at scale across the municipality.	PhD researcher appointed as Manager of the newly created Environmental Branch in 1994. Consultants appointed to spatially represent, and value ecosystem services provided by D'MOSS

				reasons other than purely biodiversity. Inclusion of land under all tenure types			
<b>2003 eThekweni Environmental Services Management Plan</b>	Further expansion of the municipal boundary, particularly the inclusion of traditional authority areas.	Increasing perception that D'MOSS represented a hindrance to the roll out of public service infrastructure.	As per phase 2, but with the removal of degraded rural and agricultural areas, and the rebranding of D'MOSS to EESMP.	Prioritisation of important areas to gain political support and move from D'MOSS to EESMP. Detailed consultation with line functions in non-environment sectors of the municipality.	63 115	As per 1999, however, the inclusion of a botanist within the environmental function allowed for prioritisation of areas for inclusion in the open space network.	Development of an Environmental Management Department under the Manager of the Environmental Branch. Appointment of new staff with additional skills in the biodiversity planning and development assessment branches
<b>2010 D'MOSS Scheme amendment</b>	While the area of the municipality remained unchanged since the 2003 plan, urban nodes outside of the City centre developed rapidly over this period.	Introduction of NEMBA elevated the importance of biodiversity and need to integrate biodiversity more effectively into land-use planning.	The most comprehensive stakeholder engagement process of all the D'MOSS iterations. Approximately 18000 letters sent to landowners as part of a land-use scheme amendment.	Inclusion into schemes as a development control layer and condition included in mapping.	74 497	Improved institutional capacity through the recruitment of scientists into the function allowed for the development of in-house, fine-scale land-cover data.	Incorporation of a climate adaptation function leading to a renaming of the Environmental Planning and Climate Protection Department. Appointment of a Town Planner to support the land-use scheme amendments. Substantial increase the in staff under the Biodiversity Planning and Development Assessment Branches.
<b>2016 D'MOSS</b>	While the area of the municipality remained unchanged since the 2003 plan, urban nodes outside of the	The development of national and provincial vegetation maps and biodiversity plans revealed scale-related	Areas added to D'MOSS were because of the inclusion of critical biodiversity areas as	Development of a fine-scale vegetation map and systematic conservation	78 782	The increased scientific capacity allowed for in-house development of feature data that	Manager: Biodiversity Planning and Scientists within the branch.

	City centre developed rapidly over this period.	issues when applying these products at a local government scale.	identified as part of a systematic conservation assessment.	assessment for Durban.		informed the systematic conservation assessment, and additional areas, primarily based on detailed vegetation mapping, were added. Aided by a partnership with UKZN that provided additional feature data and training in conservation planning.	Durban Research Action Partnership
<b>2018 D'MOSS</b>	The municipal area increased in 2016 to include another traditional authority area viz. Vulamehlo (ward 105).	Change in municipal area required an appropriate mapping response. The options poor environment of meeting conservation targets in urban environments and promoting the protection of ecological infrastructure promoted the development of nature-based solutions under the banner of restoration ecology.	The Vulamehlo area included some municipality's largest and most connected natural leading to a relatively large increase in. In addition, projects that were instated by the department relating to the restoration of system had progressed to the point that warranted additional protection	Inclusion of a large-scale reforestation project and future offset receiving areas.	94 835	Feedback loops from projects designed and implemented by scientists outside of the traditional biodiversity planning function (e.g. ecosystem-based adaptation through the Buffelsdraai Reforestation Project).	Restoration Ecology Branch responsible for undertaking the implementation of ecosystem-based adaptation projects. The Policy Branch and Environmentalists from the Biodiversity Impact Assessment Branch working in the biodiversity offset space

### *Contextual Changes and Enablers*

In response to changes in urbanisation and governance contexts, the approach to open space planning has evolved over the iterations to ensure continued institutional and political support. Open space planning for the greater Durban area was originally proposed in the late 1970s by the Natal Branch of the Wildlife Society (WS), now the Wildlife and Environmental Society of Southern Africa (WESSA), whose members were concerned about the loss of important natural areas in Durban. Investigations into the role of open space planning in town planning and changes in town planning legislation, supported by a partnership between the local university and local government, provided a platform to link conservation objectives with more traditional open space planning approaches, ultimately leading to the 1989 iteration (Director Parks Beaches and Recreation Department, 1989). This was significant in that began the process of introducing science into local government planning, which would become the central tenet to subsequent iterations of D'MOSS and land-use planning in the City.

The most significant change in urbanisation and governance context, however, was the democratisation of South Africa in 1994. The move to democracy in South Africa brought with it a host of political changes, and a shift to a developmental state with a focus on addressing the issues of poverty, economic development, and basic service provisioning (Roberts et al., 2005). This resulted in, *inter alia*, several changes to Durban's jurisdictional area that increased from 300 km<sup>2</sup> (Bayat, 1992) of the former Durban Municipality, to the amalgamation of 40 local councils in 1996 (EMB, 1999), inclusion of traditional authority areas in 2000 (EMB, 2001), and the inclusion of an additional traditional authority area in 2016, taking the total area of the eThekweni Metropolitan Municipality to 2 566 km<sup>2</sup> (EThekweni Municipality, 2020).

The evolution of planning and environmental legislation emanating from South Africa's new Constitution (RSA, 1996) was also instrumental in providing a receptive environment for mainstreaming biodiversity focused open space planning. The emergence of the Integrated Development Planning era, initially a result of the *Local Government Transition Act Second Amendment Act* (no 97 of 1996), and the inclusion of sustainable development as a key goal of that process, meant that this responsibility was metropolitan wide. The *National Environmental Management: Biodiversity Act* (Act 10 of 2004) (hereafter referred to as NEMBA) and the establishment of the South African National Biodiversity Institute (SANBI), mandated by that act for biodiversity planning and advising organs of state on biodiversity matters, represented a major step forward for the country in the mainstreaming of biodiversity into land-use planning. These key legislative advancements, therefore, provided a supportive environment for biodiversity focused open space planning and mainstreaming. Critically, scientists were no longer external to local government during this period, but were municipal employees, allowing for efficient and effective responses to mainstreaming opportunities.

#### *Approach taken*

Approaches taken across the seven iterations have included several examples of innovation, and display of conceptual flexibility, in response to shifting urbanisation and governance contexts. For example, a key element of the 1989 iteration relative to future iterations was the intention of having all 2193 ha of D'MOSS under municipal ownership. Importantly in the evolution of mainstreaming open space planning, and in contrast to the 1989 plan, only a quarter of the land in the 1999 D'MOSS footprint was considered public land, and the cost of securing and managing the large D'MOSS footprint through local government financing was considered prohibitive (EMB, 1999). As a result, the 1999 plan placed an emphasis on

management of the system through partnerships with stakeholders, and, importantly for future iterations, stated the need for land-use planning tools to control future development impacts on the environment (EMB, 1999).

Municipal council approval was required for all plans from 1989, and while different approaches were taken in line with shifting urban and political contexts, similarities emerge that were important in generating support, especially the role of science informing appropriate action. The first theme that emerged was the demonstration of the value of natural assets to political leadership and citizens. The initial plans of 1982, which was the first attempt at mapping Durban's natural assets in an open space network by the Wildlife Society (now Wildlife and Environmental Society of Southern Africa) and the Natal Town and regional Planning Commission, and 1989, while conservation focused, have strong links with traditional open space design most notably through, *inter alia*, the design of trail systems which feature prominently (Director Parks Beaches and Recreation Department, 1989). In the 1999 iteration, ecosystem services, and the emergence of new science in the valuation of these services through resource economics (Costanza et al., 1997), provided an effective way of shifting the D'MOSS narrative from one focused exclusively on biodiversity conservation, to one where it was possible to demonstrate the value of the open space system to the long-term financial sustainability of the City, and its role in meeting the basic needs of poorer communities (e.g. water supply). The new D'MOSS footprint covered approximately a third of the newly formed Durban Metropolitan Area, with ecosystem services provided for by the open space system valued for the first time at R 2.4 billion (then equivalent to US\$390 million) per year (EMB, 1999).

This conceptual shift was further advanced during the 2003 iteration and the renaming of the plan to the eThekweni Environmental Services Management Plan (EESMP). The change in

name represented a deliberate move to place additional emphasis on ecosystem services, to move away from the negative public and political perceptions of a conservation only focused open space system that was not responsive to human needs. An important influence on this was the demarcation of a new municipal boundary in 2000 that increased the metropolitan area by 67 %, and included large, predominantly rural traditional authority areas (EMB, 2003). The emphasis on ecosystem services was intended to provide an alignment with existing political priorities of local government leadership, who were now required to provide services to a far greater area than before.

NEMBA then provided the necessary legal rationale to put forward an argument for biodiversity protection in a developing, and increasingly options poor, decision making environment (McLean et al., 2020). The identification of important areas based on targets for biodiversity features represents a key element in systematic conservation planning (SCP) (Margules & Pressey, 2000) and an important narrative that, in combination with the legal requirements under NEMBA, was used in achieving political support and approval (McLean et al., 2020).

The second theme that emerged is the demonstration of land-use efficiency. In the 1989 D'MOSS, central to attaining council support was an extensive economic analysis to demonstrate that the cost of acquisition of the 441 ha of privately owned land within the D'MOSS footprint, and associated operational costs, could be offset by the proposed release for sale of municipal owned open space which fell outside of D'MOSS (Director Parks Beaches and Recreation Department, 1989). This represented the first example of the importance of using land-use efficiency trade-offs in gaining political support for an open space system in Durban.

In 1999, another aspect that was analysed as part of the new footprint was that approximately half of the new footprint was considered undevelopable due to physical constraints (e.g. oversteep areas or water courses) and/or underlying land-use restrictions (EMB, 1999). This was done to mitigate concerns by City officials and politicians regarding the impact of D'MOSS on development potential. Applying the same methodology as was used in the 1999 plan to the 2003 iteration yielded a total proposed open space system of 123 000 ha, or 54% of the new municipal area (EMB, 2001). Development pressure within the municipality, however, required a reduction in the total area in order to ensure long-term support for the plan (EMB, 2003). In response to this, agricultural and rural settlement areas, as well as areas that had been degraded or lost through development, represented the primary land-cover attributes that were excluded from the new footprint.

Approval of the revised plan by the municipal Council was also preceded by an extensive period of consultation with different line functions within the municipality, a requirement to receive support from Council. This was linked to the perception that the EESMP would directly impact on areas available for housing projects. As a result, a detailed spatial analysis was undertaken to identify the extent of conflict between the proposed housing projects and open space system. In total, 296 planned housing project areas were analysed against the EESMP. An overlap of only 798 Ha, or 1.2% of EESMP, was identified, which was further reduced based on the exclusion of areas that were unsuitable for housing development. The net result was the exclusion of a single proposed housing project area from the proposed EESMP, and written endorsement from Metro Housing (responsible for the rollout of affordable housing projects in the City) supporting the EESMP that totalled 63 115 ha (EThekwini Municipality, 2007). Notably, analysis of existing constraints to development within the EESMP further advanced the work first presented in 1999. Interviews with senior

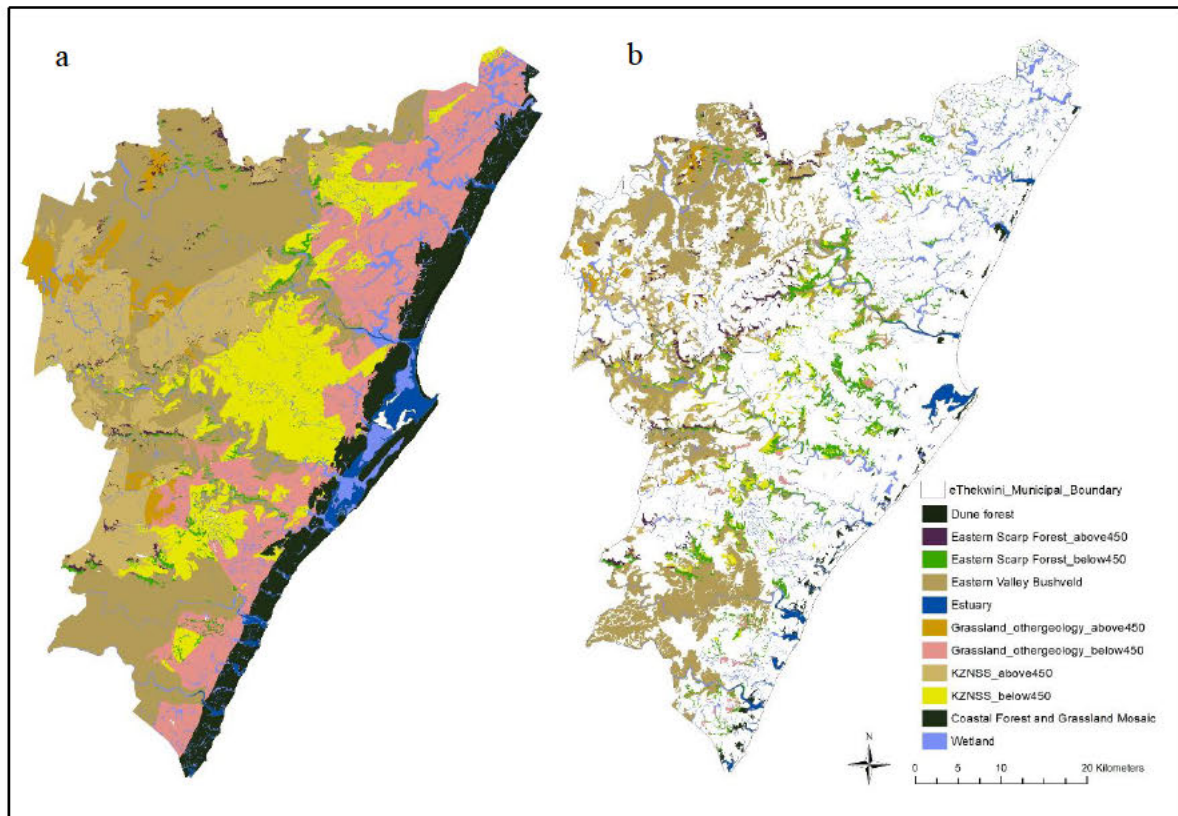
officials from Departments with legislated spatial footprints identified areas of overlap and co-benefit (e.g. protection of flood lines and electricity servitudes) (EMB, 2003), further emphasising that the open space planning was promoting land-use efficiency, and ensuring meaningful integration with other functions.

The targeted line function engagement approach was also adopted in the 2010, 2016 and 2018 iterations of D'MOSS (EESMP changed back to D'MOSS, see 3.1.3). These iterations were aided by more detailed biodiversity reporting, which illustrated, *inter alia*, the options poor environment available to achieve biodiversity targets. The SCP approach that was adopted for the 2016 and 2018 iterations highlighted the inherent efficiency associated with the method of land selection (Margules & Pressey, 2000). Importantly, the shifts in approach were not solely concerned with the addition of areas to D'MOSS, but areas were removed due to, *inter alia*, loss of ecological value, outcomes from development assessments and mapping errors.

The third theme evident across the iterations was the evidence-based nature of the open space design. The 1989 plan was informed through the use of detailed ecological information in the evaluation of the municipal open spaces (Roberts, 1993; 1994), and drawing on the theoretical underpinnings of Island Biogeography (MacArthur & Wilson, 2021) and optimal geometric nature reserve design (Diamond, 1975). Future EESMP/D'MOSS iterations used predominantly desktop-based mapping approaches to characterise levels of ecological functionality and corridor identification. This shift in approach was necessary given the substantial increase in the municipal area and was made possible by use of GIS software in the development of a landcover layer. This use of habitats as proxies for biodiversity would become a central element of subsequent iterations (McLean et al., 2020). The development of a fine-scale land cover map was a particularly important in the evolution of the open space system. The fine-scale (1:5000) of the product was fit for purpose and allowed for decisions

to be taken at a cadastral level. The iterations of 1999 to 2010 were associated with improvement in the City's GIS functionality, most notably high-resolution aerial imagery produced for Durban on an annual basis by the Photogrammetry Branch, and institutionalisation of GIS skills in the Department, and within other line functions.

Mapping the City's land cover had relied on national and provincial vegetation mapping in order to assign vegetation types to the mapped land cover units. This led to significant scale related issues, as there were many cases in which assigned vegetation types did not match with what was present on the ground. In order to address this issue, using more detailed Durban specific data sets (e.g. fine resolution geology and 2m contour shapefiles), a fine-scale vegetation map was produced for Durban (Figure 2.2). This product would represent a key input into *Durban's Systematic Conservation Assessment* (McLean et al., 2020), the outputs of which would inform the substantive additions to the 2016 Iteration of the D'MOSS.



**Figure 2.2:** a) Historical (circa 1850) and b) current (2020) vegetation type maps used for municipal planning (data source: (McLean et al., 2020)).

Included in the 2018 D'MOSS footprint were project areas emanating from professionals outside of the Biodiversity Planning Branch. The Buffelsdraai Reforestation Project, undertaken by the Restoration Ecology Branch, represented the output of a project that was nearly a decade in the making, and was a result of the City's direct involvement in climate change science (Mugwedi et al., 2018), and recognition of the importance of ecological infrastructure and D'MOSS as climate adaptation response (Roberts et al., 2012). The project was initiated in 2008, through a partnership with Wildlands Conservation Trust, and aimed at offsetting a portion of the carbon emissions from the 2010 FIFA™ World Cup through the creation of a locally indigenous forest in the buffer zone of the Buffelsdraai waste Landfill (Douwes et al., 2015).

The second project that influenced the 2018 D'MOSS iteration was the inclusion of offset receiving areas in the north of Durban. The project involved the development of a Sustainable Wetland Management Framework, tailored to address the contextual issues north of Durban, an area characterised by significant transformation of natural systems (largely as a result of extensive sugar cane farming), but also representing a focal point for greenfield development within the municipality. The pilot project was a partnership between two large landowners, with substantial development aspirations, and the Department, concerned with loss of remaining habitat, particularly wetland systems (Douwes et al., 2018). The project was led by the Department's Policy Branch, and environmentalists from the Biodiversity Impact Assessment Branch, and resulted in the inclusion of several degraded wetland systems that had been identified for rehabilitation.

#### *Mainstreaming milestones*

Increasing recognition of the open space system as a service provider resulted in support from spatial planners and, ultimately, the inclusion of the layer in Durban's 2002 Spatial Development Framework (EMB, 2003). This was an important development in the mainstreaming of environmental concerns within the City, ensuring that outcomes of the science informed plans would need to be considered in all strategic spatial planning and associated projects by other municipal functions. Durban's open space planning was, therefore, well ahead of its time in that much of the envisaged mainstreaming work (e.g. integration of biodiversity planning products into the Integrated Development Plan and Spatial Development Framework, through tools like bioregional plans and environmental management frameworks as described in NEMBA) had been in process for some time before national products emanating from NEMBA. The mainstreaming of the EESMP within the SDF allowed the Department to refocus its activities on more specialised aspects of

environmental management *viz.*, biodiversity protection, which was not addressed in other municipal sectors, and was aided by the introduction of NEMBA. This shift in focus was further emphasised by the move back from the EESMP to D'MOSS for subsequent open space plan iterations.

The key moment in the evolution of D'MOSS was the inclusion of D'MOSS into the City's Land Use Schemes in December 2010 as a development control layer, which meant that all development applications in or immediately adjacent to D'MOSS would first need to go to the Department for approval. This was significant in that, although D'MOSS had long been included in higher level City plans, the tension between the acknowledgement of environmental constraints based on science informed plans and perceived development rights associated with property zoning had, to this point, not been addressed in the City's development application process. Given the extent of the D'MOSS scheme introduction, and associated public process, tension over the impact on perceived development "rights" was inevitable. While most of these objections/grievances could be addressed through focused engagements with the public, others viewed the process as illegally curtailing development rights. The matter was ultimately heard in the High Court, where a private property owner argued that the introduction of D'MOSS into land-use schemes was unconstitutional on the basis that biodiversity protection was a concurrent national and provincial legislative competence in terms of Schedule 4 of the Constitution , and, therefore, not a Municipal mandate. The court, however, ruled in favour of the municipality on the basis that land-use planning is a local government competency and legislating for the environment through this process in no way impacted on the mandate of other spheres of government. This judgement was momentous in that it gave the legislative mandate to the work of the Department, and put

an end to any discussion around local government overreaching its mandate by undertaking environmental planning (Gyanda, 2013).

### *Champions and capacity building*

Institutional evolution is clearly demonstrated by the key actors involved in developing the various iterations of D'MOSS, moving from the initial work of the NGO and researchers, to consultants supporting a relatively small municipal environmental function, and finally to in-house generation within the municipality. The development of branches in the Department that cover specialized fields further entrenched institutionalisation through the creation and ownership of products (e.g. SCA and D'MOSS) and processes (e.g. development assessment), which was made possible by investment in scientific capacity in the municipal team. Scientists employed covered several fields, with a minimum qualification of a MSc. In addition, as D'MOSS increased in size and legislative influence, so did the team supporting it. This necessitated the establishment of new functions within the Department and the engagement with new areas of science, for example, in the application of restoration ecology and biodiversity offsetting concepts. Also important to institutionalisation was the inclusion of town planning professionals within the Department, which facilitated the transition of D'MOSS from policy to being entrenched in municipal legislation. The incorporation of town planners into a department dominated by environmental scientists allowed for effective implementation of biodiversity products in the land-use planning space, an established core mandate of local government (RSA, 1996).

Given the central role that science and application of scientific information has played in the D'MOSS story, a strong relationship with academic partners has been important. In this regard, the University of KwaZulu-Natal (previously University of Natal) was involved at various points across the D'MOSS iterations. The partnership leading to the 1989 iteration

was the first example, however, the university was also instrumental in (1) building coastal and estuarine scientific capacity through an MSc internship programme (2007-2008);(2) contributing to the development and a departmental strategic plan (2008 and 2013); and through the establishment of the Durban Research Action Partnership (DRAP, 2011 - present). DRAP uses a transdisciplinary approach to drive implementation focused research that aims to support, *inter alia*, the land-use planning and management functions of the Department (Cockburn et al., 2016). Research coming out of this partnership has covered several fields (Boon et al., 2016; Drury, 2016; McPherson et al., 2016), and has been particularly important in providing biodiversity data that has informed the SCA and D'MOSS. Also key was upskilling staff in conservation planning practice through a DRAP training workshop, by leading academics from the University of Helsinki, in both the theoretical and technical aspects of conservation planning; this led to application of the methodologies in the SCA (McLean et al., 2020).

The positioning of the Department within the City's spatial planning and land-use management functions provided the ideal institutional setting to facilitate the integration of D'MOSS as a development control layer across the hierarchy of municipal plans. A key step in catalysing this change in perspective was the appointment of an Environmental Manager (the same PhD student that was instrumental in the 1989 D'MOSS plan) in the municipality in 1994, which led to the motivation for the creation of an Environmental Management Branch within the then Urban Development Department. Importantly the same individual would remain as the head of the City's environmental function for all the subsequent D'MOSS iterations, providing leadership continuity, while proactively identifying opportunities for further mainstreaming. Examples of this have included leading Durban's local Agenda 21 programme (Roberts & Diederichs, 2002) that strongly influenced the ecosystem service

focused 1999 and 2003 iterations, shifting back to a biodiversity focus following the introduction of NEMBA (EThekweni Municipality, 2007), championing ecosystem based adaptation (Roberts et al., 2012) and resilience thinking (Douwes et al., 2018). These shifts have strongly influenced the various D'MOSS iterations.

#### 2.4.2 D'MOSS and development assessment

Protection of the environment is enshrined in Section 24 (b) of the South African constitution which states that ‘Everyone has the right...(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that (i) prevent pollution and ecological degradation; (ii) promote conservation; and (iii) secure ecological sustainable development and use of natural resources while promoting justifiable economic and social development.’ (RSA 1996). The constitution also provides for designation of responsibilities for activities and Schedule 4, part B which assigns municipal planning responsibilities to local government (RSA 1996). These, together with various legislation, provide the mandate for Durban’s and other local governments’ role, that integrates environmental planning within land-use planning processes. Table 2.2 provides an analysis of how the municipality engages with legislative requirements in land-use planning processes. Key elements from this table are summarised below

**Table 2.2:** Analysis of the Department’s role and influence in land-use planning processes.

APPLICATIONS	LEGAL CONTEXT	LEGAL CONTEXT (OBLIGATION)	LEGAL CONTEXT (D'MOSS)	PROCESS CONTEXT (CONSTRAINTS)	PROCESS CONTEXT (MECHANISMS)	PROCESS CONTEXT (SCIENCE-ACTION)	PROCESS CONTEXT (FACILITATION)
Environmental Impact Assessments	The National Environmental Management Act, 107 of 1998 (NEMA) gives effect to Section(B) of the constitution of South Africa. EIA regulations (RSA 2006, RSA 2010, RSA 2014, RSA 2017) and associated listing notices.	The eThekweni Municipality is a commenting authority in terms of NEMA processes within Durban.	Flagging layer in which applicants are advised of possible triggers for EIAs	Threatened habitat types and critical biodiversity areas as identified in Durban's Systematic Conservation Assessment and Durban Metropolitan Open Space System	<p>Comments from staff (registered environmental professionals) relating to the protection of the natural assets that may include:</p> <ul style="list-style-type: none"> <li>• The need for additional specialist studies.</li> <li>• Changes in development layout.</li> <li>• Motivation for the protection of the features based on fine-scale information.</li> </ul>	<p>Scientists employed to</p> <ol style="list-style-type: none"> <li>1. develop fine-scale biodiversity data that is used to inform the need for an assessment, and to inform comments provided during the process.</li> <li>2. provide specialist input in relation the review of submissions (e.g. wetland specialist).</li> </ol>	<ul style="list-style-type: none"> <li>• Departmental Enquiry form,</li> <li>• provision of additional biodiversity feature data to applicants, Environmental Assessment Practitioners, and specialists.</li> </ul>
Category 1 land development determinations (e.g. Introduction and amendment to land-use schemes)	The Spatial Planning and Land Use Management Act, 16 of 2013 (SPLUMA) and the eThekweni Municipality's Planning and Land-Use Management By-	The eThekweni Municipality is the competent authority in terms of land development applications. The decision maker for applications falling within this category is City Council.	As D'MOSS is part of the SDF it represents a key informant in the development and introduction of land-use schemes. The Department is a key contributor function in the development	<ul style="list-style-type: none"> <li>• Current and future conservation areas.</li> <li>• Areas with threatened vegetation types.</li> <li>• Critical biodiversity areas.</li> </ul>	<ul style="list-style-type: none"> <li>• Comments provided by the Department on the various package of plans.</li> <li>• Refinement of the D'MOSS layer,</li> <li>• Where appropriate the identification of</li> </ul>	<p>Scientists employed to:</p> <ol style="list-style-type: none"> <li>1. Develop fine-scale biodiversity data that is used to inform the development of plans.</li> </ol>	<ul style="list-style-type: none"> <li>• Terms of reference for the use and integration of environmental data for consultants within the package of plans,</li> </ul>

	Laws, 2016 (Chapter 8, section 26)		of the package of plans.	<ul style="list-style-type: none"> <li>Other important features (e.g. buffer areas, ecological corridors, ecosystem service areas).</li> </ul>	<ul style="list-style-type: none"> <li>Additional input provided through the Joint Advisory Committee through the Department's in-house professional planner.</li> </ul>	<ul style="list-style-type: none"> <li>Review work undertaken by consultants.</li> </ul>	<ul style="list-style-type: none"> <li>Provision of biodiversity data.</li> <li>Field verification by biodiversity specialists.</li> </ul>
Municipal Planning: Category 2: Departures from the SDF, zoning and rezoning of land.	The Spatial Planning and Land Use Management Act, 16 of 2013 (SPLUMA) and the eThekweni Municipality's Planning and Land-Use Management By-Laws, 2016 (Chapter 8, section 27)	The Municipal Planning Tribunal (MPT) is responsible for making decisions on this category of applications. The MPT is made up of designated municipal officials and person/s appoint by the City Council with extensive experience with inter alia spatial planning.	The MPT is governed by SPLUMA and the bylaws and must consider the environment within decision making.	<ul style="list-style-type: none"> <li>Current conservation areas,</li> <li>Areas with threatened vegetation types,</li> <li>Critical biodiversity areas,</li> <li>Other important features (e.g. buffer areas, ecological corridors, ecosystem service areas)</li> </ul>	<ul style="list-style-type: none"> <li>Comments from registered environmental professionals indicating whether the application is supported or not, and/or supported with conditions of approval (e.g. protection of remaining biodiversity features.</li> <li>Registered environmental professional forms part of the MPT and ensures oversight of environmental impact.</li> </ul>	<p>Scientists employed to:</p> <ol style="list-style-type: none"> <li>Develop fine-scale biodiversity data that is used to inform comments.</li> <li>Provide specialist comments (e.g. wetland and botanical specialists).</li> </ol>	<ul style="list-style-type: none"> <li>Enquiry form</li> <li>Provision of biodiversity data,</li> <li>Field verification by biodiversity specialists.</li> </ul>

					<ul style="list-style-type: none"> <li>Additional input provided through the Joint Advisory Committee through the Department's in-house professional planner.</li> </ul>
<p>Municipal Planning: Category 3: Special consent applications), applications for Subdivision, and development of land outside of a land-use scheme</p>	<p>The Spatial Planning and Land Use Management Act, 16 of 2013 (SPLUMA) and the eThekweni Municipality's Planning and Land-Use Management By-Laws, 2016 (Chapter 8, section 28)</p>	<p>These applications are considered and decided by the Head: Development Planning, Environment and Management</p>	<p>By virtue of inclusion in land-use schemes all applications received by the Land-use management office will be allocated to the Department for review and consideration. Applications that fall outside of the scheme will also be referred to the Department as D'MOSS is a foundational element of the SDF.</p>	<ul style="list-style-type: none"> <li>Threatened vegetation types,</li> <li>Critical biodiversity areas,</li> <li>Other important features (e.g. buffer areas, ecological corridors, ecosystem service areas)</li> </ul>	<ul style="list-style-type: none"> <li>Comments from registered environmental professionals indicating whether the application is supported or not, and/or supported with conditions of approval (e.g. protection of remaining biodiversity features).</li> <li>Additional input provided through the Joint Advisory Committee through the Department's in-house professional planner.</li> </ul> <p>Scientists employed to:</p> <ol style="list-style-type: none"> <li>Develop fine-scale biodiversity data that is used to inform comments.</li> <li>Provide specialist comments (e.g. wetland and botanical specialists).</li> </ol> <ul style="list-style-type: none"> <li>Enquiry form.</li> <li>Provision of biodiversity data to applicants and consultants.</li> <li>Field verification by biodiversity specialists.</li> </ul>

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<p>Municipal Planning: Category 4: relaxation and exemptions from the provisions of the land-use scheme</p>	<p>The Spatial Planning and Land Use Management Act, 16 of 2013 (SPLUMA) and the eThekweni Municipality's Planning and Land-Use Management By-Laws, 2016 (Chapter 8, section 29)</p>	<p>These applications are considered and decided by the Deputy Head: Development Planning</p>	<p>By virtue of inclusion in land use-schemes all applications received by the Land-use management office will be allocated to the department for review and consideration.</p>	<ul style="list-style-type: none"> <li>• Threatened vegetation types,</li> <li>• Critical biodiversity areas, and</li> <li>• Other important features (e.g. buffer areas, ecological corridors, ecosystem service areas)</li> </ul>	<ul style="list-style-type: none"> <li>• Comments from registered environmental professionals indicating whether the application is supported or not, and/or supported with conditions of approval.</li> </ul>	<p>Scientists employed to:</p>	<ol style="list-style-type: none"> <li>1. Develop fine-scale biodiversity data that is used to inform comments.</li> <li>2. Provide specialist comments (e.g. wetland and botanical specialists).</li> </ol>	<ul style="list-style-type: none"> <li>• Enquiry form.</li> <li>• Provision of data to applicants and consultants.</li> <li>• Field verification by biodiversity specialists.</li> </ul>
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## *Local Government Role in the National Environmental Management Act: EIA Regulations*

The National Environmental Management Act (Act 107 of 1998) gives effect to Section 24 of the constitution, and, while competency is assigned to national and provincial environmental authorities, NEMA obliges all organs of state to align with the principles of the Act (see *Fuel Retailers Association of Southern Africa v Director-General: Environmental Management, Department of Agriculture, Conservation and Environment, Mpumalanga Province & others, 2007* (Feris, 2008)). The municipality and Department play a key role in ensuring compliance with this legislation, and the associated EIA regulations, through development assessment processes. The Spatial Planning and Land Use Management Act (Act 16 of 2013) and eThekweni Planning By-law (13 of 2016), give effect to constitutional mandate of the municipality in land-use planning mandate. Application for land-use changes in terms of the eThekweni By-law are divided into two stages viz, pre-application enquiry and formal lodgement.

By virtue of the inclusion of D'MOSS within the lands-use scheme in 2010, all enquires that potentially impact D'MOSS are directed to the Department for comment. The initiation of an enquiry process has been particularly important, in that it provides landowners with clear direction on what process to follow, thereby reducing unnecessary financial outlay and preventing unrealistic development aspirations. Included within the correspondence are the identification of potential triggers that may require additional processes (e.g. Basic Assessment or EIA) in terms of NEMA, as well as an indication of whether the Department would support the application during the NEMA process.

Not only is there an important role in the identification of 'triggers', but the fine-scale nature of the City's biodiversity data, particularly when it comes to the mapping of ecosystems, can

equally drive the need for NEMA processes. This is particularly relevant for the distribution of threatened ecosystems, which were first gazetted in 2011 (Botts et al., 2020), with the intention of ensuring that any potential impacts to critical biodiversity would be assessed at lower ‘trigger’ thresholds than ecosystems under less threat. As an example, in terms of activity 12 of listing notice III of NEMA EIA regulations for the province of KwaZulu-Natal, the clearance of 300 m<sup>2</sup> of endangered or critically endangered vegetation types requires at least a Basic Assessment. The equivalent ‘trigger’ threshold for clearance of indigenous vegetation that is not listed as threatened is 10 000 m<sup>2</sup>. This type of activity is frequently encountered within Durban, and, given the coarse nature of the national and provincial vegetation maps, many of these impacts would proceed without assessment. The finer scale vegetation mapping and associated D’MOSS development application processes does compensate for these shortcomings by alerting landowners to the presence of threatened ecosystems at useful spatial scale. This scenario is commonly associated with the distribution of the Endangered KwaZulu-Natal Sandstone Sourveld Grassland that the Department has been able to more accurately map within Durban (Boon et al., 2016). These data are provided to landowners and environmental consultants acting on behalf of the applicant.

### *Municipal planning and D’MOSS*

In contrast to the commenting role within NEMA processes, the municipality is the decision maker (mandated authority) in terms of land-use planning applications. SPLUMA (Act 16 of 2013) provides the primary legislative framework for spatial planning within the country, and *inter alia* requires municipalities to : (1) compile Integrated Development Plans and an associated Spatial Development Framework; and (2) prepare and implement a Municipal Planning By-Law, including the preparation of land-use schemes, that act to control and regulate the use of land within the municipal area (EThekweni Municipality, 2022). In response

to the latter, the eThekweni Municipality Planning and Land Use Management By-Law (13 of 2016) was gazetted in August 2017. The bylaw provides guidance in terms of how different categories of land-use applications are processed within the municipality.

Table 2.2 provides an analysis of the different categories of land-use applications and how biodiversity information is integrated in decision making. Across all categories there is evidence of active participation in land-use planning processes from the more strategic municipal led category 1 applications to the predominantly private land-use applications associated with categories 2-4. Across all applications an emphasis is placed on ensuring fine-scale biodiversity information is applied, whether this be through the provision of fine-scale data to applicants or, where appropriate, site assessments. An example of this was the development of the Cato Ridge Local Area Plan and Draft Scheme (EThekweni Municipality, 2018), a category 1 application, and an area that had been identified for significant industrial development, but representing a centre for remnant parcels of threatened grassland systems. Through detailed engagement with the process, professionals from the Department were able to motivate, through refinement of the fine-scale vegetation mapping, for selected, previously unzoned sites to receive a proposed land-use and zoning of ‘conservation’ (EThekweni Municipality, 2018).

Mainstreaming of biodiversity into land-use decision making has also been advanced through capacity development. Comments relating to applications for potential development in D'MOSS areas were undertaken by professionally registered environmental scientists that could interpret biodiversity information and potential impacts and provide informed recommendations for decision making. Decisions include: (1) Approval without conditions - as is the case with areas that, following assessment, are found to be highly degraded, there has been a mapping error or in cases where there is no likely impact on D'MOSS. (2) Approval

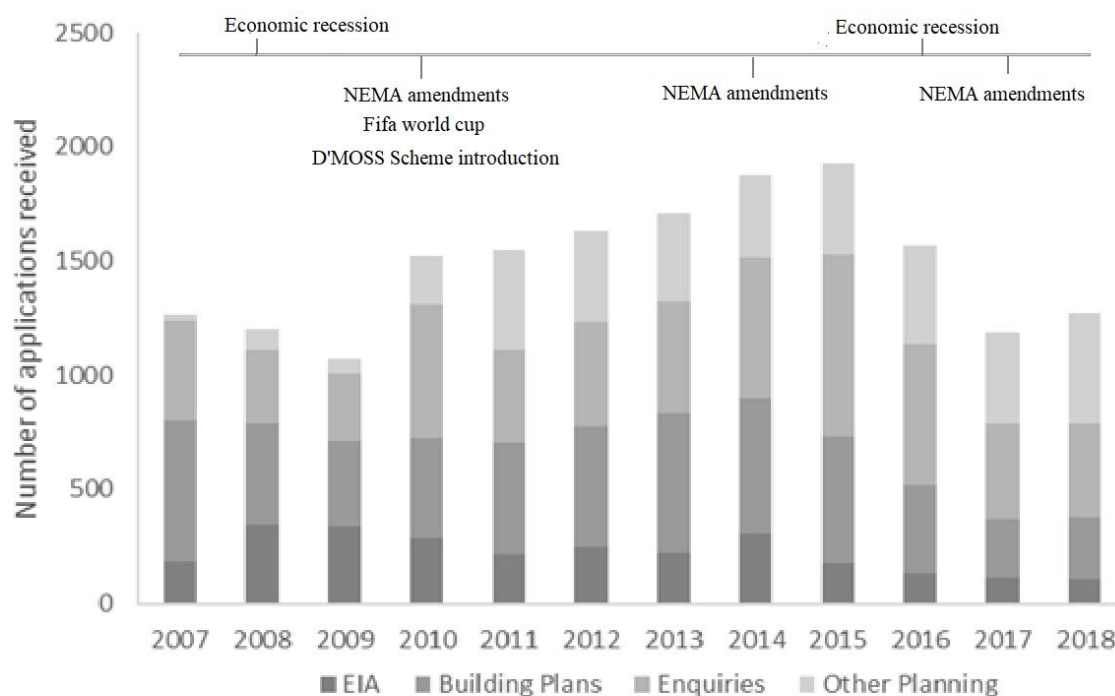
with conditions - these can include: requirements to change the development layout to avoid biodiversity features and associated buffers; the protection of remaining biodiversity features on the affected site through an appropriate protection mechanism (e.g. conservation servitude registered in favour of the municipality against the property title deed or conservation zone) thereby adding to the network of conservation areas in the City (Chapter 3); and/or biodiversity offsets. Biodiversity offsets are, however, considered a last resort, and typically occur following a NEMA process relating to the loss of threatened habitats. (3) Not approved/supported – the loss of threatened vegetation types is not supported by the Department (EThekweni Municipality, 2007) which may lead to an application not being approved. The subdivision of land, where the new proposed land parcel contains threatened vegetation is an example of an application that is typically not approved. Under exceptional circumstances, when applications for important vacant sites are received, the Department may approach the landowner to purchase the land to prevent potential loss and add to the conservation areas network. This was, however, considered a last resort given the relatively small land acquisition budget for the Department (Chapter 3).

Capacity development in key institutional structures has also been important in advancing mainstreaming. The first example related to the inclusion of a registered environmental professional to serve on the Municipal Planning Tribunal that deals with *inter alia* land-use zoning, and given the potential risk of this category of land-use planning application to biodiversity, represents an important example of the institutionalisation in ensuring that biodiversity concerns are considered in this application category. The second example related to the presence of registered professional town planner within the Joint Advisory Committee that provides recommendations on applications across Categories 1-3. This appointment was critical in guiding proactive processes (e.g. the approval of D'MOSS), advancing biodiversity

mainstreaming across spatial planning processes, and ensuring comments relating to biodiversity impacts have been adequately considered.

### *Applications Received by the Department*

Figure 2.3 shows the breakdown of development applications received by the EPCPD over an eleven-year period, totalling approximately 17 000 applications. Over the course of this period only 15 % of the applications received were the result of NEMA Environmental Impact Assessment (EIA) applications. The remaining applications were made up of building plans (33%), enquires (31%), and other planning applications (e.g. rezoning applications, 21%), including municipal infrastructure projects.



**Figure 2.3:** The number of development applications received by the Department from 2007-2018.

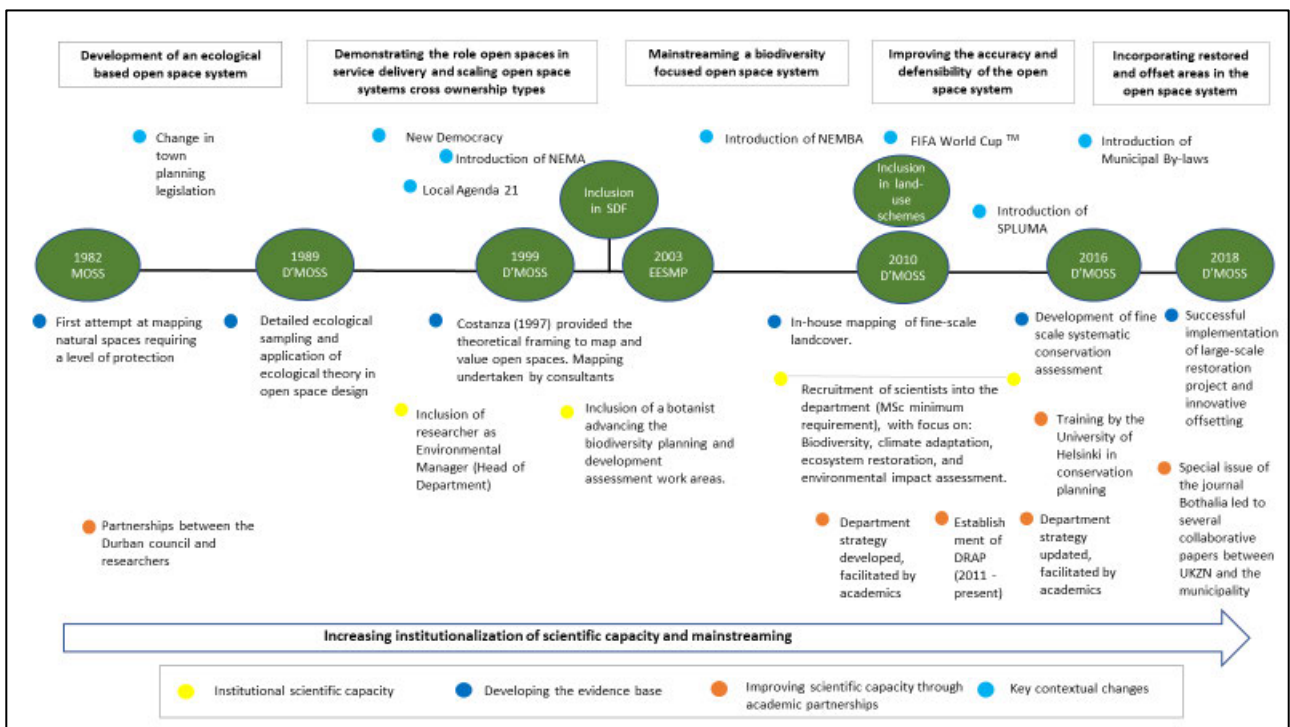
The number of applications received mirrors prevailing economic conditions, indicated by the lower numbers recorded during the economic recessions of 2008/2009 and 2016/2017. Even though the total number of applications received were comparatively low over 2008 and 2009, the impact of the 2010 FIFA World Cup™ is clearly evident in the number of EIAs received in the years preceding this, which were the highest over the eleven-year period.

Policy and legislative changes also influenced the overall numbers. The adoption of D'MOSS as part of the town planning schemes, for instance, played a role in the increase from 2009 to 2010 in total number of applications, particularly with the number of enquiries and other planning applications received over the respective years. The number of EIAs received were also directly related to changes in NEMA regulations, and, in particular, changes to the thresholds for “triggering” NEMA processes. Major changes to the regulations took place in 2010 and 2014, and in both instances the number of EIAs received decreased, which may be related to relaxations of thresholds for certain listed activities (e.g., road construction), and the exemption of certain listed activities (e.g., pipelines transporting water, sewage and storm water) within urban areas (Havenga, 2018). The inclusion of D'MOSS within schemes in 2010 has provided a necessary safety net in assessing impact that no longer meet thresholds triggering NEMA processes, and ensuring important biodiversity features were not being compromised by “death by a thousand cuts” as a result of the cumulative impact of small scale development applications (Boon et al., 2016).

## **2.5 Discussion**

This paper documents the evolution of Durban’s open space planning over the past 40 years and contributes to addressing the paucity of research in this field from countries of the Global

South (Pauleit et al., 2021; Wilkinson et al., 2013). Through the analytical frameworks there is evidence of the advancement of mainstreaming biodiversity concerns within local government processes, institutional functions, and land-use decision making. This has been achieved through effective and sustained leadership; the use of science and scientific information in advancing the policy and legislative environment, and building political support by responding to shifting governance contexts; investment in institutional scientific capacity, and generating scale appropriate biodiversity information (Figure 2.4). These are areas, which are typically seen as barriers to implementing urban biodiversity planning ((Shih et al., 2020), where Durban’s biodiversity function has invested sustained resources, and displayed innovation in addressing challenges.



**Figure 2.4:** The role of science in the evolution of open space planning in Durban (see Results for details)

It took almost three decades from the origin of D'MOSS to have it fully embedded within town planning schemes, supporting the view that the time-consuming nature of mainstreaming biodiversity and land-use policy implementation are often not fully appreciated (Allred et al., 2021; Wilkinson et al., 2013). The number of D'MOSS iterations produced during this period further emphasised that effective mainstreaming cannot be achieved through generation of a single product (Manuel et al., 2016), but requires that policy capacity be maintained and evolve over time (Wellstead et al., 2011). This responsibility often falls to individuals/departments to champion the biodiversity cause at a local level (Nilon et al., 2017). While several champions and key actors have been emerged through the different iterations of open space plans, the role of the researcher that contributed to the 1989 iteration of D'MOSS and subsequent Head of Department has been important in driving strategic direction of the function, elevating Durban's environmental profile (Shih & Mabon, 2018), ensuring the preservation of institutional memory, and providing leadership continuity.

An important component of local government leadership/champions is the ability to identify opportunities for policy advancement and linking to the political agenda to ensure continuity (Shih et al., 2020). This has been clearly demonstrated in the 'conceptual flexibility' applied to the shifting social, economic, and political pressures. This "conceptual flexibility" would emerge as a constant through the evolution of open space planning in Durban. Drawing on findings from another city, the City of Melbourne has demonstrated significant policy advancement in mainstreaming biodiversity concerns through the intentional transition from a "Urban Forestry" to "Urban Nature" policy agenda (Bush et al., 2023). These shifts in focus reflect the changing global discourse of the time, while supporting the premise that conservation actions, and particularly in an urban setting, operate within a social-ecological system that requires continual adaptation to changing contexts (Gavin et al., 2018). In the case

of Durban, these shifts in focus were an intentional move to reinforce the open space system as an asset directly tied to service delivery, which is often not adequately recognised by developing cities (Cilliers et al., 2013). Furthermore, consistent messaging aligned with prevalent global environmental discourse of the time served to educate officials and politicians, thereby creating familiarity with concepts that could otherwise be a barrier to implementation (Stokes et al., 2010). An example of this is the recognition of D'MOSS as key climate adaptation response within Durban's Climate Change Strategy (Roberts et al., 2012)

A common theme that emerged across the open space planning iterations and was clearly used to foster institutional and political support, was the ability to demonstrate land-use efficiency in open space plan design. This was achieved through: (1) trade-offs in municipal owned land parcels in the 1989 iteration that was able demonstrate financial sustainability of the proposed plan. In a resource constrained environment, land trading to maximise biodiversity conservation is often inevitable (Di Minin & Moilanen, 2014), and understanding the full suite of costs in the design of a habitat network is essential to ensure cost-effective allocation of resources for biodiversity conservation (Drechsler, 2011). (2) The quantification of areas within the open space plans considered to be undevelopable was important in demonstrating efficiency when open space planning shifted from an envisaged network of municipal owned land to a development control layer across ownership types (Director Parks Beaches and Recreation Department, 1989; EMB, 1999). These type of synergistic land-use approaches are prevalent in ecosystem based adaptation approaches to disaster risk reduction (McVittie et al., 2018), and the identification of co-benefits helps build support amongst stakeholders and decision-makers (Alves et al., 2018). These are areas that also represent opportunities for future conservation area expansion (Chapter 4) (3) Finally, the adoption of systematic conservation planning as a primary methodology informing open space design provided an important

communication tool within the City, as land-use efficiency (or complementarity) is a central component of the method (Margules & Pressey, 2000), which had been adopted and applied extensively within the conservation agencies of the country (Botts et al., 2020).

The lack of institutional capacity represents the most cited barrier to mainstreaming biodiversity considerations into land-use planning (Elmqvist et al., 2013; Manuel et al., 2016; McDonald et al., 2018; Wilkinson et al., 2013), and particularly in the development of techno-scientific knowledge and the ability to apply this knowledge within the policy landscape (Shih et al., 2020). Central to the success of environmental policy at the local level is that it is grounded in science (Ives et al., 2010) as demonstrated in the City of Cape Town (Holmes et al., 2012) The evidence-based nature of Durban's open space plan design, made possible by the recruitment of technically capable staff with scientific training, has contributed towards gaining approval, institutionalisation of biodiversity concerns, and integration within development processes. The role of academics, and more specifically the University of KwaZulu-Natal, has also been important at various points in assisting in scientific capacity development, knowledge generation and ensuring that strategic direction is in line with global thinking of the time (Cockburn et al., 2016).

Importantly, as a result of the improved institutional scientific capacity, ecosystem mapping has been undertaken at scale that is appropriate for urban planning (i.e. relevant at the individual property level) (Aronson et al., 2017). This is seemingly an underappreciated aspect of urban conservation planning, but, as has been highlighted in the case of threatened grassland system (Boon et al., 2016), represents an important innovation towards achieving biodiversity targets and preventing loss through development assessment processes. Similarly, in a review focusing on the use of biodiversity data in spatial planning and impact assessment within the European Union, scale of biodiversity data supplied through online data portals was highlighted

as a challenge for practitioners operating in this field (Underwood et al., 2018). Most cities that have local level biodiversity data are reliant on rapid and cost-effective habitat mapping as surrogates for biodiversity (Boykin et al., 2021; Nilon et al., 2017), but see (Bux et al., 2021; Holmes et al., 2012) ((Kendal et al., 2017) as outliers with more comprehensive data informed conservation planning. We certainly support the use of habitat maps as surrogates for biodiversity as an interim approach for cities with limited resources as it *inter alia* provides a data foundation that can immediately interact with urban spatial planning and land-use management. The caveat for this approach, however, is that habitat maps can be poor surrogates for certain species (Grantham et al., 2008) and taxonomic groups (Bräuniger et al., 2010), and requires interrogation and adaptation over time (Di Minin & Moilanen, 2014). Effective sustainable environmental decision-making requires investment in appropriate resolution environmental data (Underwood et al., 2018).

The greater focus on implementation of conservation plans in South Africa has resulted in increasing recognition of the importance of fine-scale plans (Botts et al., 2019), which is a welcome response in an attempt to addressing aspects of the ‘implementation gap’ that is prevalent in the conservation planning field (Knight et al., 2008). Key to closing this gap has been the evolving national legal framework (see NEMA, NEMBA and SPLUMA) that has advanced biodiversity mainstreaming at the local level, compelling local level political support, and moving biodiversity planning at the local level from a voluntary endeavour to an auditable legal requirement. Based on experiences from Durban, key spatial outputs such as the national vegetation maps (Dayaram et al., 2019) that are linked directly to land-use legislation (Botts et al., 2020) have advanced biodiversity mainstreaming, but require adaptation to ensure effectiveness at the local level (Adams et al., 2019). Adaptative design in conservation planning requires both scaling down and scaling up processes (Pressey et al., 2013). This paper has

highlighted the value of fine-scale data in land-use planning processes, and given the significant impact that listing of threatened ecosystems has had on development assessment (Botts et al., 2020), there is a risk that coarse data will lead to poor biodiversity outcomes. Focused attention on accurate delineation of threatened ecosystems is required, or whether a more aggregated approach to vegetation classification in certain biomes/regions could promote a better biodiversity outcome (De Cáceres et al., 2018). The second recommendation relates to ‘scaling up’, as there is a clear need for the creation of a platform for local governments to engage with mandated provincial and national conservation authorities to effectively integrate fine-scale data into national products, while acknowledging the constraints associated with balancing standardisation with innovation (Botts et al., 2019). This iterative and responsive approach represents a key component of transitioning from regional scale to local action (Pressey et al., 2013), and supporting vertical integration across the spheres of government that is essential for effective land governance (DFFE, 2023; Huang et al., 2018).

Building capacity in the application of biodiversity information in the context of land-use planning processes by local government officials is also important as decisions can have a major impact on biodiversity outcomes (Allred et al., 2021). This has been advanced by the in-house generation of biodiversity data and conservation planning products, thereby strengthening the link between conservation planning and implementation (Roux & Nel, 2013). An important intervention, however, was the recruitment of individuals with training in environmental sciences who were able to use this information within development assessment processes. In a study of six municipalities in the Eastern Cape (South Africa), capacity constraints in small and intermediate municipalities, highlighted the risk of EIA requirements for certain projects going unnoticed (Wilhelm-Rechmann & Cowling, 2013). The development of screening processes and active engagement in the development assessment space, as

demonstrated in this paper, has contributed to slowing the rate of biodiversity loss in Durban, and, in some cases, even contributed to active protection of sites (Chapter 3). Measuring impact of conservation practises, however, is challenging (Baylis et al., 2016) and especially so in measuring avoided-loss (Manuel et al., 2016). Despite these challenges, further research is required to advance our understanding of the impact these professionals have in reducing biodiversity loss in Durban. These data are essential for identifying areas of future focus, including the need for the refinement of existing tools or the creation of new ones. In this regard, and given the ongoing pressure for large-scale development, an offset policy for Durban needs to be considered to address inconsistencies in adherence to established offset principles (Brownlie et al., 2017; Nkosi, 2021).

Addressing the planning-implementation gap in conservation planning field (Knight et al., 2008) requires, *inter alia*, a receptive institutional setting and associated tools for integrating conservation planning products (Watson et al., 2011). Institutional positioning of the Department under the Unit responsible for spatial planning and land-use management has allowed for greater capacity development, policy and legislative advancement, and mainstreaming of biodiversity concerns. An example was the inclusion of town planner within a biodiversity focused department, who was able to navigate planning regulations and process requirements in the transition of D'MOSS from policy to legislation, and supporting the position that multidisciplinary approaches are essential in achieving biodiversity conservation outcomes (Dick et al., 2016). In a comparison between the approaches taken between Cape Town and Durban in conservation plan implementation, the institutional positioning of Durban's environmental function under the Spatial Planning Division was identified as a key factor in the effectiveness of land-use planning interventions (Bux et al., 2021). As demonstrated in this paper, the importance of institutional positioning, however, extends

beyond land-use integration, and includes access to, and influence on, land-use decision making processes. This type of horizontal integration is vital to ensure continued mainstreaming of biodiversity within decision making, and an essential component of effective governance within a dynamic socio-ecological system (Cormier et al., 2019). In a comparison between intermediate sized and metropolitan municipalities, it was shown that, despite conservation maps being present within the SDFs of intermediate sized municipalities, land-user planners did not consider them in routine work and environmental officers present in the same organisation were typically not included (Wilhelm-Rechmann & Cowling, 2013). These types of inconsistencies are prevalent across local governments in South Africa and other countries (Ahmed & Puppim de Oliveira, 2017; Makhuvha, 2020; Shih et al., 2020), and represent a significant threat to biodiversity and envisaged mainstreaming. Identifying opportunities to mitigate inconsistencies is important, as has been highlighted by the inclusion of a registered environmental professional as part of the Municipal Planning Tribunal, which represents a minor but potentially influential governance response.

In conclusion, this paper demonstrates the important role a local government can play in addressing the biodiversity crisis through land-use planning, and that effective mainstreaming requires considerable, focused effort and resourcing that needs to be sustained over time. This case study may be valuable to other local governments, particularly those situated in similar socio-ecological contexts. It is hoped that case studies like these, and the lessons learnt, will promote more rapid and effective mainstreaming in other local governments. Science has been a central actor in the evolution of D'MOSS and the responsiveness to contextual changes, and there is a need for this to remain the case, especially in the face of a changing climate and urbanisation pressures (Knapp et al., 2021). Ecological processes will be altered, and greater reliance on natural assets to mitigate extreme natural events will be required (Beierkuhnlein,

2021). Given the complexities of this urban-biodiversity nexus, the transdisciplinary nature of the DRAP programme represents an important vehicle to identify the next conceptual shifts and ensure the D'MOSS remains fit-for purpose.

## 2.6 References

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## CHAPTER 3

### **Local Government Response to Urban Biodiversity Conservation Challenges within a Global Biodiversity Hotspot**

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### **3.1 Abstract**

The post 2020 Global Biodiversity Framework advocates for a whole-of-government and whole-of-society approach to address the global biodiversity crisis, with increasing calls for local governments to play a more active role in biodiversity conservation. We present a local government led examination of tools aimed at increasing biodiversity protection, management, and ecosystem restoration in the City of Durban, South Africa, located in a global biodiversity hotspot. Using analytical frameworks and local government data, we assessed the efficacy of tools applied, and identified barriers and potential enablers to improve conservation outcomes. We confirmed areas of success in the development of fit-for-purpose town planning tools that have contributed towards avoided loss of biodiversity, and the implementation of tools that have increased the protection of important biodiversity sites. Development of land management and restoration functions have further advanced conservation outcomes through restored ecological processes, and improved management of threats. Despite positive contributions to biodiversity conservation, several challenges persist, including unequal biodiversity protection and investment in relation to local population socio-economic status, cross-sectorial barriers, governance silos, and inadequate incentives for protection and management. Increasing biodiversity conservation on landholdings under traditional and private land tenure represents an important next step for the City. Upscaling of successful management tools, improving financial incentives for landowners, and adopting a more community centred approach to conservation governance, represent key opportunities for the City. We emphasise the important role that a local government can play in contributing towards broader biodiversity goals and identify opportunities and challenges in the development and application of biodiversity conservation tools at the local government scale, through the lenses of governance, equity and justice, and inclusivity.

Keywords: urban biodiversity, conservation expansion, local government, ecological management, Durban

### **3.2 Introduction**

The world is facing a triple planetary crisis of biodiversity loss, climate change, and pollution (UNEP, 2024). Urbanisation represents a key driver of this global polycrisis (Güneralp et al., 2020; UNEP, 2024), leading to increased attention on the role of cities and local governments in addressing environmental sustainability (Bulkeley et al., 2021). Previous global biodiversity targets have not been met (Maxwell et al., 2020), and transformative change is required to alter negative trajectories (Gupta et al., 2024). Effective and integrated governance arrangements, as well as the role of cities and local government, feature prominently in the *possible actions and pathways to achieve transformative change* (IPBES, 2019) and Target 12 of the post 2020 Global Biodiversity Framework that aims to *Enhance Green Spaces and Urban Planning for Human Well-Being and Biodiversity* (UN, 2022). This call to action is particularly relevant to those cities that are within biodiversity priority areas, as failure to effectively deal with the threats of urbanisation in these areas will increase extinction rates and directly impact ambitious global biodiversity goals (McDonald et al., 2018). Average population densities within Global biodiversity hotspots have also increased at twice the rate relative to the rest of the world for the period of 1995-2015 (Cunningham & Beazley, 2018), further emphasising the need for urgent intervention.

Rarely have cities and their local governments been acknowledged as significant contributors to actively increasing the conservation area estate, and, thereby, contributing towards broader conservation targets (Soanes et al., 2019). There are various reasons for this, such as governance mandates for biodiversity typically positioned at provincial/regional and national

government levels (Nilon et al., 2017), but at the core is the idea that urban is the antithesis of natural, and should be avoided due to potential direct and indirect threat of transformation (Soanes & Lentini, 2019). This is often reflected in conservation planning approaches, and subsequent policies and protected area expansion strategies, which typically promote the selection of larger vegetation units at the expense of fragmented patches (Tulloch et al., 2016). The problem with avoiding cities, and particularly those within biodiversity hotspots, is that these areas often harbour significant threatened biodiversity (Ives et al., 2016), and, contrary to traditional conservation planning approaches, the importance of small habitat patches to global conservation efforts has been shown to be so important that failure to incorporate these areas in conservation area expansion strategies will result in significant biodiversity loss (Wintle et al., 2019). It is also clear that realising conservation opportunities will be essential to build resilience in response to the global polycrisis, and to achieve area-based targets (Pörtner et al., 2022; UNEP, 2024; UN, 2022). Furthermore, the avoidance of urban areas for achieving biodiversity outcomes does not adequately account for direct local benefit associated with access to biodiversity, and value derived from avoided service delivery costs (Bulkeley et al., 2021; IPBES, 2019).

Biodiversity conservation in fragmented urban landscapes is not limited to land protection, but requires management interventions to ensure ecological processes are maintained (e.g. fire management in grassland systems) and that additional threats to biodiversity are adequately addressed (e.g. combatting invasive alien species and preventing over-exploitation of natural resources) (Ramalho et al., 2014). Despite these challenges, urban areas often represent ideal settings for conservation activities in terms of conserving biodiversity, while allowing people to actively engage with nature (Soanes & Lentini, 2019), with all the benefits that brings (Tomita et al., 2017). Cities and local government are also defined by a service delivery

mandate (e.g. land-use planning, water supply, sanitation, stormwater control), and, given the strong relationship between biodiversity and the supply of ecosystem services and human well-being (Elmqvist et al., 2013; Gupta et al., 2024; IPBES, 2019), should represent a central component of local government planning. This is particularly relevant to developing cities, where investment in, and protection of, urban green infrastructure offers opportunities to aid in cost-effective service delivery and contribute to the alleviation of the socio-economic challenges facing these cities (Lindley et al., 2018).

The City of Durban, South Africa, located in the middle of the Maputaland-Pondoland-Albany (MPA) biodiversity hotspot, is one of 33 global biodiversity hotspot cities that, given their relative size and rate of expansion, have a particular responsibility in ensuring the protection of globally significant and threatened assets (Weller et al., 2017). The City of Durban and its partners, have addressed biodiversity concerns over the past four decades, developing several tools for biodiversity protection, management, and restoration.

This paper, through an analysis of tools applied by the City of Durban and its partners to protect and manage biodiversity, aims to:

- 1) Illustrate how a local government can contribute to broader conservation goals;
- 2) Assess the efficacy of the tools applied in biodiversity protection, management, and restoration; and
- 3) Identify priority future action and enablers required to improve conservation outcomes.

To address these questions, we used analytical frameworks to assess the tools applied in the protection of biodiversity features, and the tools applied in the management and restoration of these areas. These frameworks are supported and supplemented by additional local level data.

### 3.3 Methods

#### 3.3.1 Location and context

The 2 566 km<sup>2</sup> City of Durban is administered by the eThekweni Municipality in the province of KwaZulu-Natal (KZN), South Africa (McLean et al., 2020). The variety of landforms and climatic conditions in the eThekweni Municipal Area (EMA), as well as its unique biogeographical position, in the centre of the Maputaland-Pondoland-Albany global biodiversity hotspot (Mittermeier et al., 2005), has resulted in a wide range of terrestrial and aquatic ecosystems that are home to a rich diversity of organisms (Boon et al., 2016).

With 4.1 million people, Durban is the third largest metropolitan by population in South Africa, representing more than a third of the provincial population in an area that is less than 3% of the provincial total (EThekweni Municipality, 2022). The result is that Durban's rich natural environment has been under significant pressure and negatively impacted over the past 150 years, initially by extensive agriculture, and then, increasingly, by rapid urbanisation, resulting in the cover of the original vegetation types being reduced by approximately two-thirds (Boon et al., 2016). Rates of loss of natural habitat are particularly high in KwaZulu-Natal, averaging 1.2% per annum between 1994 and 2011, and likely to be substantially higher in the more densely populated Durban (Jewitt et al., 2015). The municipality accommodates a variety of land-uses, with 32% of the municipal area considered to be urban (e.g. residential, commercial and industrial) located largely to the East and along the major national transport routes (N2 and N3 highways) (EThekweni Municipality, 2022). Approximately 68% of the municipality is classified as rural, although this does include pockets of dense settlement, and commercial farms (approximately 10% of the rural area) located mainly in the western hinterland (EThekweni Municipality, 2022). Much of this rural landscape falls within traditional authority areas (hereafter referred to TAAs) administered by the Ingonyama Trust Board, that is held in

trust for the Zulu people with the Zulu King as the sole trustee (Nel, 2021). This creates a unique and complex dual governance system, where the municipality is responsible for land-use planning and management in terms of the land-use scheme for the entire area, but only has formal authority in non-TAAs (EThekwini Municipality, 2022).

The socio-economic context of Durban, with a high degree inequality (Gini co-efficient = 0.62) and more than a third of the population living below the poverty line (EThekwini Municipality, 2022), further exacerbates pressure, through growing informality and reliance on reducing natural resources (EThekwini Municipality, 2020). In addition, the availability of land to support development is limited by, *inter alia*, the steep topography that characterises the City, placing additional pressure on threatened habitats types (e.g. grassland systems) that are typically associated with the flatter, more ‘developable’ areas (EThekwini Municipality, 2020).

### 3.3.2 Approach

Insights detailed in the paper are based on 40 years of experience in the field of local government biodiversity conservation. This case study, and the associated analytical frameworks, have been used to generate understanding of local impacts and outcomes, and this understanding is then generalised beyond the local. This approach is supported by literature (Flyvbjerg, 2011; Steinberg, 2015; Tsang, 2014), with process tracing representing an important approach in providing evidence to support assertions, with theoretical implications that may extend beyond the boundaries of the case study, and being comparable to large N-methodologies in generalisability (Steinberg, 2015). Two analytical frameworks were produced for the: (1) biodiversity protection tools; and (2) management and restoration tools applied to protect and manage important biodiversity areas. These two frameworks, through

thematic and content analysis, identified: (1) key policies/legislation enabling the tool (2) how the tool was applied; (3) outcome in terms of protection and management; (4) strengths of the respective tools; (5) weaknesses of the respective tools; and (6) next steps required for improvement and opportunities to scale these tools.

A third analytical framework, based on comparative and content analysis, was applied across all the tools assessed and categorised in term of: (1) impact on policy and practice – tool ranking based on measurable biodiversity conservation outcomes and operational continuity; (2) contribution to socio-economic development- tool ranking based on success in creating green jobs, supporting local economies, and fostering community involvement; and (3) suitability for implementation within TAAs. Tools were ranked based on a combination of measurable biodiversity outcomes and operational continuity of the tool. Based on this assessment each tool was ranked in terms of performance relative to the three criteria (Green/High = 5, Orange/Moderate = 3, Red/Low = 1), and represented graphically. Total cumulative scores for the three criteria were calculated to contrast the effectiveness of the current toolset.

Datasets that were used in highlighting the impact and relative success of these tools have been drawn from various municipal GIS databases and reporting tools, including: (1) Durban's State of Biodiversity reporting (EThekweni Municipality, 2024a); (2) Durban's Systematic Conservation Assessment (McLean et al., 2020); (3) Durban's Strategic Environmental Assessment (EThekweni Municipality, 2020); and (4) the Biodiversity Management Department's environmental information network, viz: development applications; conservation areas; land acquisition; environmental zones (EThekweni Municipality, 2023).

## **3.4 Results**

### 3.4.1 Biodiversity protection

Table 3.1 provides an analysis of the tools applied in biodiversity protection using the analytical frameworks. The patterns are summarised below

**Table 3.1:** Analytical framework describing the local government tools used in the protection of biodiversity within Durban

Tools Applied	Policy Environment	Contribution to Biodiversity Protection	Outcome	Strengths	Weaknesses	Next Steps/Opportunities
<b>Durban Metropolitan Open Space System</b>	Municipal Planning is a function assigned to municipalities (RSA Constitution: Section 156, schedule 4B). The Spatial Planning and Land Use Management Act no. 16 of 2013 (SPLUMA), and eThekweni Municipality Spatial Planning and Land Use Management Bylaw, 2016 provide the legal context for implementation.	As a result of the inclusion of D'MOSS in the Municipality's scheme provisions as a development assessment overlay, any planning application for a site included in or immediately adjacent to D'MOSS must be assessed and approval by the Biodiversity Management Department.	The entire system is 95 000 ha, and includes threatened ecosystems, Critical Biodiversity Areas, and other features of potential significance in terms of biodiversity, and the delivery of ecosystem services. Over 17000 applications received and assessed over the period 2007-2018 (Chapter 2). 358 ha of registered conservation servitudes.	Ensures that environmental considerations are considered during development assessment processes.  Acts as a safety net for development processes that may not 'trigger' assessment based on national environmental legislation thresholds	Limited effectiveness within traditional authority areas (TAAs),	Integration with national development assessment products and processes to ensure an additional level of oversight from national and provincial conservation authorities.  Work towards an integrated land-use planning approach within TAAs, with greater adherence to municipal planning schemes.  Registration of outstanding Conservation Servitudes.

<b>Strategic Environmental Assessment</b>	<p>The Spatial Planning and Land Use Management Act no. 16 of 2013 (SPLUMA), and Local Government: Municipal Planning and Performance Management Regulations (2001), promulgated in terms of the Municipal Systems Act (Act No 32 of 2000), provides the legal framework for strategic analysis of Strategic Development Frameworks (SDF)*.</p>	<p>The tool analyses the City's environmental performance at the most strategic spatial planning level and provides an analysis of the City's performance relative to conservation targets and avoided biodiversity loss.</p>	<p>The most comprehensive review of the state of Durban's natural systems to date. Highlighting the significant challenge in meeting conservation targets for the City.</p>	<p>Analysis of the SDF promotes engagement across several municipal line functions with competing spatial ambitions.</p> <p>Opportunity to engage with City leadership regarding the state of biodiversity within Durban.</p>	<p>Current product has yet to integrate future socio-economic considerations in the assessment of strategic environmental impact.</p>	<p>Phase two of the SEA will require the development of socio-economic scenarios that will be used to determine possible implications for the achievement of established sustainability thresholds in Durban and which will be used to assess options for future urban form and development trajectories.</p>
<b>Lower Order Spatial Planning</b>	<p>First stage of implementation of the Integrated Development Plan (IDP)* and SDF. The Spatial Planning and Land Use Management Act (no. 16 of 2013) required that municipalities have "wall to wall" coverage of the municipal area with a land use management system (i.e., Municipal land-use scheme).</p>	<p>As the bridge between strategic planning and land-use schemes these processes provide opportunity to refine information, and, in some cases, reinforce protection of natural assets.</p>	<p>Refinement of environmental layers that inform land-use planning, and particularly the inclusion of important conservation worthy areas as primary land-uses in newly formed schemes.</p>	<p>Provides a platform for line functions with often competing spatial plans to engage in detailed collaborative planning in administratively defined areas.</p> <p>Opportunities to ensure that biodiversity information is confirmed through more detailed studies.</p>	<p>Translation of these planning products into land-use schemes can lack the land-use controls required for biodiversity protection.</p>	<p>Limited opportunities to change primary land-use due to the presence of already existing wall-to-wall schemes; however, significant opportunity to undertake conservation planning at a precinct level and promote conservation area expansion at a practical level.</p>

<p><b>Conservation Zone</b></p>	<p>A Conservation Zone is land (other than publicly owned land) dedicated to the conservation and management of natural areas of land and/or water for the ecosystem services that the areas provide, biodiversity that they support, and/or their landscape, historic or scientific interest values.</p>	<p>Introduces land-use controls on private land parcels that prevents transformation of the natural asset. Intended to be applied on privately owned land, and envisioned primarily for split zoning of properties, where the environmental feature is protected while the remaining area has a development type land-use.</p>	<p>This tool has been sparingly used since the initial large-scale split-zoning of properties surrounding key areas in the Outer West Planning Region. Ultimately this process was rescinded due to a procedural error in the advertising of the scheme amendment.</p>	<p>Provides clear land-use direction on private land via split-zoning of property. Cost effective in comparison to servitudes, and less reliant on landowners for implementation.</p>	<p>Large-scale split zoning remains untested.</p>	<p>A tool with significant promise as a split zone can protect remaining environmental features on individual properties and remove ambiguity regarding available developable footprints.</p> <p>A cost-effective alternative to servitudes (as the landowner would not be required to incur land surveying costs) that may have been required as a result of a development assessment process, but never implemented.</p>
<p><b>Land Acquisition</b></p>	<p>The only annual capital budget item aimed at securing biodiversity in support of Programme 3 of Plan 1 of the IDP which outlines the requirement for ensuring long term sustainability of Durban's natural resource base.</p> <p>Sites acquired are intended to be proclaimed as Nature Reserves or protected Environments in terms of National Environmental Management: Protected Areas Act (No 57 of 2003)</p>	<p>Targeted implementation tool with a particular emphasis on conserving threatened habitats and/or supporting the expansion of existing conservation areas.</p> <p>Transfer of property purchased for conservation purposes from private individuals with possible development aspirations to a local government department.</p>	<p>750 ha of important conservation areas purchased predominantly in support of existing conservation areas or targeted threatened habitats</p>	<p>Provides immediate definitive protection of the biodiversity asset. Ability to target strategic land parcels important for effective conservation area expansion. Limited parties involved in implementation</p>	<p>Limited capital budget available.</p> <p>Process has historically relied on a willing seller to proceed</p>	<p>Move to a three-year approval cycle for property acquisition, and expropriation with compensation as the preferred tool, allows for shorter Supply Chain Management processes, and the ability to take advantage of municipal capital savings</p>

<b>Nature Reserve Proclamation</b>	National Environmental Management: Protected Areas Act (No 57 of 2003)	<p>The conservation gold standard, providing the greatest level of protection to natural assets.</p> <p>Addressing the disjuncture of municipal nature reserves with NEMPAA was priority for the Department, resulting in a joint project with Ezemvelo KZN Wildlife and the City’s Natural Resources Division (NRD) who are directly mandated to undertake management of these reserves.</p>	11 Nature Reserves proclaimed in terms of NEMPA since 2015	<p>Highest level of protection available.</p> <p>Opportunities to secure more resources due to status.</p>	<p>The initial pilot has taken considerable time to reach completion.</p> <p>Distribution of Protected Areas reinforces spatial socio-economic inequality</p>	<p>Primary tool that will be used in consolidating the outcomes of other processes (e.g. land acquired or zoned for conservation purposes.</p> <p>Proclamation of protected areas in poorer areas of the City.</p>
<b>Biodiversity Stewardship</b>	eThekweni Municipality Biodiversity Stewardship Policy (2017) is strongly informed by national and provincial approaches to biodiversity stewardship.	The primary tool used for TAAs, and relies on the development of partnerships with traditional leaders within key biodiversity areas,	Five letters of support from key TAAs	<p>Preferred approach to conservation area expansions at a National and Provincial level, primarily due to the cost-effective nature of the intervention.</p> <p>Empowers landowners to protect and manage land, which reduced the strain on government resources,</p>	<p>Lack of suitable financial incentives to “sell” the concept to landowners.</p> <p>Arrangements within TAAs are complicated by existing governance arrangements where authority would be required from traditional leaders and the Ingonyama Trust Board.</p>	<p>The development of objectives that provide significant economic opportunities is critical for the success of this intervention.</p> <p>Partnerships with key line functions within the City will be important.</p>

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<b>Environmental Rates Certificates</b>	The eThekweni Rates Policy Sections (eThekweni Municipality 2008), provides for landowners to apply for an environmental rates certificate	Conditions for the certificate, and associated rates rebate, include formal protection of the feature via an appropriate zone or servitude and evidence of a management plan.	While there have been a few certificates issued, the lack of clarity on how environmental features are factored into the determination of property rates has been a limiting factor.	In theory, the incentive-based approach provides an ideal solution to promote landowner taking responsibility for driving biodiversity protection and management.	Lack of clarity regarding the approach to rating of properties with environmental features means that it is difficult to effectively implement this project currently.	Greater clarity is required in terms of rating of properties with important environmental features, and linked to this, a requirement to change the rating policy to incentivise landowners to protect these areas
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\* An Integrated Development Plan (IDP) is a key city strategy that informs and guides all service delivery and development in the municipality. A Spatial Development Framework (SDF) guides the overall spatial distribution of current and future land-uses in line with the objectives of the IDP.

### *Avoided Biodiversity loss through spatial and land-use planning*

Avoided loss through mainstreaming biodiversity considerations into spatial and land-use planning initiatives represents possibly the most significant positive impact regarding biodiversity protection in Durban. Central to this effort has been the Durban Metropolitan Open Space System (D'MOSS), integrated within the City's Spatial Development Framework since 2002 and within land-use planning schemes since 2010. The influence of D'MOSS is evident in three areas, viz: (1) mandated assessment of potential biodiversity impacts from proposed developments; (2) integration of biodiversity priorities within strategic spatial planning products and processes; and (3) the requirement for horizontal engagement across municipal functions (Table 3.1).

Influence at the individual property level is evident by the number of applications received for assessment (Table 3.1), and, critically, ensures assessment of developments that do not meet the spatial thresholds for assessment under national and provincial impact assessment processes. Avoided Biodiversity loss outcomes, through conditions outlined in the approval of land-use planning applications, have been achieved through reduced development footprints, outright rejection of inappropriate development, or reconfiguration of development footprints (Chapter 2). Of concern, however, is the relative ineffectiveness of D'MOSS within TAAs, where it is largely ignored in the allocation and development of land (based on customary law in terms of the Traditional and Khoi-San Leadership Act, 2019 Act No. 3 of 2019), an illustration of the land-use planning and management challenges posed by the dual governance system. That only 7% of the total applications received fell within TAAs, despite rapid land-use change in some of these areas, emphasises a governance gap. This disparity in the implementation of D'MOSS regulations represents a significant threat to biodiversity, in

that 55% of D'MOSS, including some of the most critical and connected areas, fall within TAAs.

D'MOSS, as a primary planning layer in spatial planning processes, enables engagement with other municipal functions (e.g., Housing, Water and Sanitation, Roads) to address the implications of potential land-use changes (Table 3.1). A key component of avoided loss in the City is messaging around development constraints due to the presence of important biodiversity features. The development of sustainability thresholds in the first phase of Durban's Strategic Environmental Assessment (EThekweni Municipality, 2020) represents the most recent advancement in this area (Table 3.1), and highlights the very high exceedance of sustainability thresholds for terrestrial and aquatic systems (EThekweni Municipality, 2020), which is in line with recent global findings (Gupta et al., 2024).

Although horizontal integration of biodiversity considerations has been advanced through these tools, translation of spatial planning products to property level conservation outcomes requires further attention (Table 3.1). The Cato Ridge Local Area Plan and Draft Land Use Management Scheme Process (EThekweni Municipality, 2018) represented the most significant process at this scale from a conservation and City planning perspective. This area includes much of the remaining threatened grassland systems in Durban, a key area of focus in terms conservation area expansion programmes, but has also been earmarked for use as a logistics hub and industrial production zone in support of port development plans (EThekweni Municipality, 2018). Through detailed engagement with sectors, and refinement of habitat mapping data, important conservation areas were assigned a proposed conservation zone, representing an important an important conservation outcome (Chapter 2). The translation of the draft scheme through the approved Outer West Scheme has, however, provided a level of

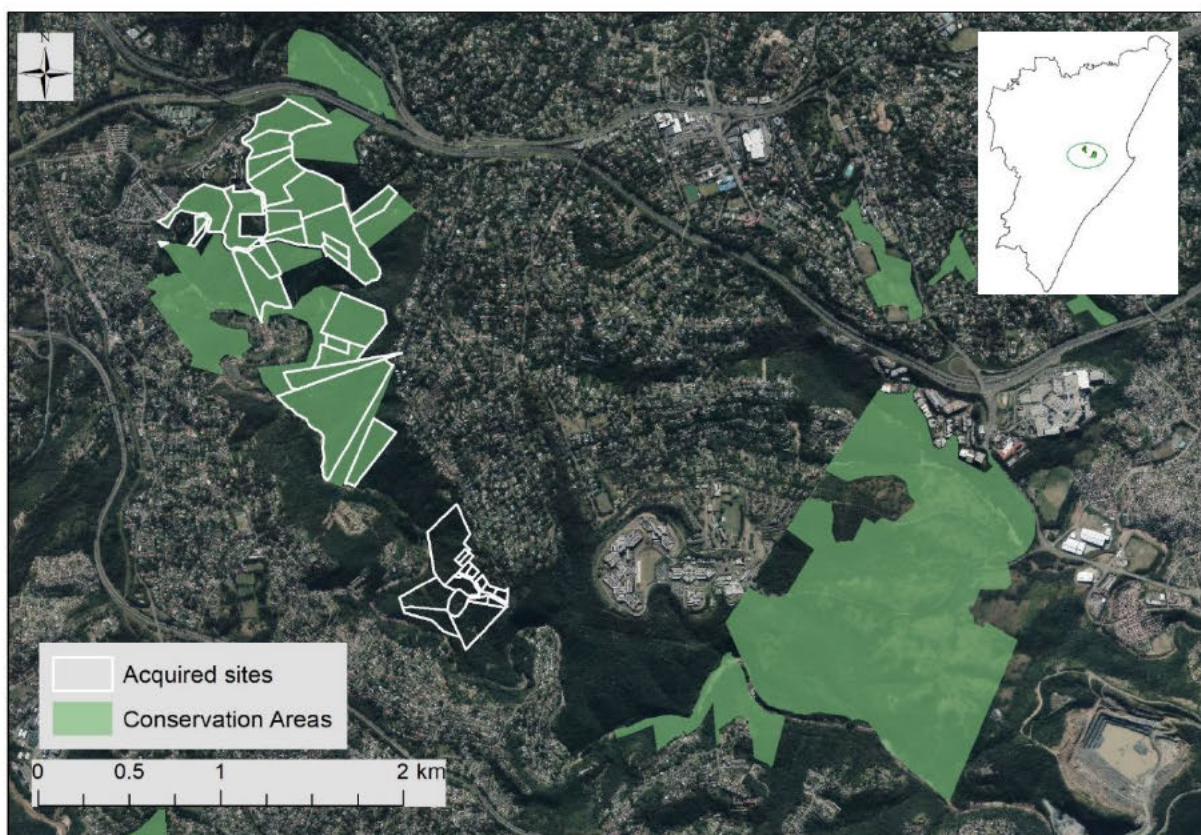
ambiguity as these areas have been grouped into a *Land-Use Management Holding Area* (eThekweni Municipality, 2023). The zone does list conservation as a primary use, however, there are no precluded activities, and all other land-uses are available via special consent, thereby hindering opportunities to advance and ensure conservation outcomes (eThekweni Municipality, 2023).

Improving the translation of hierarchical and broad-scale spatial plans to definite land-uses, development of socio-economic scenarios to assess ecological thresholds against options for future urban form, and developing a more integrated land-use planning system in TAAs, represent opportunities to further avoided loss outcomes using spatial planning tools (Table 3.1). To compliment these horizontal integration interventions, additional benefit can be delivered by focusing on vertical integration opportunities created by national policy advancements. Greater alignment of threatened vegetation mapping across government scales represents an important opportunity to improve avoided loss outcomes in Durban (Table 3.1), particularly for threatened vegetation types that have more stringent requirements in environmental assessment processes (Botts et al., 2020).

#### *Increasing the conservation estate through traditional tools*

Several proactive tools have been tested and applied in an attempt to increase formal biodiversity protection within Durban, which currently represents 7.16 % of D'MOSS or 2.73 % of the total municipal area (EThekweni Municipality, 2024a). There have been notable achievements with certain tools, including the land acquisition project which has contributed to the protection of Critically Endangered KwaZulu-Natal Sandstone Sourveld grassland (Table 3.1), where more of the habitat has been conserved through local government interventions than by national and provincial biodiversity authorities (Boon et al., 2016). A

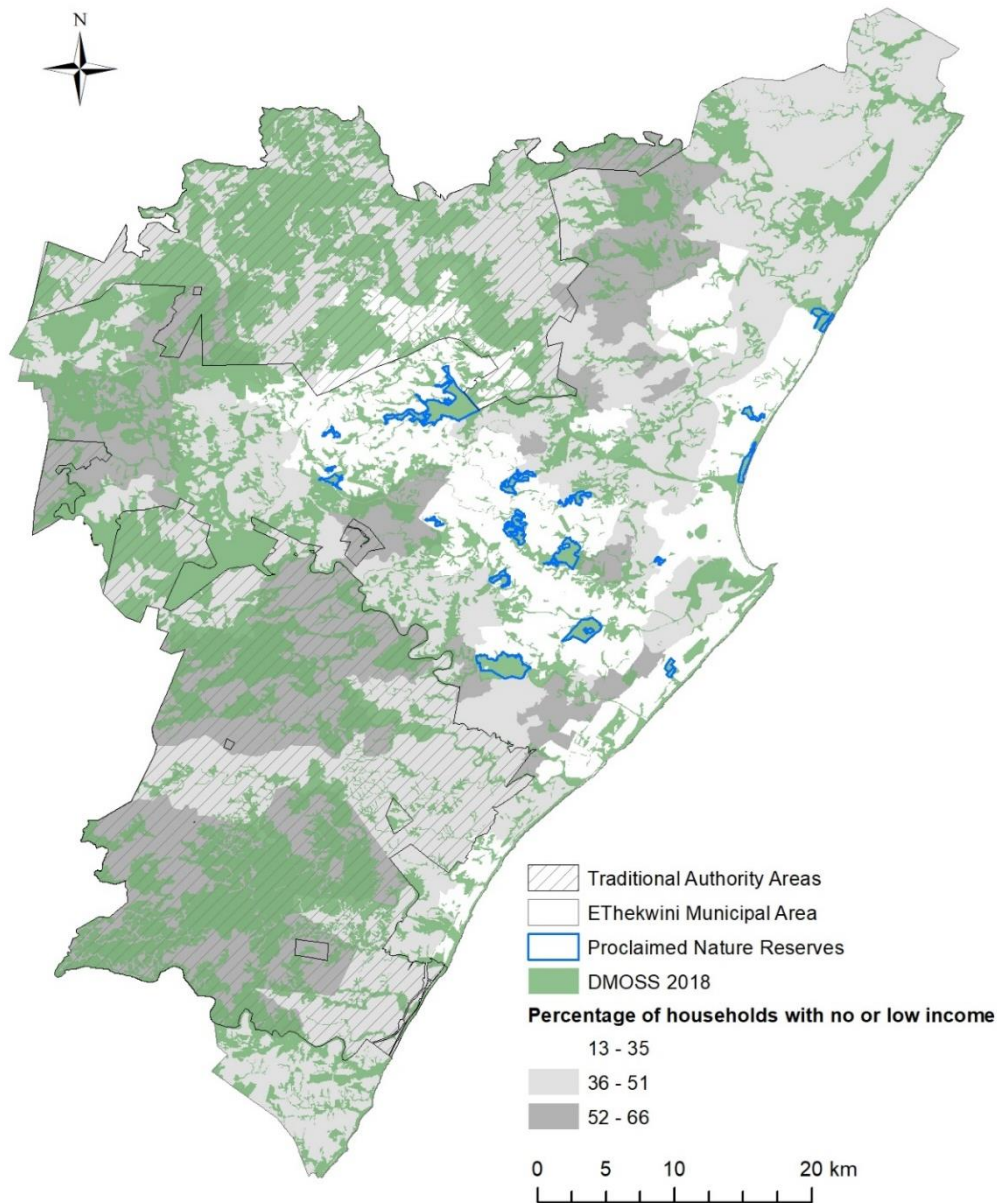
major emphasis of the programme, particularly during its first decade, was acquiring sites near existing conservation areas. A total of 133 (79 %) of the acquired sites were situated within two kilometres of an existing conservation areas, with the ultimate intention of proclaiming many of the sites to enlarge an existing nature reserve. Figure 3.1 shows the important contribution made by the land acquisition programme in consolidating the now proclaimed Paradise Valley Nature Reserve, and the progress made in securing the ecological corridor between the Paradise Valley and Roosefontein Nature Reserves. The identification of



**Figure 3.1:** Conservation area expansion through targeted land acquisition within the Paradise Valley – Roosefontein corridor to promote connectivity between the conservation areas and the protection of biodiversity features. Green areas with white outlines indicate land that has been acquired and proclaimed as part of the nature reserve, while areas with only white outlines indicates land that has been acquired for conservation purposes and has yet to be formally proclaimed as part of the nature reserve. Inset indicates the proximity of these sites withing the eThekweni Municipality.

sites for acquisition has been based on several important objectives, with protection of intact and threatened ecosystems representing a particular focus. A total of 128 (76 %) of the acquired properties contain vegetation types considered to be threatened (Vulnerable, Endangered or Critically Endangered), with the protection of Least Threatened vegetation types (e.g. Eastern Scarp Forest) more typically associated with the expansion or consolidation of existing conservation areas (e.g. towards the protection of ecological corridors as per Figure 3.1).

Durban has also been successful over the past decade in enhancing biodiversity protection through traditional protected area expansion and the proclamation of nature reserves (Table 3.1), which has improved the legal protection of sites, demonstrating that this type of protection can be effectively led by organisations aside from provincial and national conservation authorities. The current distribution of proclaimed nature reserves relative to the percentage of households with no or low income (categorised as per (Statistics South Africa, 2015)), a symptom of past apartheid planning, illustrates the greater access that wealthier communities have to proclaimed nature reserves and all the benefits associated with the services that these areas provide (Figure 3.2). These reserves, many of which have only recently been proclaimed, are largely associated with the older established suburbs of Durban.



**Figure 3.2:** Distribution of proclaimed nature reserves relative to the percentage of households that have no/low household income (Statistics South Africa 2015), and the distribution of traditional authority areas and the Durban Metropolitan Open Space System (Data sources: Statistics South Africa, eThekweni Municipality’s GIS repository).

Supporting the land acquisition programmes, and in alignment with local government’s core mandate of land-use planning, has been the design of fit-for-purpose land-use zones in Durban. The Environmental Conservation Reserve (ECR) has, to date, largely been used to

provide appropriate protection for land owned by the municipality for conservation purposes (Table 3.1). Historic Public Open Space (POS) zoning attached to many of the municipal nature reserve sites was considered particularly problematic as permitted activities were not compatible with conservation objectives. ECR has largely addressed this issue, however, smaller sites of conservation significance still have POS as the underlying zoning. In addition, amalgamation of several local councils into a metropolitan municipality (EMB, 1999) led to several historical land-use zones with land-uses seemingly consistent with conservation objectives (e.g. Bush Reserve and River Reserve). The ECR zone provides a vehicle to consolidate and address these discrepancies, while increasing the conservation estate and highlighting sites that may be included in municipal land management programmes.

#### *Formal protection of privately owned land*

Given the limited budget to undertake acquisition focused protected area expansion, and that 38 % by area of threatened vegetation types within Durban is under private ownership (Chapter 4), additional tools have been tested to improve the conservation status of certain sites. In comparison to the more traditional approaches to conservation area expansion, tools intended to be applied on private land have, to date, not contributed significantly to the overall conservation estate (Table 3.1).

The roll out of a conservation servitude is one such tool that has been applied to certain land-parcels through conditions resulting from development assessment processes, where the remaining biodiversity feature is protected by the registration of a servitude against the title deed. There are at least 358 ha of registered conservation servitudes, however, this figure should be greater as there are several servitudes that have not been registered despite being a condition of development permission, and this will need to be addressed through administrative action. A downside of conservation servitude registration, and a possible

explanation for the lack of implementation, is the financial burden associated with surveying and registration of the servitude against the property title deed. An option to mitigate this issue is through the rezoning of these areas to Conservation Zone, which is a process that can be implemented through local government processes, and, thereby, reduce the reliance on third parties.

The underutilisation of the Conservation Zone presents a key opportunity for the City and future conservation area expansion (Table 3.1). In 2010, the eThekweni Municipality's Biodiversity Management Department (BMD, then Environmental Planning and Climate Protection Department) initiated a split zoning process of 1800 properties along the Kloof/Waterfall Escarpment, including grasslands and forests of conservation value. This ambitious amendment received numerous comments and objections and was eventually rescinded due to a procedural error in the advertising of the land-use scheme amendment. Split zoning on private land, introducing a conservation zone, is crucial for municipal land-use planning as it allows for long-term environmental protection while promoting development, without government capital expenditure (Table 3.1). The rezoning along the Kloof escarpment was a bold move to integrate D'MOSS intentions into individual cadastre. This process should be reinitiated as it clarifies land-use planning, ensures environmental protection, and potentially allows for inclusion in large-scale municipal land management programs. Given many D'MOSS areas are undevelopable, this approach could increase the conservation estate with minimal impact on landowners' development aspirations. Based on the level of public resistance to the previous process, focused engagements with affected landowners will be necessary to gain support. Key messages should address: 1) actual vs perceived impact on development rights as many of these properties are either biophysically constrained or contain threatened vegetation that would limit further development (Chapter

4); and 2) landowners' management responsibilities, particularly regarding invasive alien plant control and fire management, and the potential for management support for these obligations.

A key tool that was envisioned to incentivise the protection of private land is Environmental Rates Certificates which provide the potential for landowners with key biodiversity features on their land, subject to meeting protection and management conditions to receive a rebate on property taxes (or property rates) (Table 3.1). Unfortunately, there has, to date, been few certificates issued, which can be attributed to several issues relating to rating of properties with environmental features. Firstly, to promote development, the City's Real Estate (RE) Department, responsible for City wide property valuations and rates calculations, attaches substantial rates values to "vacant land". Promotion of development in this way clearly conflicts with the stated aims relating to environmentally sustainability and calls for a more nuanced approach to rating of vacant land with important environmental features. Secondly, in more recent years RE has started to apply discounts to certain D'MOSS areas as part of the City-wide valuation processes. This is certainly a benefit to landowners. An unintended consequence of this intervention, however, has been the impact on the number of rates certificates received, as landowners are no longer incentivised to institute formal protection and management of the site. Given that D'MOSS covers more than a third of the municipal area, the potential loss of rates revenue may be significant, and in the absence of long-term protection, possibly unjustified. This represents an opportunity for cross sectoral collaboration between BMD and RE towards the development of a more just rating system that scale incentives based on conservation outcomes. Finally, the budget allocated to environmental rates certificates limits the number of applications that can be received, and the application of a flat percentage discount does not account for site variability in management costs and/or

avoided costs associated with conservation outcomes. This would seemingly represent an opportunity for policy advancement towards a more nuanced tool that is responsive to these site differences.

#### *Formal protection within traditional authority areas*

Biodiversity conservation within TAAs represents a significant governance challenge, highlighted by the lack of conservation areas and the limited impact of spatial and land-use planning tools (Table 3.1). To address this, the BMD (then EPCPD) established a biodiversity stewardship function in 2012, focusing on TAAs, and using the biodiversity stewardship model (SANBI, 2018) as a guide to implement work in Durban. Biodiversity stewardship is recognized for its cost-effectiveness and has become the primary tool for meeting biodiversity targets in South Africa (Cumming et al., 2015). Key to this model are incentives for landowners, such as financial rebates and management support (Barendse et al., 2016; Rawat, 2017).

In TAAs, land title is held by the state, which limits financial incentives tied to ownership. Supporting incentives from municipalities include management activities like invasive species control and grassland burning. These incentives have been sparingly provided due to municipal requirements for site protection to ensure investment security. This raises questions about what constitutes 'protected' status, and the value of partial stewardship agreements (Table 3.1).

Even with management support, significant biodiversity protection in TAAs is unlikely without suitable financial benefits for local communities. Durban is consistently marketed as a tourism destination, and the value that natural assets provide to this sector are conservatively valued at R2.4 billion pa (approximately \$183 million USD equivalents, based on ZAR 13.1:1

USD, as of 30 June 2017) (Turpie et al., 2017), and, predictably, highlights the value of beaches as a major contributor to this sector. At face value the opportunities provided by several of the larger connected natural areas offer significant nature based/cultural tourism opportunities aimed at both local and international tourists. Realizing this potential within TAAs requires top-down support, business plan development, and partnerships with the private sector. Many TAAs projects align with the City's strategic goals for limiting urban sprawl and upper catchment protection (Sim et al., 2016), suggesting a coordinated municipal approach could promote conservation-focused projects with municipal planning co-benefits.

#### 3.4.2 Ecosystem management and ecological restoration tools

Table 3.2 provides an analysis of the tools applied in ecosystem management and ecological restoration using an analytical framework. The patterns are summarised below:

**Table 3.2:** Analytical framework describing the major management and ecological restoration tools aimed at enhancing biodiversity within Durban.

Tools Applied	Policy Environment	Contribution to Management	Outcome	Strengths	Weaknesses	Next Steps/Opportunities
<b>Working for Ecosystems</b>	Following the introduction of the National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004) and funding received by the National Environmental Department, the programme was initiated in 2006.	Public employment programme, with a focus on empowering previously marginalised groups, aimed at the control of Invasive Alien Plants (IAPs) within important biodiversity areas and key catchment areas.	2018/19 – 2022/23 financial year ranges: <ul style="list-style-type: none"> <li>• 0 - 3282 ha IAP control.</li> <li>• 0- 13 987 person days (33 - 63% youth and 31 -36% female employment).</li> <li>• 0 – 776 training person days.</li> <li>• Total budget 0 - R13.7m (\$876 519, based on, ZAR15.63:1 USD, average exchange rate 2018-2023)</li> </ul>	Inclusion of IAPs control within the City's operational budgets.  Working across land tenure types within priority sites  Job creation and upliftment.	Dependent on available funding, and complicated supply chain management processes.	Linked strongly to protected areas expansion, the model may provide the necessary tool to support management of newly formed protected areas, particularly within TAAs.
<b>Fire and Invasive Species Control Programme (including Working on Fire)</b>	In line with the requirements of NEMBA and the National Veld and Forest Fire Act (Act 101 of 1998) the project was initiated in 2009, primarily to manage the increasing conservation estate and grassland systems.	Public employment programme, with a focus on training individuals and small business support to undertake IAP control and apply fire management within priority EPCPD sites, and ad hoc support to other important sites.	2018/19 – 2022/23 financial year ranges: <ul style="list-style-type: none"> <li>• 28 – 500 ha IAP control.</li> <li>• 162 -417 ha of grassland burning</li> <li>• 2970 - 11283 person days (22 – 27% female employment).</li> <li>• 0 – 443 training person days.</li> </ul>	The reinstatement of fire as an ecological process within urban grassland systems.  Emphasis on bush encroachment control and IAP control in	Dependent on available funding, and complicated supply chain management processes.	Scaling will continue to be in line with the increase in the protection of grassland systems (e.g. outcomes of land acquisition programmes). The demand for control burning services is also likely to manage bush encroachment within restoration sites.

			<ul style="list-style-type: none"> <li>Total budget R3 m - R13.6m (\$191 938 - \$876 519, based on, ZAR15.63:1 USD, average exchange rate 2018-2023))</li> </ul>	support of grassland conservation.		
<b>Giba Gorge Special Rating Area</b>	The Giba Gorge Environmental Precinct (GGEP) is classified as Special Rating Area under Section 22 of the Municipal Property Rates Act [No. 6 of 2004] and associated Special Rating Area Policy (2020).	GGEP is the first to utilise this legislated tool for environmental management purposes. Funds for management activities are raised from private landowners (through an additional levy over and above their property taxes) and a contribution from the Municipality, which owns a significant portion of land in the Gorge. These funds are then directed to a Section 21 company that undertakes conservation management activities.	In total, the project conserves over 200 ha of Critically Endangered KwaZulu–Natal Sandstone Sourveld Grassland and old growth Eastern Scarp Forest in a major urban hub of Durban.	A cost-effective model in comparison to traditional protected areas.  Direct community involvement resulting in greater local support.	Lacking the organisation structures that are present within established conservation authorities, and, therefore, reliant on committed individuals,	A cost-effective model that can be used to drive community involvement and ownership. May require creativity and the identification of co-benefits to rollout to other areas with differing socio-economic contexts.
<b>Protected Area Management</b>	National Environmental Management: Protected Areas Act (No 57 of 2003)	Typically, this work is associated with a mature organisational setting focused on implementing a management plan for the Protected Area (PA). It is usually carried out by staff members stationed at the PA.	Poor outcomes in terms of Management Effectiveness of proclaimed municipal nature reserves relative to other provincial reserves.  Large number of vacant posts.	Established organisation with staff that directly underate the work and therefore less reliant on project-based funding.	Several PAs operate without an approved management plan.  Generally, a lack of community involvement in	Completion of management plans for all proclaimed Nature Reserves. Actively partnering with local community groups (e.g. conservancies)

				Ability to deal with threats beyond IAPs (e.g. poaching)	the management of the reserve.
<b>Conservancies</b>	Voluntary conservation organisation with limited legal requirements in comparison to other models. Registration with KZN Conservancies Association and Ezemvelo KZN Wildlife required.	39 active conservancies, many of which have a focus on ecosystem rehabilitation.	Across all conservancy activities in 2021, 18 399 volunteer hours were undertaken and over \$639 000 contributed, of which 61% of this value was related to environmental rehabilitation (e.g. IAP control).	Community driven resulting in greater local support for conservation.  Volunteer focus means that it is often cost affective	Limited legal standing.  Over reliance on individuals.  Integration of various government programmes and models with conservancies into a more co-ordinated conservation strategy.
<b>Reforestation Programme</b>	Initiated in response to climate mitigation and adaptation requirements associated with the hosting of mega events viz., the 2010 FIFA™ World Cup and United Nations Framework Convention on Climate Change COP17/CMP7 held in 2011.	Focus on mitigation, adaptation and driving biodiversity protection, enhancement, and job creation. “Treeprenuer’ model, created by a local NGO, used in promoting reforestation of locally indigenous forest species within the buffer zone of the Buffelsdraai Landfill, Paradise Valley, and Inanda Mountain scarp forest.	2018/19 – 2022/23 financial year ranges: <ul style="list-style-type: none"> <li>• Trees planted (ha) 53 – 185</li> <li>• Reforestation budget was R7.4 - 10. 6 million (\$473,448 - \$678 182, based on, ZAR15.63:1 USD, average exchange rate 2018-2023).</li> <li>• 213 -329 active ‘treeprenuers’</li> <li>• 8 920 - 15 323 green job person days created.</li> </ul>	An ecosystem-based approach, with multiple co-benefits for biodiversity and local community upliftment.  Inanda Mountain reforestation project represents the most significant investment within TAAs to date.	Active restoration of threatened systems such as grasslands and coastal forest will need to be implemented for the City to make significant progress in meeting conservation targets.  More broadly this will be an important opportunity to scale, addressing socio-economic challenges and improving urban sustainability.

### *Managing the increasing municipal conservation estate*

To compliment the increasing protection of land, the introduction of large-scale poverty alleviation programmes aimed at the control of invasive alien plants (IAPs) on these sites, and reintroduction of fire management as an ecological process, have been fundamental to conservation of these areas (Boon et al., 2016). While there are several pieces of legislation that address aspects of IAPs, the introduction of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (including the Alien and Invasive Species Regulations (National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Alien and Invasive Species Lists, 2020., 2020)), brought the issue to the forefront for all spheres of government, requiring these institutions to, *inter alia*, prepare plans for, and report on, the eradication of IAPs. The Working for Ecosystems programme was initiated in 2006, following funding from the National Environmental Department, and was subsequently handed over to the municipal Treasury unit following a requirement from the National Auditor General for the municipality to undertake the legal obligations associated with the control of IAPs within the municipal area (as per NEMBA). This was significant in that IAP control was included for the first time as a line item within the municipality's operational budget. The targeted purchasing of threatened grassland systems also revealed a notable management void, viz. the lack of controlled burning, a critical process for the maintenance of grassland (Boon et al., 2016), but also required by law (Table 3.2). The appointment of Working on Fire (another large-scale poverty alleviation programme, now under the banner of the Fire and Invasive Species programme) in 2009, represented a significant moment for conservation in the City, in that highly threatened grassland systems could be managed through controlled burning, preventing the loss of these critical ecosystems to bush encroachment (Boon et al., 2016). The introduction of fire management into BMD operations has the added benefit of

addressing the requirements of the National Veld and Forest Fire Act (Act 101 of 1998) that places a responsibility on landowners to maintain properties appropriately to avoid uncontrolled fires. Job creation (with a focus on women, youth, and persons with disabilities), and training in IAP control, are central components of both the programmes, the former being particularly important in attaining political support for funding allocation.

Although both these programmes have been successful in adding an ecological management arm to conservation area expansion, there is a clear need to increase activities within TAAs. In addition, a concerning aspect of the programme has been the delays associated with lengthy and complicated supply chain management processes which govern the procurement of services by public entities. Over the past five years, implementation has been delayed by two years by these processes, resulting in limited fire management for two fire seasons. In the absence of alternatives, this represents a critical risk to previous IAP management investments, ecological functioning, and financial liability to the City because of uncontrolled fires.

#### *Management of established protected areas*

Most formal protected areas with the City are state owned and managed. Ezemvelo KZN Wildlife, the provincial conservation authority, manages six nature reserves in the City, while eThekweni Municipality manages eleven proclaimed nature reserves. The ownership and management of these latter reserves has typically been the responsibility of the Natural Resources Division of the City. As the BMD continues to increase the conservation estate through proactive protected area expansion tools, the risk of biodiversity management decision-making silos is increasingly apparent with two separate structures undertaking conservation area management. To drive coordinated, effective and resource efficient

biodiversity protection and management, this governance arrangement will need to be analysed and addressed.

In addition, while there has been success in attaining adequate protection status for many of the reserves, the rollout of supporting approved management plans, as required by the National Environmental Management: Protected Areas Act (No 57 of 2003) (NEMPA), has been slow. The completion of these documents is vital to ensure effective management of these areas and address developing governance challenges. State funding is, however, rarely consistent and/or guaranteed, and there is limited community involvement (e.g. conservancies, active advisory forums, or 'Friends of' groups') in the management of municipal PAs. Addressing this shortcoming would seem a natural progression that would build a level of resilience into the system.

#### *The role of active citizenship in conservation management*

A conservancy represents a voluntary group of landowners and other interested and affected parties that cooperatively manage natural resources in an environmentally sustainable manner and have been registered as a conservancy with the relevant provincial conservation authority (SANBI, 2018). In total there are 39 active conservancies within Durban, ranging in size, areas of focus, and effectiveness (KZNCA, 2021). Many of the conservancies, including the largest and most active conservancy, Kloof Conservancy, and the first urban Conservancy in South Africa, the Everton Conservancy, focus considerable resources (financial and volunteer hours) on the management of threatened ecosystems (KZNCA, 2021) (Table 3.2). These management activities are supported by the BMD through the provisioning of herbicide, training, and assistance with fire management. Importantly, many of these conservancies undertake management activities on state owned land in addition to their own private properties. As a predominantly volunteer based system, conservancies lack the legislative

standing afforded to other management models; however they represent a mechanism for ensuring local support for projects, undertake cost-effective management, and represent a valuable and important addition to biodiversity conservation activities of government. As is the case with the distribution of protected areas, conservancies tend to be associated with more affluent areas of the City, and the logical next step is ensuring the establishment of additional conservancies within previously disadvantaged areas of high conservation value.

Although not a conservancy, the Giba Gorge Environmental Precinct (GGEP) provides an important case study of how public-private partnerships, driven by active citizenship can work in Durban. The Municipal Property Rates Act (2004) makes provision for the formation of Special Rating Areas (SRAs) for the supply of ‘top-up’ services to specific areas. The Giba Gorge Environmental Precinct (GGEP) is the first to use this legislated tool for environmental management purposes. GGEP funds conservation management through levies on private landowners and municipal contributions (Table 3.2). Managed by a not-for-profit company (i.e. Section 21) and a volunteer management committee, GGEP oversees over 200 ha of critically endangered KwaZulu-Natal Sandstone Sourveld Grassland and old-growth Eastern Scarp Forest. This model has demonstrated success through continuous management, job creation, and community involvement, providing a potential template for replication in other areas. A more detailed review is required to fully understand the value of this model in comparison to more traditional protected area approaches. It is, however, anticipated that the model is substantially more cost effective than other municipal protected areas due to, *inter alia*, the savings associated with services provided by the management committee (e.g. financial reporting, human resource services, and construction maintenance), additional savings from service providers as a consequence of Not-for-Profit Organisation status, and flexibility to management approaches.

Although GGEP is the only conservation focused SRA, the concept of precinct management has gained momentum in Durban over the past decade. There are currently 11 SRAs and 10 Management Associations within Durban that undertake various public services (e.g. security, cleaning) (Layman, 2019). In terms of budget allocation, security services accounts for the greatest proportion of generated funds representing 63% of total budgets (Layman, 2019). Giba Gorge is surrounded by middle/high value properties, with natural physical boundaries, thereby providing ideal conditions for the establishment of a conservation based special rating area. This context is important as there are few similar areas where this model could be directly replicated. Exploring hybrid models where precincts with multiple and complementary objectives (e.g. bush encroachment control, patrolling, and security) may be required in other areas in the City.

There are, however, limits in terms of what areas this model would suit with socio-economic conditions of areas likely to dictate levels of support and financial viability. What the project does highlight is that if active citizen groups (e.g. conservancies) have a suitable institutional structure, then it is possible for the municipality to enter into partnerships, and provide funding and support services (e.g. fire management, IAP control, and management advice). This is an important mechanism to support conservation work of conservancies and provide a foundation for conservation area expansion across land tenure, including within TAAs. Conservancies represent an important entry point in biodiversity stewardship, and, to date, have not been adequately incorporated within the City's conservation expansion work, as evident by the lack of formal agreement to support a partnership between conservancies and the City. The decentralisation of conservation funding may facilitate this, and allow for greater resilience in biodiversity management systems, an important consideration given the reliance on the large-scale programmes mentioned above.

### *Active restoration activities*

The origins of restoration interventions within Durban are rooted in climate change mitigation and adaptation in response to the hosting of two mega events in the City of Durban viz., the 2010 FIFA™ World Cup, and United Nations Framework Convention on Climate Change's Conference of the Parties, seventeenth session, in 2011 (UNFCCC COP 17) (Table 3.2). The municipality took a decision to not follow the traditional approach of purchasing carbon credits to offset the carbon footprint of the event, but rather introduce offset principles that responded more appropriately to local issues, with biodiversity protection/enhancement and job creation being key priorities (Diederichs & Roberts, 2016).

The flagship reforestation projects, viz Buffelsdraai, Paradise Valley, and Inanda reforestation projects, have represented Durban's first venture into largescale active restoration. These programmes have yielded valuable ecological and social outcomes (Table 3.2), but, equally important, are the substantial costs that have been involved in the establishment and ongoing operations of these projects (Roberts et al., 2012). This reflection is important, in that achieving biodiversity outcomes through habitat protection is more effective than restoration due to *inter alia* financial limitations and time lags (Rey Benayas et al., 2009). The reality is, however, far more complicated when achieving conservation targets within option poor and fragmented landscapes that characterise cities. In this context, active restoration is an essential component of any biodiversity strategy aimed at achieving conservation targets where transformation thresholds have been transgressed (Possingham et al., 2015). Investment in ecosystem restoration also allows for the selection of sites that optimise conservation outcomes, illustrating that both protection and restoration of ecosystems are important as part of broader conservation planning (Possingham et al., 2015).

The United Nations Declaration of 2021-2030 as the decade of ecological restoration (UN, 2019) provides an important platform to expand on the ecosystem restoration work, and will likely offer similar opportunities to governments that are able to effectively demonstrate the delivery of restoration projects. Identifying these opportunities and expanding active restoration projects to threatened vegetation types represents an important next stage in the evolution of this function.

### 3.4.3 Effectiveness of tools applied

Table 3.3 categorises the respective tools in terms of impact on policy and practice, contribution to socio-economic development and suitability for traditional authority land. The contexts that led to the development/implementation illustrates the City's proactive stance taken in attempting to advance biodiversity conservation outcomes. This is evident in number of tools applied within the land-use and spatial planning field, but particularly in the development and application of tools outside of local government's core mandate of land-use planning.

Figure 3.3 presents the cumulative scores of each tool against the three criteria presented in Table 3.3. The total score for *positive impact on policy and practice* was 48 (Figure 3.3). D'MOSS, Land Acquisition, Giba Gorge Special Rating Area, and the Reforestation Programme all scored highly (Table 3.3). Common across these tools is that they have resulted in measurable biodiversity conservation outcomes, there has been direct oversight by a single department, and the tools have operated continuously since their inception. The FISC and WFE programmes have been critical to conservation action within the municipality, however, gaps in operations prevented a higher rating.

The total score for *contribution to socio-economic development* was 45 (Figure 3.3). Tools such as WFE, FISC, GGEP and the reforestation programme all scored highly (Table 3.3). These tools have been successful in creating green jobs, supporting local economies, and fostering community involvement. The number of vacant positions within the department responsible for municipal nature reserve management prevented a higher score for protected area management.

The total score for *suitability for Traditional Authority Areas* was 23 (Figure 3.3), reflecting the challenges in implementing conservation tools within these areas. Biodiversity Stewardship, WFE, Conservancies, and the Reforestation Programme were the highest scoring tools, with scores of 3. Investment security and lack of suitable financial incentives prevented scaling and higher scores for these tools. The low scores across the land-use planning tools reflects the current lack of planning integration across this land tenure type.

The Conservation Zone and Environmental Rates Certificates categorised as ‘low’ across the categories due to the relative ineffectiveness of the interventions to date (Table 3.3 and Figure 3.3). This represents a challenge for the City as these tools were designed specifically for private landholdings, creating risk to conservation outcomes in these areas. Across the tools, stronger governance represented an important factor in terms of increased tool effectiveness. Addressing internal municipal governance barriers in the land-use and spatial planning tools (e.g. translation of lower order spatial planning products and rezoning of legacy zones to ECR), and vertical integration of spatial information (associated with D’MOSS) into national biodiversity plans should represent key areas of focus. Similarly, the fragmented nature of the land management governance system, and associated procurement support, requires attention. Service level agreements between the two municipal department actively involved in land

management, and a similar agreement with conservancies, are short-term interventions that could be considered to improve the effectiveness of the management system.

These findings emphasize the need for Durban to expand the current toolset. Initial exploratory work on the potential for conservation banking (Macfarlane et al., 2015) and payment for ecosystem service models (INR, 2020) have been undertaken, but not implemented. Conservation banking models (INR, 2020) remain relatively untested in a South African context, however, reference to its use in the recently completed National Biodiversity Offset Guideline (DFFE, 2023a) may provide the policy environment to advance this work area. Critically, this guideline may help address inconsistencies in the application of biodiversity offsets within Durban (Nkosi, 2021) and the country (Brownlie et al., 2017). Given that the majority of land-use applications potentially impacting D'MOSS fall outside of provincial and national environmental assessment processes, the development of a local offset policy may be required (Chapter 2).

**Table 3.3:** Integration analysis of tools applied ((1) Positive impact on policy and practice – measurable biodiversity conservation outcomes and operational continuity; (2) Contribution to socio-economic development - successful in creating green jobs, supporting local economies, and fostering community involvement; and (3) Suitability for Traditional Authority Areas (TAAs) - applied in TAAs with measurable outcomes with operational continuity). Categorisation of the tools applied (high = green, moderate = orange, or low = red) in response to policy and practice, socio-economic development, and suitability for TAAs. Future potential of tools and opportunities to improve outcomes.

Tool	Context for development/use of tool	Assessment of tool performance	Positive impact on policy and practice	Contribution to Socio-economic development	Suitability for Traditional Authority areas	Future potential of tool and opportunities to improve outcomes
Durban Metropolitan Open Space System	Evolved significantly over four decades. Intended to act as a development control layer to minimise the impact of development on the natural resource base, by assessing potential impacts of proposed developments.	Represents a critical component of land-use decision making, informed by ecological data, and contributes towards avoided loss in development assessment processes. Limited impact, however, within Traditional Authority Areas.				<p>Given the complexities of the dual governance system additional work is required to improve impact, through: (1) Improved governance relationships between the ITB and the eThekweni Municipality; (2) improved vertical integration of D'MOSS elements (e.g. Critical Biodiversity Areas and Threatened Vegetation Types) within national spatial planning products leading to more stringent environmental assessment process for threatened biodiversity.</p> <p>There is a need to undertake a climate change risk analysis of D'MOSS and the associated Systematic Conservation Assessment.</p>

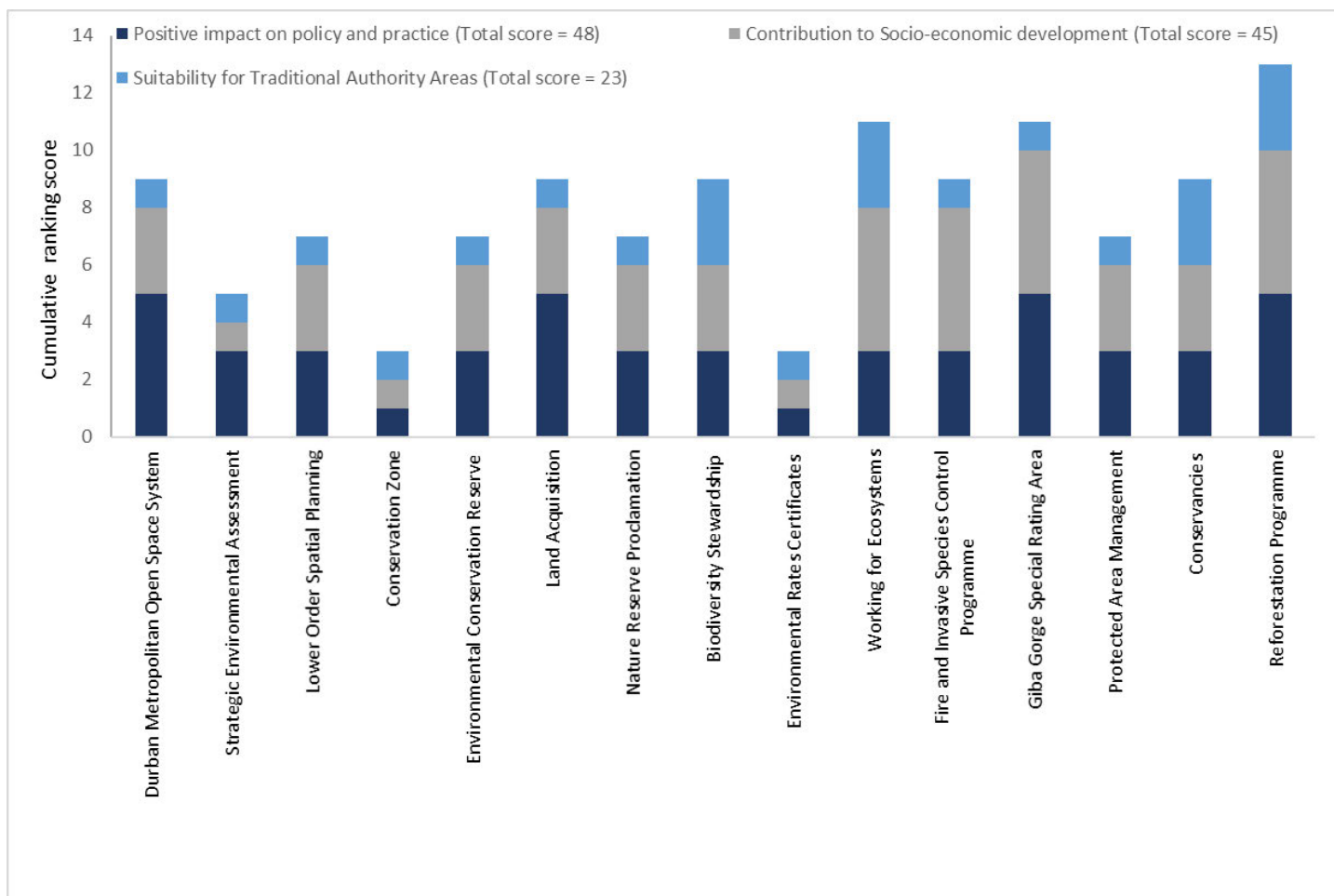
Strategic Environmental Assessment	A legislative requirement that assesses environmental performance against current and future spatial development	The most comprehensive and inclusive assessment, to date, of Durban's natural resource base, and, critically, the development of sustainability thresholds. The lack of completion of a socio-economic analysis against these thresholds represents a gap that compromises effectiveness.				Completion of the second socio-economic phase of the SEA that will enable decision makers to balance future planning against environmental thresholds.
Lower Order Spatial Planning	A bridge between strategic planning and the land-use schemes allowing for more detailed spatial planning for specific areas, and across sectors with often competing spatial priorities. Seen as an opportunity to further embed protection of environmental assets.	While this process has resulted in successes in entrenching D'MOSS and, in some cases, the identification of areas for greater protection, the translation of these plans into land-use schemes is not definitive enough to ensure protection.				Addressing the translation of intended land-uses into appropriate conservation zones.  Working with TAAs, through processes such as the Rural Development Strategy to advance biodiversity mainstreaming and utilise this platform to promote appropriate nature-based planning.
Conservation Zone	The zone was developed following an acknowledged gap in the availability of suitable zone types for the protection of biodiversity features on private land.	Largely ineffective to date following an initially unsuccessful roll-out of the tool in the outer west planning region.				This tool needs to be reinitiated as a mechanism to protect remaining biodiversity features on private land. Central to this roll-out may be a greater focus on communication with landowners and targeted project sites

Environmental Conservation Reserve	The zone was developed following an acknowledged gap in the availability of suitable zone types for the protection of biodiversity features on public land, and particularly the Public Open Space Zone that did not adequately address this shortcoming.	This zone has been effectively applied to newly acquired land for conservation purposes, and to provide municipal areas intended to be proclaimed as nature reserves with suitable interim protection. This zone has, however, not been effectively rolled out across state land with complementary land-uses.				Opportunities to improve conservation outcomes include: (1) targeting of State-owned land with biodiversity features for split zoning; and (2) rezoning legacy zones (associated with passive land-uses) that would contribute to the conservation estate.
Land Acquisition	Developed to purchase targeted sites of considerable conservation importance	A successful project that has contributed to the protection of threatened ecosystems and expansion of conservation areas. Only limited by available budget.				Budget availability is likely to remain a limiting factor in scaling this intervention. The inclusion of land cost an initial filter during prioritisation may contribute to increasing the impact of this tool.
Nature Reserve Proclamation	This tool was originally used to provide adequate protection to municipal areas that were named Nature Reserve but, lacked the formal status in terms of NEMPAA	The project has been successful in elevating the conservation status of several existing municipal “Nature Reserves”, and the proclamation of additional sites secured through and acquisition. Currently an imbalance in the distribution of proclaimed areas between socio-economic groupings.				This tool represents the end point of protection initiatives. Current governance challenges impacting traditional authority areas will need to be overcome to allow the application of this tool in TAAs.
Biodiversity Stewardship	In the absence of appropriate tools for	Signed agreements with five traditional				Two core issues will need to be addressed to improve outcomes in TAAs through biodiversity

	TAAAs, the biodiversity stewardship programme was initiated to promote biodiversity protection in these areas.	authorities committing to working with the BMD, but no formal protection of areas to date. Avoided loss through detailed engagements with TAAAs is difficult to measure.				stewardship: (1) incentivisation and investment in these areas to promote conservation aligned land-uses; and (2) Fostering a more integrated governance system that may require partnerships with third parties to advance such initiatives.
Environmental Rates Certificates	Designed to promote protection and management of remaining biodiversity features on private land through a rebate of property rates.	Limited success because of ambiguity in the contributions of remaining land towards overall rates of a property, discounts already applied to land with D'MOSS present, and limited available budget assigned to rebates.				The value of this tool in its current form is questionable. To address this issue, clarity on the rating of land with D'MOSS present will be required. Incentivisation should be analysed through a lens of protection and management of biodiversity features across properties.
Working for Ecosystems	Developed in response to national legislation and associated funding compelling municipalities to meet obligations in the control of Invasive Alien Plants (IAPs).	The project has been successful in providing a key management activity to strategic biodiversity areas, including traditional authority areas, while contributing to the creation of green jobs and associated political support. Procurement related delays in the programme have, however, impacted outcomes.				Addressing risks to operational continuity represents the most important factor that requires addressing. In the absence of changes to the current procurement system, decentralisation of funding to conservancies, active citizen groups and NGOs may represent an alternative. In addition, there is a need for increased investment within TAAAs to foster greater outcomes in these areas.
Fire and Invasive Species Control Programme	Developed in response for the need to manage acquired sites, and particularly the need for fire	The project has been successful in providing IAP and fire management to key sites, while contributing to the				Addressing risks to operational continuity represents the most important factor that requires addressing. In the absence of changes to the current procurement system, decentralisation of funding may represent an alternative. In addition,

	management of grassland systems.	creation of green jobs and associated political support. Procurement related delays in the programme have, however, impacted outcomes. Support to TAAs has also been limited due to lack of security of investment.				there is a need for increased investment within TAAs to foster greater outcomes in these areas
Giba Gorge Special Rating Area	A pilot project designed to create a management model for the protection and management of public and private land as a single system. Governed by the local community, with support from the municipality.	The project has been successfully implemented for 15 years providing continuous management to a key area within the municipality, creating long-term green jobs and community involvement.				Opportunities to replicate this tool at scale may be limited by contextual factors such as socio-economic conditions and the advantage of distinct natural boundaries. Hybrid Special Ratings Areas (e.g. security and conservation) may represent an opportunity to advance this work area.
Protected Area Management	Most the City's nature reserves are managed by the Natural Resources Division. Most of these reserves are in the older more established suburbs of the City.	Although providing a management of these critical areas several nature reserves have performed poorly when assessed against reserves across the province. The large number of vacancies across the function prevented a higher scoring in contribution to socio-economic development.				Addressing the current governance fragmentation in terms of management and scientific capacity should represent a key focus area for the City.
Conservancies	These voluntary groups of active citizens have developed largely	An undervalued contributor to broader conservation goals within the municipality.				Inclusion of conservancies within the broader conservation strategy of the City is essential in the promotion of inclusive and cost-effective conservation management. Formalising the

	independently of municipal conservation initiatives, and act across land tenure types.	These groups continue to generate funding, contributing resources and managing several important areas within the City. The lack of legislative standing and continuity of operations prevents higher scores across metrics.				relationship with the City, testing project funding through these agreements, and motivating for the development of projects within TAAs represent important goals to advance conservation outcomes.
Reforestation Programme	Largely opportunistic in nature, this programme developed as climate mitigation and adaptation responses to the hosting of global mega events.	Successful programmes that have led to important biodiversity outcomes and sustainable job creation. The programme has involved significant resourcing, but, importantly, has been applied within TAAs.				Availability of suitable sites and the significant financial investment required to initiate projects of this nature are likely to represent limiting factors in scaling. These projects do, however, represent opportunities to address current imbalance in the allocation of resources and funding within poorer areas of the City.
Additional tools to be considered						Conservation Bank, and Payment for Ecosystems Services models.



**Figure 3.3:** Combined score for each tool applied in terms of positive impact on policy and practice, contribution to socio-economic development, and suitability for traditional authority areas. Scoring for each criterion were based on the assessment provided in Table 3 (Green/High = 5, Orange/Moderate = 3, Red/Low = 1). A cumulative score of all tools for each criterion is also provided.

### 3.5 Discussion

This paper provides evidence of how Durban and its partners have deeply engaged in urban biodiversity conservation, applying, and adapting various tools to expand the conservation estate, curb biodiversity loss, restore ecosystems and address urbanisation-related threats. Notable successes include avoided biodiversity loss through land-use planning, increased

protection of threatened ecosystems, proclaimed protected areas, and poverty alleviation programmes aimed at restoring key ecological processes. Despite these achievements, challenges remain. These include unequal protection and investment in relation to socio-economic status and apartheid era segregated spatial planning, horizontal governance barriers impacting the effectiveness of tools, and inadequate incentives for private and traditional land protection. This paper provides a case study on how a local government can contribute to the ‘Whole-of-government and whole-of-society’ approach described in the Kunming-Montreal Global Biodiversity Framework (CBD, 2022), while supporting the increasing recognition that local governments are well positioned to drive transformative change in biodiversity governance (Kok, 2022). To enhance conservation outcomes, issues of the role of governance, promotion of equity and justice, and social inclusion are explored further.

#### *Role of governance in biodiversity outcomes*

This research emphasises the need for local government to take an active role in advancing biodiversity outcomes, and is particularly relevant to cities in biodiversity priority areas, where provincial or national spheres of conservation governance may avoid urban areas in expansion programmes (Soanes & Lentini, 2019). Despite highly threatened biodiversity, conservation expansion has been almost exclusively undertaken by the municipality over the past decades. At a state level, this situation is likely to remain unchanged due to the limited capacity for provincial conservation authorities to contribute significantly to the 30x30 area-based biodiversity conservation expansion targets (DFFE, 2023b), further emphasising of the importance of local government playing a leading role.

While there have been successes, only 7 % of D’MOSS is protected, indicating a need to increase protection levels to ensure biodiversity persistence. In comparison, The City of Cape Town (CoCT) has conserved 65 % of the 85 000 ha BioNet (D’MOSS equivalent) (City of

Cape Town, 2022). There are contextual factors that explain the discrepancies, such as the presence of Table Mountain National Park in the City (proclaimed in 1998), significant provincial and national support from conservation authorities due to the level of endemism and threat status of vegetation types in the CoCT, early international funding, and the absence of the dual governance system within Durban (Boon et al., 2016; Bux et al., 2021; Holmes et al., 2012; Rebelo et al., 2011).

There are key differences in approach between the two cities, including the presence of time-bound protected area expansion targets within strategic planning documents for the CoCT (City of Cape Town, 2022). While conservation targets are used to inform the development of D'MOSS (McLean et al., 2020) and the selection of sites for further protection (e.g. land acquisition), conservation targets are more commonly used in articulating ecological thresholds linked to spatial and land-use planning (Chapter 2). In a review of 135 plans from 40 cities, the goals for nature conservation were often present within plans for cities, however, quantitative targets for conservation action were less frequently articulated, and, thereby, risking the success of such plans (Nilon et al., 2017). The inclusion of annual area-based biodiversity conservation targets represents an important lesson for Durban to take forward in advancing conservation area expansion, but these need to be informed by data that indicate what opportunities are realistically achievable, and over what period (Chapter 4).

Durban has, however, invested significant resources in advancing the mainstreaming of biodiversity through integration of D'MOSS within the hierarchy of spatial and land-use planning products, and addressing biodiversity concerns through development assessment processes (Bux et al., 2021) (Chapter 2). The advancement of this policy and legislative environment, and investment in scientific institutional capacity, have contributed to protection through avoided loss (Chapter 2), which represents a critical part of biodiversity

mainstreaming, but for which it is inherently difficult to measure actual impact (Manuel et al., 2016). Advancing biodiversity outcomes will require addressing vertical governance barriers (Huang et al., 2018), viz the integration of local biodiversity information into national spatial planning products that offer additional legislative protection (Chapter 2). Furthermore, ineffective translation of strategic planning products to property level land-use schemes that would result in improved biodiversity outcomes represents an emerging planning-implementation gap that requires attention (Ermgassen et al., 2022; Ferraro & Failler, 2024; Knight et al., 2008).

The limited impact of land-use and spatial planning tools in TAAs calls for an integrated approach to planning that can effectively combine customary law-based land allocation and formal municipal planning. A previously promoted hybrid planning system offers innovative support options including the deployment of planning to assist traditional authorities in land-use decision making (Sim et al., 2018), and shares several similarities with the recommended approach towards indigenous conservation areas from across the world (Tran et al., 2020). Central to this is the recognition of agency, and empowering community-led conservation programmes to create quality governance structures (Dawson et al., 2021). The development of an EThekwini Traditional Rural Spatial Development Framework and Land Use Management Plan (EThekwini Municipality, 2024)) represents an important first step in promoting effective dual governance by attempting to integrate planning priorities of municipal and traditional authorities into a consolidated planning instrument (EThekwini Municipality, 2024). Understanding the implementation of this process and outcomes represents an important opportunity for future research.

The variety of tools tested and applied highlights the complexity, and required adaptability, of local environmental governance and the absence of a singular solution for achieving

conservation targets (Gurney et al., 2021; Lemos & Agrawal, 2006). Rezoning of land represents an important component of local governments' response to biodiversity protection in many countries (Barut et al., 2016; Bruggeman et al., 2015; Gurrán et al., 2015; Hansen et al., 2022), and similarly reflected in the design of fit-for-purpose land use zones in Durban, which has allowed for appropriate protection of public land. Conservation Development (CDs) ordinances in the United States share a number of similarities with the underutilised Conservation zone, including: the avoiding of key biodiversity features in development design and the promotion of a more concentrated development or 'density bonus' on the developable sections of the property (Reed et al., 2014). CDs have been shown to offer significant potential conservation area expansion options as demonstrated in counties of Colorado, where the majority of CDs occurred immediately adjacent to protected areas (Mockrin et al., 2017). Like Durban, the development of suitable incentives and appropriate management of CDs remain barriers to successful scaling (Reed et al., 2014). The uncertainty surrounding the Environmental Rates Certificate poses a problem for incentivizing private landowners. Property tax relaxation is a key incentive for conservation agencies, offering financial benefits to landowners and local governments and less costly than traditional land acquisition (Schuster et al., 2018).

The control of invasive species and maintenance of ecological processes are essential components of managing for biodiversity in urban areas (Aronson et al., 2017), but the social outcomes (e.g. job creation) is what has allowed for political support and scaling for these programmes (van Wilgen & Wannenburg, 2016). The relative success of the poverty alleviation programmes as a management arm to the increasing conservation estate risks the development of governance silos, with both the BMD and NRD responsible for different conservation areas. Governance silos are considered a major barrier to implementation of

conservation plans (Powell, 2010) and inhibit sustainability within cities (South African Cities Network, 2021). In addition, the lack of techno-scientific capacity and resources are consistently highlighted as barriers to local biodiversity conservation outcomes (Shih et al., 2020). This is particularly urgent when considering that four of Durban's Nature Reserves were listed among the lowest scoring reserves in terms of biodiversity management indicators in the *State of Provincial Reserves in South Africa* (Patel et al., 2023). The same report highlighted capacity and skills as the most frequently identified challenge facing provincial reserves (Patel et al., 2023) and, given that much of the scientific and IAP budget sits within the BMD (Chapter 2), the need for a closer working relationship is clear. Similarly, field rangers from NRD are designated to undertake certain enforcement action on municipal owned sites that staff from BMD are unable to do. Addressing these governance silos through a service level agreement represents a critical next step for the future of biodiversity conservation in the City. Improved coordination in the management of protected and conservation areas is central in addressing skill gaps and enhancing the efficient use of resources (O'Connell et al., 2019).

Horizontal barriers to effective management extend beyond governance silos and include aspects of the legislated (MFMA, 2003) procurement processes. Non-compliance with, or inefficient implementation of the current public procurement processes can severely stifle effective service delivery (Matebese-Notshulwana, 2021). This has led to calls for an overhaul that adopts approaches in line with the private sector (Manyathi et al., 2021). Inefficient implementation of processes can severely hamper conservation outcomes in Municipalities (Brooks, 2017), especially for high budget, conservation related public tenders. Particularly relevant to the large-scale poverty alleviation programmes is the development of long-term supplier relationships that would promote continuity in operations (Manyathi et al., 2021).

### *Equity and justice in biodiversity outcomes*

The largescale poverty alleviation and reforestation programmes operating within the City represent important interventions that address core socio-economic issues in addition to achieving conservation outcomes. The spatial distribution of the protected area network in relation to household income has, however, emphasised the level of spatial inequality or *green apartheid* (Venter et al., 2020) that persists across race and income geographies in post-apartheid cities (Anderson et al., 2020; Giombini & Thorn, 2022). Income related spatial inequalities in access to protected areas, biodiversity and urban green spaces, or ‘the luxury effect’ (Hope et al., 2008), however, represents a more systemic problem across cities in both the developed and developing world (Aznarez et al., 2023; Leong et al., 2018; Sharifi et al., 2021; Sims et al., 2022; Wu & Kim, 2021). This emphasises the need, and in line with the GBF, for equity and justice to represent key concerns for biodiversity planning and management. Similarly, South Africa’s recently gazetted Climate Change Act (Act No. 22 of 2024) seeks to enable the just transition ”...towards a low-carbon, climate-resilient economy and society and ecologically sustainable economies and societies...” (Climate Change Act (Act No. 22 of 2024)). The convergence and complementarity of actions required to advance equity and justice in both biodiversity and climate change outcomes offers an important framing for future action in the City.

Most remaining natural areas, outside of protected and conservation areas, are located in low-income areas, necessitating City-wide action to address this issue *by reframing conservation action through the lens of reconciliation and redress* (Armitage et al., 2020). This will require appropriate investment, of both financial and professional capacity, and particularly the development of suitable models that can promote effective conservation outcomes in TAAs. Importantly, the natural environment in TAAs is integral to the area's social and economic

fabric, making community-owned conservation areas essential, moving away from exclusionary protected areas (McCann et al., 2015). A review of over 600 protected areas in 34 developing countries found that multi-use protected areas with tourism improved socio-economic and wellbeing metrics for nearby communities, while tourism alone did not (Naidoo et al., 2019). Furthermore, exclusionary protected areas have the potential to aggravate poverty levels and levels of inequality in communities within protected areas (Ma et al., 2019). Fostering these necessary socio-ecological conditions towards conservation outcomes will require environmental professionals to challenge conventional local government approaches to conservation area expansion, particularly within TAAs, through the promotion of an adaptive, pluralistic approach to conservation (Gavin et al., 2018).

### *Inclusions*

The idea of "inclusive conservation" has been introduced as a framework to address and integrate equity considerations in biodiversity conservation and protected area management strategies (Raymond et al., 2022). Inclusivity in the achievement of biodiversity goals features prominently within the GBF, more so than previous global strategies (e.g.; Aichi Targets), and includes recognition of the importance of indigenous peoples and communities through inter alia Target 22, that aims to *Ensure Participation in Decision-Making and Access to Justice and Information Related to Biodiversity for all* (Watson et al., 2023). In terms of conservation outcomes, the current bottom-up approach of the Biodiversity Stewardship Programme and conservancies needs to be supplemented by coordinated City level support. In Australian cities, top-down organisational support was viewed as a key enabler in advancing indigenous community support for urban biodiversity conservation (Taylor et al., 2022). Achieving this integrated approach will require a reframing the value of these open spaces from conservation priorities to valuable green infrastructure that offers significant economic savings and social

outcomes, but requiring investment to maintain (Gulati & Scholtz, 2020). This approach offers considerable potential in TAAs for empowered inclusion.

Overlaid on this complex governance challenge is the possibility that local government may not be best placed to lead stewardship projects within TAAs, due to political dynamics and often contested authority between traditional leadership and local government (Ramolobe, 2023). The most advanced example of conservation area expansion within TAAs to date relates to the proposed Sobonakhona Protected Environment, led by the Endangered Wildlife Trust, a conservation NGO, that is in the process of being proclaimed under Biodiversity Stewardship (Acker, 2022). Actively partnering with NGOs and the private sector in TAAs may represent an important opportunity to advance conservation outcomes, as demonstrated in the examples of indigenous land conservation from other countries (Schlick, 2011; Snyman & Spenceley, 2019; Zimmerman et al., 2020).

Building resilience in conservation governance systems is critical to mitigate operational issues and scale conservation outcomes (Holley & Sofronova, 2017), and in this regard the role of active citizenship towards the development of a mosaic governance system is important. Mosaic governance is defined as *the diversity of processes that may facilitate existing active citizenship and stimulate its upscaling through a mix of governance modes and policy interventions tailored to the socio-ecological context of urban landscapes* (Buijs et al., 2019), with several examples of successful implementation in other cities (Buijs et al., 2024; Dobšinská & Daško, 2024). The GGEP and several conservancies' projects serve as important examples of mosaic governance in Durban. Mobilizing the diversity of active citizens required to scale interventions, however, requires partnerships with civil society, often through NGOs that are able to effectively bridge the gap with local governments (Buijs et al., 2019; KimDung et al., 2016). Importantly in the case of GGEP, it has demonstrated that decentralisation of

conservation funding can be a viable option to compliment centrally controlled management systems (Atisa et al., 2021). While decentralised governance funding arrangements can be effective in certain situations, these need to be supported by increased monitoring of management effectiveness (Sayer & Margules, 2017).

### *Conclusions*

Many areas considered conserved in this paper will not be proclaimed as formal protected areas, but could be considered for potential recognition as other effective area-based conservation measures (OECMs)(CBD, 2018; DFFE, 2023c). An important component of OECMs is the recognition of managed areas that sustain biodiversity irrespective of their primary objective, thereby offering an opportunity to increase equity in conservation decision making and the range of actors involved (Gurney et al., 2021). OECMs represent an important vehicle to increase the conservation estate in key biodiversity areas (Donald et al., 2019), and offer opportunities to recognise a diverse range of actors (including previously marginalised groups), improve governance, and attract conservation financing (Marnewick et al., 2021).

The City of Durban has demonstrated the important role that cities, and particular cities within biodiversity hotspots, can play in contributing towards broader conservation efforts. Progress has been made over the past four decades, but in the face of rapid urbanisation and with only a relatively small proportion of D'MOSS formally protected and managed, the need to scale these interventions is apparent. Tools will undoubtedly need to evolve to respond to changing contexts (Gavin et al., 2018), and new tools will be required to cope with the significant biodiversity loss associated with an increasingly likely 1.5<sup>0</sup> C overshoot (IPCC, 2022). Given the relative importance of land under traditional authority and private control, the development of an integrated and community-centred conservation area expansion strategy through the OECM lens for the City of Durban is recommended.

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## CHAPTER 4

### **Identifying Opportunities for Terrestrial Area-Based Conservation within an Urban Global Biodiversity Hotspot (Durban, South Africa)**

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## 4.1 Abstract

Achieving ambitious area-based conservation targets within the Global Biodiversity Frameworks requires a ‘whole of society’ approach, particularly from biodiverse regions of the world, with increasing acknowledgment of the role of cities and local governments. We present a practitioner-led examination of opportunities to expand the conservation network of an urbanizing biodiverse city using local government mechanisms. We used local government spatial biodiversity data, land tenure information, and existing conservation areas, to determine the spatial distribution of remaining biodiversity features. Spatial congruency analyses were performed to identify areas that could be included into the conservation area network based on complementary land-use zoning, unrealised conservation servitudes, and disaster risk related development constraints. Additionally, areas were identified for either targeted rezoning or land acquisition based on environmental-related development constraints and property costs. Finally, the different opportunities/mechanisms were analysed using an analytical framework to determine feasibility of implementation, potential effectiveness, policy and practise requirements, and co-benefits for building climate change resilience. Traditional authority areas and private landholding were found to harbour most biodiversity features outside existing conservation areas. Inclusion of complementary land-use zones and unrealised conservation servitudes represent short-term interventions that could increase the areas of threatened vegetation under protection by more than 30%. There was a 63% overlap between disaster risk areas and remaining critical biodiversity areas, indicating a significant opportunity to advance area-based conservation through appropriate and currently undeveloped land-use planning interventions, with multiple co-benefits linked to climate resilience and sustainable urban planning. The development of suitable mechanisms and incentives to drive area-based conservation in traditional authority areas and realising the opportunity to advance protection

of threatened vegetation through the targeted rezoning of properties, represent the most important interventions to scale area-based conservation in Durban. We provide innovative mechanisms to increase Durban's conservation estate, bridging the planning-implementation gap, which is potentially applicable to conservation in other biodiverse city regions of the Global South.

Keywords: conservation opportunities, urban biodiversity, co-benefits, local government, Durban

## **4.2 Introduction**

The world is experiencing a rapid and deepening anthropogenic-driven biodiversity crisis (IPBES, 2019; WWF, 2020). The Kunming-Montreal Global Biodiversity Framework (GBF), established by the 15th Conference of Parties to the UN Convention on Biological Diversity, ambitiously calls for the effective conservation of 30 percent of ecologically representative and connected terrestrial systems by 2030 (UN, 2022). The work of the Intergovernmental Panel on Climate Change (IPCC) calls for 30-50% conservation of Earth's land, freshwater and oceans in order to achieve climate resilient development (Pörtner et al., 2022). The magnitude of this task is underscored when reflecting on the previous Strategic Plan on Biodiversity of the CBD, particularly Aichi Target 11, where, despite increases in protected area extent, targets were not met, especially in terms of ecological representation (Maxwell et al., 2020), with extreme consequence for the development of a set of safe and just Earth-system boundaries (Gupta et al., 2024) Furthermore, population growth between 1995-2015 occurred at twice the rate within global biodiversity hotspots relative to the rest of the world (Cunningham &

Beazley, 2018), with projected rapid urbanisation rates of these areas representing a significant threat to global biodiversity targets (Seto et al., 2012; Simkin et al., 2022).

Against this backdrop, governments within biodiverse countries have a particular responsibility to promote area-based conservation initiatives. South Africa, a signatory of the CBD, has responded to this call through a *White Paper on Biodiversity Conservation and Sustainable Use* (DFFE, 2023a) and a *Draft National Biodiversity Economy Strategy* (DFFE, 2024). These policy advancements include specific goals linked to rapid increase in area-based conservation in line with the GBF. Importantly, and in line with GBF's 'Whole-of government, whole-of-society approach', the role of local governments in the protection of biodiversity is acknowledged (DFFE, 2023a). This is further reflected in the *White Paper on Biodiversity Conservation and Sustainable Use*, 'Enabler 1: Integrated, Mainstreamed and Effective Biodiversity Conservation and Sustainable Use: Integrated policy and practice across government...' (DFFE, 2023a). Envisioned mainstreaming in the context of local government, however, is often contextualised through the lens of "avoided loss" by integrating biodiversity concerns into spatial and land-use planning applications (Botts et al., 2019). While this represents a core mandate for local government and a critical intervention in curbing biodiversity loss, contributions to area based conservation from cities and local governments can often be undervalued (Soanes et al., 2019; Xie & Bulkeley, 2020).

The small and often fragmented nature of urban biodiversity means it is overlooked in conservation planning and protected areas expansion (Tulloch et al., 2016), despite often representing critical, globally significant areas in terms of ecological representation and persistence (Ives et al., 2016; Soanes & Lentini, 2019; Wintle et al., 2019). The increasing call for Other Effective Conservation Measures (OECMs) to play a more meaningful role in area-based conservation (Gurney et al., 2021), reflected in the GBF, provides an opportunity for

role-players outside of national and regional conservation authorities to frame area-based conservation work in the context of broader goals (Marnewick et al., 2021). This is particularly relevant for cities and local governments, like the City of Durban, that have been actively contributing towards protection of biodiversity protection for several decades (Chapter 3).

Located within the Maptualand-Pondoland-Albany (MPA) biodiversity hotspot (Mittermeier et al., 2005), Durban is one of 33 hotspot cities across the global biodiversity hotspots that have a particular responsibility to ensure the protection of globally significant and threatened assets (Weller et al., 2017). The City of Durban has sought to address biodiversity concerns by developing tools for biodiversity protection, management models to address threats to conserved areas, and active habitat restoration interventions. These mechanisms are context specific, often linked to land tenure types, and have varied in level of effectiveness (Chapter 3). In an increasingly options-poor environment (EThekweni Municipality, 2020), identifying potential opportunities to secure areas represents a critical step in informing area-based conservation strategies. Importantly, and speaking directly to the service delivery mandate of local government, the value of protection of natural areas represents essential nature based solutions to advance ecosystem service delivery and adaptation to climate change (Pörtner et al., 2021).

Using city level spatial data, we aimed to provide an overview of potential opportunities that, if realised, would advance area-based conservation in the city, and the multiple co-benefits associated with it.

The objectives of this paper were, therefore, to:

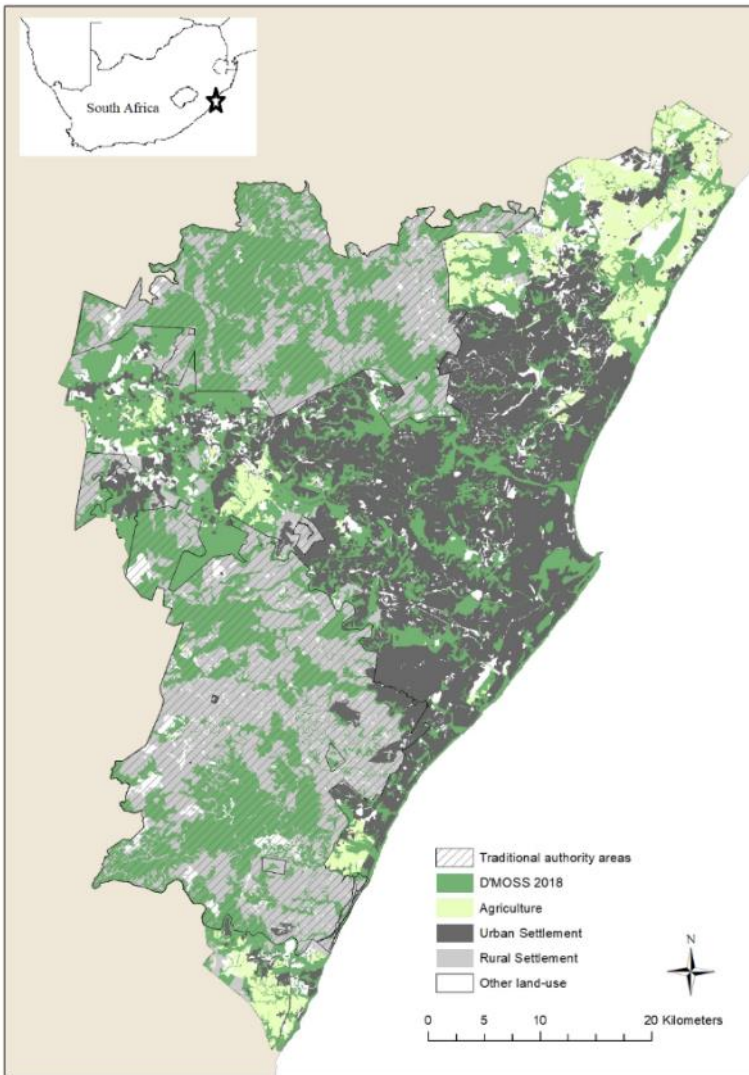
- 1) Spatially identify the extent of terrestrial biodiversity features outside of the current conservation area network, and across land tenure types.

- 2) Identify opportunities to increase the conservation area estate using existing local government conservation mechanisms across land tenure and biodiversity feature types.
- 3) Identify priority areas where existing mechanisms are less suited to achieve conservation outcomes and would require alternate mechanisms to promote area-based conservation.
- 4) Assess the feasibility of these opportunities/mechanisms. potential effectiveness, policy and practice requirements to advance these opportunities/mechanisms and co-benefits for building climate change resilience.

## **4.3 Methods**

### 4.3.1 Study area

The 2 556 km<sup>2</sup> City of Durban is administered by the eThekweni Municipality in the province of KwaZulu-Natal (KZN), South Africa (McLean et al., 2020) (Figure 4.1). The variety of landforms and climatic conditions in the eThekweni Municipal Area (EMA), as well as its unique biogeographical position, in the centre of the Maputaland-Pondoland-Albany global biodiversity hotpot (Mittermeier et al., 2005), has resulted in a wide range of terrestrial and aquatic ecosystems that are home to a rich diversity of organisms (Boon et al., 2016). The EMA contains three of the country's nine terrestrial biomes viz, savanna, forest, and Indian Ocean Coastal Belt, and includes several threatened vegetation types, and species of conservation significance (McLean et al., 2020).



**Figure 4.1:** The eThekweni Municipal Area with main land uses, indicating the traditional authority area administered by the Ingonyama Trust Board, with the balance falling under the formal municipal scheme, and the 2018 Durban Metropolitan Open Space System (D'MOSS) (Data source: (EThekweni Municipality, 2020)).

Durban is the third largest metropolitan by population in South Africa, with approximately 4.1 million people (EThekweni Municipality, 2022), representing more than a third of the provincial population in an area that is less than 3% of the provincial total. The result is that Durban's rich natural resource base has been under significant pressure and negatively impacted over the past 150 years, initially by extensive agriculture, and then increasingly by

rapid urbanisation, resulting in the cover of the original vegetation types being reduced to approximately two-thirds (Boon et al., 2016). Rates of loss of natural habitat are particularly high in KwaZulu-Natal, averaging 1.2% per annum between 1994 and 2011, and likely to be substantially higher in the more densely populated Durban (Jewitt et al., 2015).

The socio-economic context of Durban, with a high degree inequality (Gini co-efficient = 0.62) and more than a third of the population living below the poverty line (EThekwini Municipality, 2022), further exacerbates pressure through growing informality and the increasing reliance on natural resources (EThekwini Municipality, 2020). In addition, the availability of land to support development is limited by, *inter alia*, the steep topography that characterises the city, placing additional pressure on threatened habitats types (e.g. grassland systems) that are typically associated with the flatter more ‘developable’ areas (EThekwini Municipality, 2020). Much of the remaining rural landscape falls within traditional authority areas (hereafter referred to TAAs)(Figure 4.1) administered by the Ingonyama Trust Board, that is held in trust for the Zulu people, with the Zulu King as the sole trustee (Nel, 2021). This creates a unique and complex dual governance system, where the municipality is responsible for land-use planning and management in terms of the land-use scheme for the entire area, but is only the formal authority in non-TAAs (EThekwini Municipality, 2022).

#### 4.3.2 Biodiversity spatial datasets applied in analyses

##### *Durban Metropolitan Open System and Critical Biodiversity Areas*

The Durban Metropolitan Open Space System (D'MOSS) represents the city's flagship environmental product, and is defined as ‘A series of interconnected open spaces under public, private and traditional authority ownership that seeks to protect biodiversity and ecosystem

services for future generations' (EPCPD, 2017). This product, totalling 95 000 ha in extent, has evolved significantly in terms of legal status and underlying methodology, with its greatest contribution to biodiversity protection being in the form of avoided loss (Chapter 2). D'MOSS is not a land-use zone, but rather a development control overlay that requires land-use applications be assessed, and approval granted, prior to development proceeding (EPCPD, 2017). Biodiversity protection and management reporting within the annual *Durban State of Biodiversity Report* is also communicated as percentages of D'MOSS (EThekweni Municipality, 2024a).

A key informant in the development of D'MOSS is the critical biodiversity areas layer, which is the outcome of *Durban's Systematic Conservation Assessment* (SCA) (McLean et al., 2020). This layer is a spatial representation of features important for meeting the City's conservation targets, including vegetation/ecosystem types and species of conservation concern (McLean et al., 2020).

#### *Vegetation types*

Changes to D'MOSS are informed by, *inter alia*, the SCA (McLean et al., 2020). Habitat types represent a key component of the SCA as biodiversity surrogates, and, as such, the City has undertaken a fine-scale (1:5000) landcover map for the municipality, which includes vegetation classification and ecological condition (McLean et al., 2020). Due to the fine-scale nature of underlying layers (e.g. geology and digital elevation models) there are boundary differences between the vegetation map for Durban and other spheres of government. For the purposes of this paper the local vegetation data used in analyses were restricted to threatened vegetation types. Table 4.1 describes the different vegetation types used, closest provincial equivalent, and associated threat status (Jewitt, 2018).

**Table 4.1:** Vegetation types used in this paper, the closest provincial equivalents, and associated provincial threat status.

<b>Broad Type</b>	<b>Municipal vegetation types</b> (McLean et al., 2020)	<b>Provincial vegetation types</b> (Jewitt, 2018)	<b>Provincial threat status</b> (Jewitt, 2018)
Forest	Dune Forest	Dune Forest	Critically Endangered
	Coastal Forest and Grassland Mosaic	Coastal Forest	Critically Endangered
Grassland	Grassland other geologies above 450m elevation	Dry/Moist Coast Hinterland Grassland	Vulnerable/Critically Endangered
	Grassland other geologies below 450m elevation	Indian Ocean Coastal Belt Grassland	Critically Endangered
	KwaZulu-Natal Sandstone Sourveld_above_450m	KwaZulu-Natal Sandstone Sourveld	Critically Endangered
	KwaZulu-Natal Sandstone Sourveld_below_450m	Indian Ocean Coastal Belt Grassland	Critically Endangered

#### *Existing conservation areas*

The Biodiversity Management Department maintains a database of conserved areas that fall within the municipality. Among the more significant contributors to conservation areas, and relevant to the identification of future conservation areas, include: proclaimed nature reserves (provincial and municipal); land acquired for conservation; areas zoned for conservation; and conservation servitudes (EThekweni Municipality, 2024a). Descriptions of these respective mechanisms are provided for in Table 4.2. As of June 2023, the reported conservation area network totalled 7020 ha, representing 7% of D'MOSS and less than 3% of the municipality (EThekweni Municipality, 2024a).

**Table 4.2:** Overview of current mechanisms applied in the protection of biodiversity (adapted from Chapter 3).

<b>Mechanisms Applied</b>	<b>Policy Environment</b>	<b>Contribution to Biodiversity Protection</b>
<b>Conservation Zone</b>	<p>A Conservation Zone is land (not publicly owned, nor declared as a protected area) dedicated to the conservation and management of natural areas of land and/or water for the ecosystem services that the areas provide, biodiversity that they support, and/or their landscape, historic or scientific interest values.</p> <p>The Spatial Planning and Land Use Management Act no. 16 of 2013 (SPLUMA), and eThekwini Municipality Spatial Planning and Land Use Management Bylaw, 2016 provide the legal context for implementation</p>	<p>Introduces land-use controls on private land parcels that prevents transformation of the natural asset. Intended to be applied on privately owned land, and envisioned primarily for split zoning of properties, where the environmental feature is protected while the remaining area has a development type land-use.</p>
<b>Environmental Conservation Reserve</b>	<p>Publicly owned land dedicated to the conservation and management of natural areas of land and/or water for the ecosystem services that the areas provide and the biodiversity which they support.</p>	<p>Applied to state owned land that has typically been purchased by Biodiversity Management Department or municipal nature reserves (typically conversion from Public Open Spaces), introducing land-use controls that prevents transformation of natural assets. This zone is currently applied on land proclaimed as Protected Areas (in terms of the National</p>

	<p>The Spatial Planning and Land Use Management Act no. 16 of 2013 (SPLUMA), and eThekweni Municipality Spatial Planning and Land Use Management Bylaw, 2016 provide the legal context for implementation</p>	<p>Environmental Management: Protected Areas Act 57 of 2003) and sites that would be considered OECMs.</p>
<p><b>Land Acquisition</b></p>	<p>The only annual Municipal capital budget item aimed at securing biodiversity in support of Programme 3 of Plan 1 of the Integrated Development Plan (IDP) which outlines the requirement for ensuring long term sustainability of Durban's natural resource base.</p>	<p>Targeted implementation mechanism with a particular emphasis on conserving threatened habitats and/or supporting the expansion of existing conservation areas. Transfer of property from private individuals with possible development aspirations to a local government department.</p>
<p><b>Conservation Servitudes</b></p>	<p>Typically applied as condition of approval during a development assessment processes. Environmental Impact Assessments, land subdivisions and multi-unit development applications are examples of development application types where this mechanism is more frequently used.</p> <p>These servitudes are as a result of D'MOSS inclusion within the land-use scheme, The Spatial Planning and Land Use Management Act no. 16 of 2013 (SPLUMA), and eThekweni Municipality Spatial Planning and Land</p>	<p>A servitude is registered against the property's title deed in favour of the municipality. Ownership and management responsibility remain with the applicant and use of the area is permitted if the activity does not impact the ecological integrity of the underlying feature.</p>

### 4.3.3 Opportunity analyses

All analyses for this work was undertaken using ArcMap 10.7.1 (ESRI, 2019). Each of the identified opportunities were analysed against the biodiversity spatial datasets contained in 2.2. to identify potential contributions to the conservation estate.

#### *Current protection status across land tenure types*

As reflected in 2.2.4., mechanisms applied to increase Durban's conservation estate are context specific and directly related to tenure type. To identify opportunities for conservation area expansion it was, therefore, important to understand the spatial distribution of biodiversity features in terms of land tenure. Land tenure was derived from the municipality's land tenure dataset, and supplemented with additional tenure layers, viz. municipal owned land, TAAs and the general valuation roll (eThekweni Municipality, 2024). Tenure types were categorised into: (1) municipal; (2) national and provincial state; (3) state owned entities; (4) private; (5) traditional authorities; and (6) undetermined land ownership. Existing protected and conservation areas were removed from the analysis, with the remaining areas of D'MOSS, CBAs and threatened vegetation types identified against the land tenure types.

#### *Conservation servitudes*

Conservation servitudes have been applied as part of conditions of development assessment processes, where a development footprint is approved subject to the registration of a

conservation servitude in favour of the municipality (Chapters 2 and 3). Compliance with these conditions have been inconsistent and, as a result, several areas have yet to be included within the conservation area estate. Properties identified for conservation servitudes are recorded in the Biodiversity Management Department's development application database. These records were joined to the property boundaries layer and merged with the municipality's servitudes layer to determine the number of properties that have yet to have conservation servitudes registered. The biodiversity spatial layers were then applied to these properties to indicate the area of remaining D'MOSS, CBAs, and threatened vegetation that would potentially be added to the conservation estate through formalising these.

#### *Land-use zone complementarity*

The municipal area has evolved considerably of the past 40 years, including the amalgamation of 40 local municipalities in 1996, and inclusion of TAAs in both 2000 and 2016 (Chapter 2). Currently, there are five land-use sub-schemes within the municipality, with several passive land-use zones that are consistent with conservation purposes, but which have yet to be included in the conservation estate. Progress has been made in the zoning of certain municipal nature reserves and acquired sites to Environmental Conservation Reserve (ECR) (Boon et al., 2016); however, there are several properties where this has not taken place (Chapter 3). The different zones within the five schemes were analysed for consistency with the preferred zones for public (ECR/Nature Reserve) and private (Conservation Zone) conservation purposes. Potentially complementary zones were extracted from the schemes (EThekweni Municipality, 2023e, 2023c, 2023d, 2023b, 2023a) and combined to produce a single layer. These data were then analysed against the different environmental masks as per 2.2 to determine potential contributions to the conservation area estate.

### *Disaster risk complementarity*

Disaster risk areas are considered to undevelopable due to bio-physical constraints (supported by land-use policy/legislation constraining development of such land) and represents a risk to people and infrastructure. The four disaster risk areas considered in this analysis were:

- i) Steep land - Durban's landscape is characterised by undulating topography, with steep valleys and gorges. Land-use policy within the municipality suggests that development should not be undertaken on slopes steeper than 1 in 3 without an approved geotechnical plan (EThekwini Municipality, 2022).
- ii) Flood-risk areas - The nature of the topography includes several small catchments within the EMA, resulting in a large network of approximately 4000 km. In terms of disaster risk, the 1:100 year flood-line is reflected in land-use policy, and land within this line is considered as non-developable (EThekwini Municipality, 2022).
- iii) Unstable land - Certain geological types also represent a risk to potential development to infrastructure as a consequence of slip failures, and are areas where development is not supported (EThekwini Municipality, 2022).
- iv) Coastal erosion risk areas - As Durban is a coastal city, it is at risk from the impacts of sea level rise and coastal storm events, leading to the development of a coastal erosion zone for the city (EThekwini Municipality, 2020).

These data, which formed part of the first phase of Durban's Strategic Environmental Assessment (EThekwini Municipality, 2020) were combined and overlaid with the different biodiversity spatial layer to indicate the total area of overlap, and also expressed as a percentage

of the overall feature. All existing protected and conservation areas were removed from these analyses. These data were then used to determine area contributions across the biodiversity spatial layer related to properties that are located immediately adjacent to existing conservation areas. As all currently conserved areas fall outside of TAAs, land under TAA tenure was excluded from the analysis.

### *Targeted split-zonings*

Rezoning land for conservation purposes represents a key mechanism for local governments to advance biodiversity protection. Several properties, often with parts of the property already developed (e.g. suburban residential areas), contain remnant patches of threatened vegetation. Including these remnant patches in the conservation estate through appropriate rezoning represents an important and largely unrealised opportunity in Durban (Chapter 3). This can be achieved through split-zoning the property, where the developable portion of the property retains the existing development-type zone (e.g. residential, industrial) and the remaining environmental feature is protected through an appropriate zone (e.g. CZ or ECR). Associated with this split-zoning can be provisions to allow an increased developable density on the development-type zone.

To identify potential opportunities for application of this mechanism certain filters were applied:

- i) Only threatened vegetation types were used as these have the highest level of legislative protection in development assessment applications and are, therefore, likely to represent a development constraint.

- ii) Acknowledging the administrative burden associated with such a process and promoting the protection of larger sites, only properties with > 500 m<sup>2</sup> of threatened vegetation were considered.
- iii) As this mechanism is not intended to sterilise development opportunities on individual sites, properties with < 80% threatened vegetation coverage of the property were considered. Properties over this threshold were considered in 2.3.6.

#### *Land acquisition, donations and offset receiving areas*

The land acquisition programme has been in existence since 2002 and contributed approximately 783 ha to the conservation estate, with particular success noted in the protection of threatened ecosystems (Boon et al., 2016) and the expansion of existing conservation areas (Chapter 3). Prioritisation processes have, to date, relied on expert-based approaches, informed by socio-ecological information for each site, and/or reactive responses to threats associated with the potential development of high biodiversity sites. Budget is a limiting factor in land acquisition, however, this factor is only considered once properties have been identified for acquisition. To ensure that the mechanism performs effectively, incorporating costs early in the prioritisation process can provide the basis for setting realistic annual targets and moving towards the efficient use of available funding.

To identify opportunities for land acquisition, based on property cost, the following approach was taken:

- i) Due to the financial constraints of the land acquisition mechanism for area-based conservation, it is considered a last resort for protection and/ or sites of strategic importance. Complementing the approach taken in 2.3.5 only properties with > 80% threatened vegetation coverage of the property were considered. This filter assumes

that protection of biodiversity features at this scale would likely limit development potential and therefore compensation would be necessary to ensure the area is included in the conservation estate.

- ii) The municipality maintains a registered parcels layer that includes a market value field, which is an indicative property value used in property rates (property tax) calculations. These values, and the area of threatened vegetation contained in each property were used to generate a cost per hectare for each of the properties.
- iii) The cost per hectare values were then used to determine theoretical potential outcomes based on an annual R3 million over a five-year period, and an average cost per hectare of threatened vegetation for these properties was generated.

Over the course of the land acquisition programme, various state-owned land has been donated to the Biodiversity Management Department. This is particularly associated with properties with limited development potential and, therefore, often unsuitable for the purposes of the relevant state department (e.g. provincial housing). State owned properties meeting the same criteria of < 80% threatened vegetation coverage were selected as sites for potential future donation by state department.

#### *Opportunities in traditional authorities*

In terms of customary law, land allocation in TAAs is the responsibility of the Inkosi (Chief) in each traditional authority (Torquebiau et al., 2012). As there are 32 traditional authorities in the municipality, it is important to understand the distribution of biodiversity features within the TAAs to prioritise areas where the best conservation outcomes could be achieved. Biophysically constrained CBAs (as per 2.3.4) and threatened vegetation were intersected with the 32 traditional authorities to determine the potential relative contribution of these areas to

biodiversity conservation. Biophysically constrained CBAs were used as they represent areas of limited development potential, and, therefore, may offer an opportunity to engage with traditional leaders around land that is naturally aligned to biodiversity conservation.

#### 4.3.4 Feasibility, effectiveness, implications for policy and practise, and climate resilience co-benefits

In order to advance these opportunities/mechanisms in terms of practical application, an analytical framework was used to examine: 1) Feasibility; 2) Potential effectiveness; (3) Implications for policy and practise; and (4) Potential co-benefits for climate change resilience.

Feasibility in this context refers to the practicality of realising the conservation opportunity based on several areas, including: (1) technical feasibility – mechanisms that are available to implement conservation action; (2) economic feasibility – budget available to implement actions; (3) Institutional feasibility - presence of governance frameworks and institutional support to implement actions; and (4) social feasibility – indication of landowner and public support for conservation actions and alignment with socio-cultural values. High feasibility indicates projects that can be implemented with limited barriers across the four criteria; moderate feasibility indicates the presence of challenges in implementation that will require addressing (e.g. focused landowner engagement), while low feasibility indicates significant barriers that will require innovation and major changes to realise opportunities. These rankings are informed by the outcomes of Chapter 3 with regards to historic performance of mechanisms across land tenure types

Effectiveness in this context refers to the potential of the opportunity to contribute to broader biodiversity and sustainability goals if successfully implemented, and is based on several

criteria, including: (1) biodiversity effectiveness – protection of important biodiversity features (e.g. habitats and species); (2) management effectiveness - sustainability of management activities (e.g. invasive alien plant control and fire management); and (3) societal effectiveness – contributing towards the delivery of ecosystems services and disaster risk reduction. High effectiveness refers to opportunities that if realised would result in long-term biodiversity protection and management, with sustained societal benefits (e.g. delivery of ecosystem services and disaster risk reduction). Moderate effectiveness indicates opportunities that would likely require adjustment to maximise positive benefits. Low effectiveness indicates mechanisms/opportunities that are unlikely to contribute significantly to biodiversity and societal outcomes.

## **4.4 Results**

### **4.4.1 Environmental features across land tenure types**

The distribution of D'MOSS, CBAs and threatened terrestrial vegetation types, outside existing conservation and protected areas, relative to land tenure (Table 4.3), represent the areas where future conservation expansion initiatives will need to take place. TAAs represented the most significant tenure type in terms of Durban's natural resource base, with several of the largest more connected natural areas, as reflected by 68% of CBAs falling within these areas. This represents a significant governance challenge for local government-led conservation initiatives due to the ineffectiveness of current mechanisms in achieving conservation outcomes under this tenure type (Chapter 3). Private land represented the next most significant tenure type, ranging in contribution across the environmental masks from 19 - 38%. The relatively large contribution towards threatened vegetation was due to remaining coastal forest systems falling

under this tenure type. Government land combined (Municipal, Provincial, National, and State-owned entities) represented 8 - 12% of the biodiversity spatial layers. Given the city's relative success in the rezoning and proclamation of public land (Chapter 3), this represents an important opportunity for future conservation area expansion.

**Table 4.3:** Area of each land tenure type within each environmental mask (Durban Metropolitan Open Space System (D'MOSS), Critical Biodiversity Areas (CBAs), and Threatened Vegetation Types).

Tenure type	Tenure type						
	area within the municipality (ha)	D'MOSS Area		CBAs Area		Threatened Vegetation Area	
		(ha)	(%)	(ha)	(%)	(ha)	(%)
<b>Municipal</b>	20944	6101	7	1999	4	632	5
<b>National and Provincial</b>	14023	3346	4	1446	3	525	4
<b>State owned entities</b>	5377	1086	1	447	1	273	2
<b>Private</b>	84076	19574	22	9673	19	4738	38
<b>Traditional Authorities</b>	113984	53314	61	34810	68	5598	45
<b>Undetermined</b>	17530	4172	5	2613	5	804	6
<b>Total</b>	255936	87592	100	50988	100	12570	100

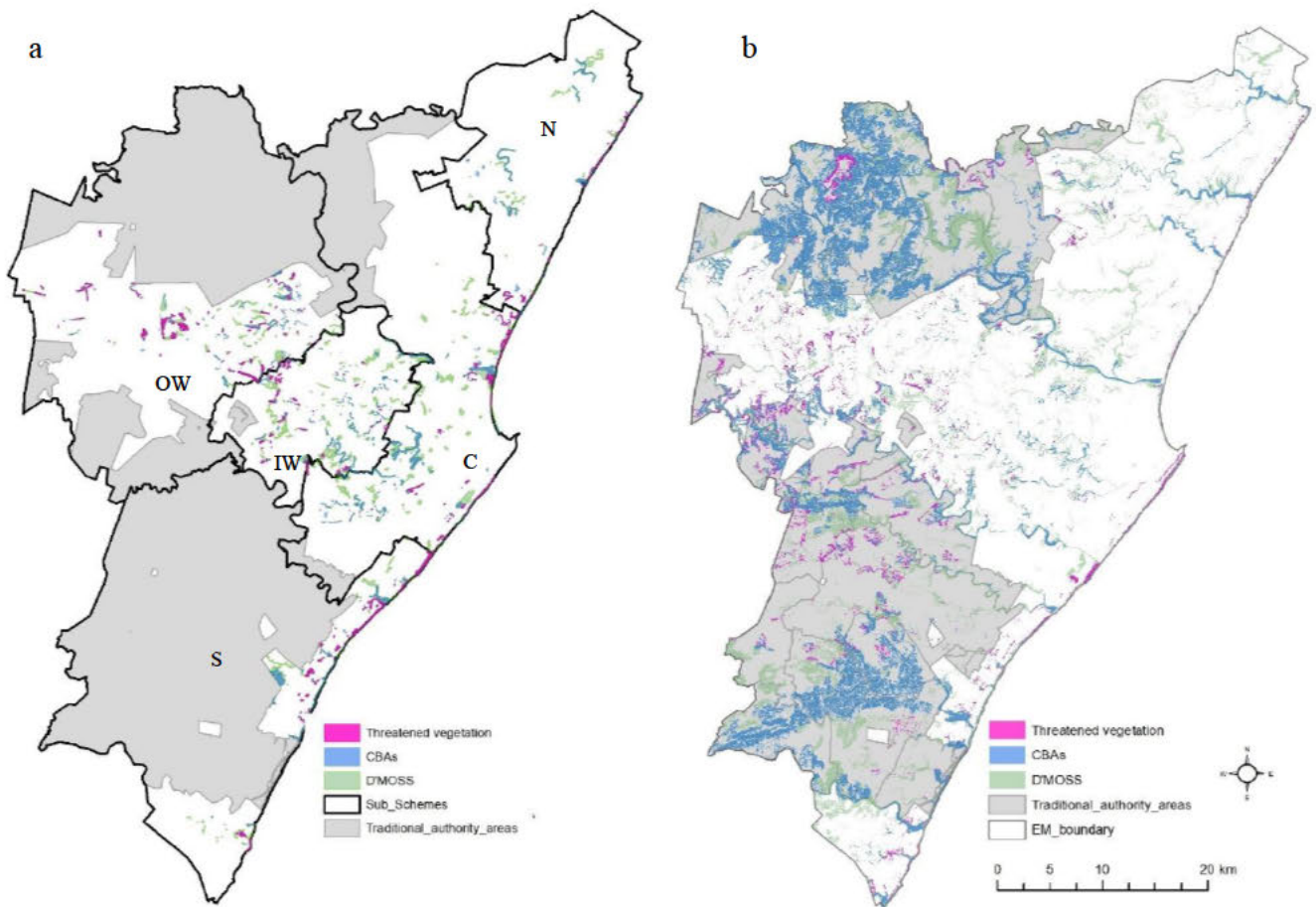
#### 4.4.2 Conservation servitudes

Conservation servitudes represent an important mechanism for protecting biodiversity features during development assessment processes as conditions attached to the approval of a development. A total of 800 properties were identified as requiring a conservation servitude as a result of a development assessment, of which 309 had not been surveyed. The 309 properties included: 2358 ha of D'MOSS; 1449 ha of CBAs; and 276 ha of threatened vegetation. These figures represented the areas of the biodiversity spatial layers across the entire land parcel and were likely overestimations of the footprint required to be set aside as a conservation servitude as the condition of development approval. The intention of the mechanism, however, is to

protect remaining biodiversity features, and the remaining areas of threatened vegetation, and to a lesser extent CBAs, provided an indication of what area within conservation servitudes could be added to the conservation area network. Protection of remaining threatened vegetation through this mechanism would increase the area of threatened vegetation in the conservation areas network by 11%.

#### 4.4.3 Land-use zone complementarity

A total of 21 passive or conservation aligned zones were selected from the five land-use sub-schemes for the municipality (Figure 4.2; supplemental material Table S4.1). In total, 3315 ha of D'MOSS, 1326 ha of CBAs and 523 ha of threatened vegetation were present within these zones (Figure 4.2). Public Open Space (POS) zones represented the greatest contributor across the environmental masks, and provides an important opportunity to, where appropriate, rezone this land to ECR and incorporate it within the City's conservation area network. In this regard, the focus of any rezoning exercise should be on CBAs and threatened vegetation with POS zones, as D'MOSS incorporates several areas of POS (e.g. golf course and recreational parks) that may not require the level of protection and associated management associated with the ECR zone. The development history of Durban, with several changes in municipal extent, incorporation of local councils, and with five land-use planning schemes, has resulted in several legacy zones that could be incorporated into the conservation area network. These will need to be either rezoned to Conservation Zone (private land) or ECR (public land) depending on land tenure. The incorporation of the 523 ha of threatened vegetation identified should be prioritised within this process, as this would equate to a 22% increase of threatened vegetation within the conservation area network.



**Figure 4.2:** a) across five land-use sub-schemes (C = Central, IW = Inner West, N = North, OW = Outer West, S = South) and traditional authority areas; b) Spatial overlap between biodiversity spatial layers (D'MOSS, CBAs, and Threatened Vegetation Types) and bio-physical constraints across the extent of the municipality, and including traditional authority areas.

#### 4.4.4 Bio-physical development constraints

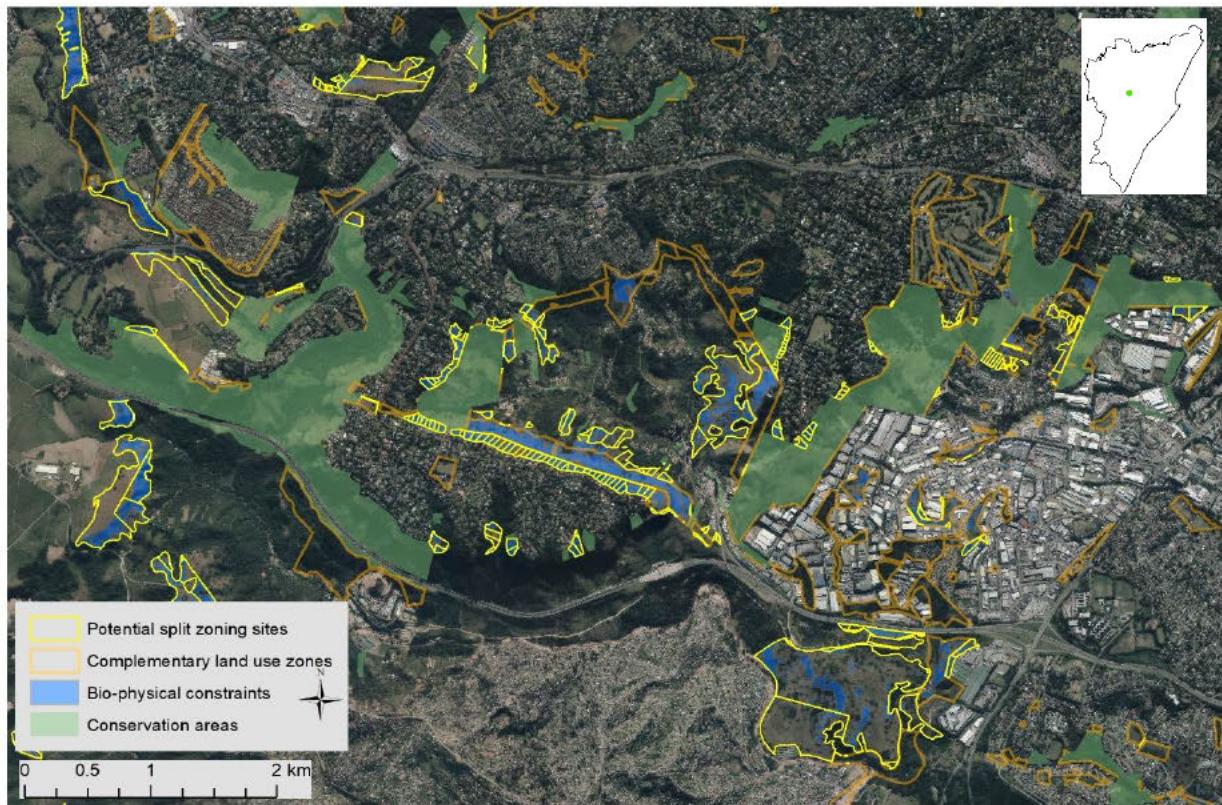
The spatial overlap between the biodiversity spatial layers and the generated bio-physical constraints layer indicated a high degree of spatial congruence (Figure 4.2b). A total of 53 291 ha of D'MOSS, 32 181 ha of CBAs and 4 553 ha of threatened vegetation fall within the bio-

physical constraints layer. This equates 61 % of D'MOSS, 63 % of CBAs and 36% of threatened vegetation outside of the existing conservation network. The lower percentage overlap recorded for threatened vegetation relative to D'MOSS and CBAs is due to the association of grassland systems with lower gradients where development is not bio-physically constrained, and highlights transformation risk posed to these already threatened systems. There are several ways in which these data could be used, including: (1) informing development assessment comments; (2) identifying areas for future conservation action (see 3.5 and 3.6); and (3) the expansion of existing conservation areas. In terms of the latter, a total of 4913 ha of D'MOSS, 2750 ha of CBAs and 796 ha of threatened vegetation that overlap with the biophysical constraints layer, are located adjacent to existing conservation areas. The inclusion of these areas through an appropriate mechanism (e.g. conservation zone) would lead to the promotion of larger conservation areas, with the biodiversity representativity and persistence benefits that come with it, but, importantly, this process would add to areas where pre-existing conservation land-management activities are undertaken by the municipality (e.g. invasive alien plan control).

#### 4.4.5 Targeted split-zonings

A total of 2008 properties contained more than 500 m<sup>2</sup> of threatened vegetation, with less than 80% total property coverage, and represented a total area of 4908 ha of threatened vegetation. The intention of split zonings is to promote the protection of remaining biodiversity features on land without compromising a landowner's development opportunities. In this regard, the 80% threshold filter applied may be considered too restrictive, but a counter argument is that this analysis is restricted to threatened vegetation types, and in most cases Endangered or Critically Endangered ecosystems with legislative protection against transformation. Importantly, more than half of the properties are adjacent to existing conservation areas and

total 3160 ha (64% of the total area identified for split-zoning potential), potentially providing an opportunity to increase the size of existing conservation areas with established management activities. Such a mosaic of complementary land-uses and split zoning of predominantly private properties (where development potential had already been realised) can provide near contiguous connectivity with existing conservation/managed areas in the Durban's outer west planning region (Figure 4.3). Furthermore, there is considerable overlap between the proposed split zoning areas and biophysical constraints layer, providing additional motivation to provide appropriate protection and management to these areas.



**Figure 4.3:** An example of how split zoning and complementary land-use zones could combine to promote protection and connectivity between existing conservation areas (Giba Gorge to the West and Kloof South Escarpment to the East). Inset: location with the eThekweni Municipality. Biophysical constraints were also intersected with the proposed properties for split-zoning to illustrate limited development potential over many of these properties, and how these two elements together can enhance connectivity.

#### 4.4.6 Land acquisition, donations and potential offset receiving areas

A total of 197 government owned properties, excluding those identified in 4.4.2., with > 80% of the property covered by threatened vegetation, were identified. This equated to 171 ha of threatened vegetation. Given the limited development potential associated with these sites, opportunities to transfer these areas to the municipality’s biodiversity management department,

or rezoning to ECR, should be explored. This would not only add areas to the conservation estate, but alleviate the land management responsibility for state departments where conservation management is not a core mandate.

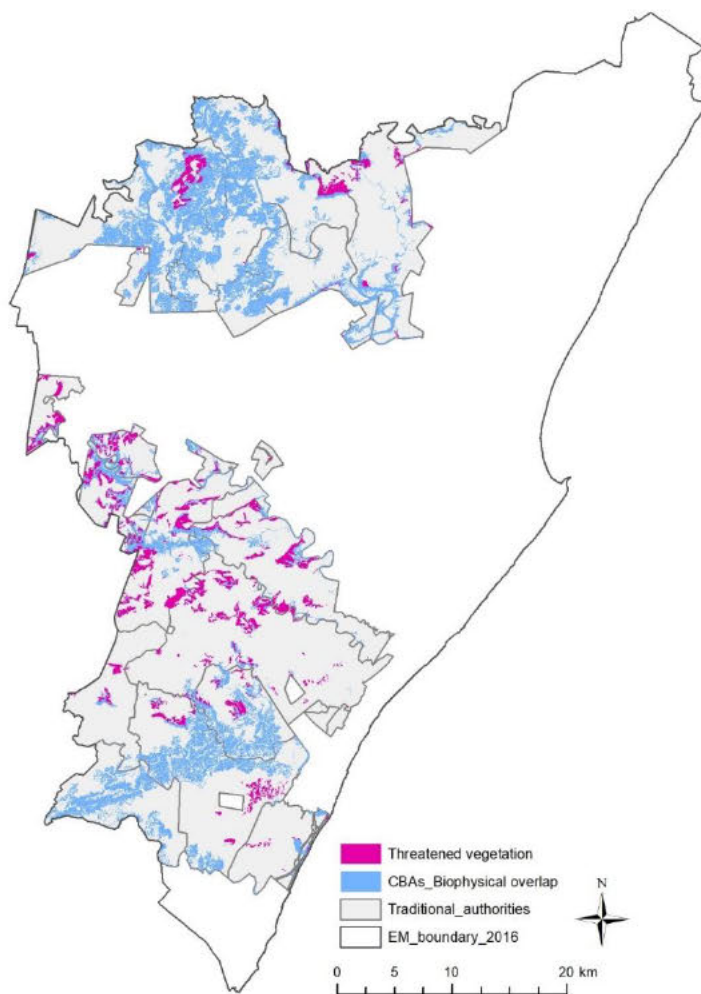
Applying the same coverage filter to land other than state and TAAs, and where property information is available, identified 279 properties covering 580 ha of threatened vegetation. Given the limited potential development footprint of these areas, land acquisition may represent the appropriate mechanism for including these predominantly private owned sites within the conservations network. Thirty properties had a market value of zero and these were excluded from the cost per hectare analysis, however, these properties include 38 hectares of threatened vegetation and require further investigation into the reason for the assigned market values and opportunities to incorporate these areas into the conservation estate. Nineteen properties with a market value of over R3 million (USD 168 745, based on 1 USD = 18.10 ZAR, 18 November 2024) were also excluded, as this value exceeds the current annual land acquisition budget. Alternate options to increase protection for these 19 properties, including 105 ha of threatened vegetation, would need to be considered (e.g. rezoning a portion of the land to Conservation Zone or offset receiving areas).

Using cost per hectare of threatened vegetation and a five-year R15 million (USD 828 729, based 1 USD = 18.10 ZAR, 18 November 2024) budget, it would theoretically be possible to acquire 91 properties covering 323 hectares of threatened vegetation, representing an average cost of R 46 440 (USD 2 565, based 1 USD = 18.10 ZAR, 18 November 2024) per hectare. This analysis is purely indicative as it does not factor in other filters that are important in the land acquisition process (e.g. willing seller and proximity to managed areas), but it does provide an additional metric that can be considered in these processes to ensure that limited budget is being allocated effectively. This also highlights that the land acquisition mechanism

will need to be supplemented by other mechanisms, with landowner engagements representing a particularly important step in ensuring larger sites are protected through an appropriate mechanism.

#### 4.4.7 Opportunities in Traditional Authority Areas

The incorporation of biophysically constrained CBAs and remaining threatened vegetation across the 31 traditional authorities into large and managed conservation areas represents arguably the City's most important opportunity for significant conservation outcomes (Figure 4.4). Nine of the TAAs included 5 291 ha of threatened vegetation (supplementary material Table S4.2), representing > 90 % of the remaining threatened vegetation across this land-tenure type. The distributions of 23 370 ha of biophysically constrained CBAs is more evenly distributed, with 14 of the TAAs containing > 700 ha in each. Understanding the contribution of these different authorities is important given the degree of influence individual leaders have on land-use and allocation. Importantly, however, the connected nature of these natural areas illustrating the potential to create large connected conservation areas across TAAs (Figure 4.4).



**Figure 4.4:** The distribution of threatened vegetation, and areas of critical biodiversity areas and biophysical overlap, across all traditional authority areas.

#### 4.4.8 Feasibility, effectiveness, implications for policy and practise, and climate resilience co-benefits

The opportunities/mechanisms differed in terms of feasibility and effectiveness with land tenure representing an important factor influencing these outcomes (Table 4.4). Mechanisms targeting government land (e.g. land-use zone complementarity, targeted split-zoning of public

land) are considered highly feasible due to the presence of pre-existing mechanisms and previous successes in implementation (Chapter 3). Similarly, the potential for inclusion of these areas within established municipal land management programmes enhances effectiveness. Direct engagement with the public sector departments is required, and framing these interactions based on limited development potential of these areas and/or the potential for management support through the municipal land management programmes represent policy and practice requirements that could assist in promoting improved conservation status of these areas.

Social feasibility, in terms of potential landowner support, reduced feasibility scores for mechanisms targeting private land (e.g. targeted split zoning on private land and land acquisition), which is based on previous outcomes from large-scale rezoning processes (Chapter 3). Although an established mechanism for biodiversity protection, budget limitations prevent land acquisition from receiving a higher feasibility score. Conservation servitudes, in contrast to the other private land focused mechanisms, is less impacted by social feasibility as the mechanism seeks to enforce the landowner's legal requirement to protect these sites, and, therefore, contributed to the mechanism receiving a high feasibility score. In terms of policy and practice requirements, administrative action may be required to ensure that these required servitudes are surveyed and registered. A more practical and efficient solution could be for the municipality to rezone to Conservation Zone the features highlighted in the conditions of approval within land-use decision notices. The risk of inconsistencies in management approach reduced potential effectiveness across the private land targeted mechanisms (i.e. conservation servitudes, and targeted split-zoning on private land). Improving effectiveness will require policy and practice interventions such as management support, through the inclusion of these

sites within existing land management programmes, and/or providing a suite of incentives (e.g. property rebates, management advice and training).

The bio-physical constraint layer is an outlier in that it traversed land tenure and represented a potential input for operationalisation by other mechanisms, which did impact technical feasibility. The strong alignment with disaster risk aversion, ecosystem service supply, and limited conflict with development, however, suggested that this opportunity could be considered institutionally, economically, and socially feasible. As a consequence, this opportunity was considered moderately feasible based on all these factors. Potential effectiveness score for this opportunity was, however, considered to be high given its large spatial extent and protection of important biodiversity and ecosystem services. This represents an opportunity for coordinated municipal planning with several co-benefits linked to responsible land-use planning (e.g. disaster risk aversion). The development of a land-use zone that encompasses these multiple co-benefits should be seen as an important intervention to advance policy and practice.

Due to the considerable technical and institutional challenges faced in the implementation of biodiversity conservation projects within TAAs (Chapter 3), overall feasibility at this point was considered low. Given that TAAs harbour most of the remaining biodiversity outside of existing protected and conservation areas, potential effectiveness is high, which calls for focused effort to develop new mechanisms to advance biodiversity conservation outcomes in these areas.

There were numerous co-benefits for climate change resilience across these opportunities. Increasing areas under conservation would have both mitigation and adaptation co-benefits, but these would vary based on scale and opportunity/mechanism type. All opportunities/mechanisms provided additional habitat to allow species movement, but

mechanisms like land acquisition and conservation servitudes were more specific in their focus on corridor and refugia protection. Land-use zoning complementarity, targeted split zoning, biophysically constrained CBAs, and TAAs represented opportunities at scale that could contribute to service delivery and disaster risk management.

**Table 4.4:** The feasibility and effectiveness of different opportunities/mechanisms for area-based conservation (ranked High, Moderate, low).

Policy and practice requirements, and co-benefits for climate change resilience.

<b>Mechanism/Opportunity</b>	<b>Feasibility</b>	<b>Score</b>	<b>Effectiveness</b>	<b>Score</b>	<b>Required policy and practice steps</b>	<b>Co-benefits for climate change resilience</b>
Conservation Servitudes	Landowners legally required to formally protect sites due to conditions in the land development decision issued by the municipality.	High	Although the mechanism will lead to long-term protection of the sites, the majority of these sites are privately owned which presents a risk of inconsistencies in approach and management effectiveness	Moderate	Legal enforcement of conditions of development approval, and/or rezoning process to be undertaken to secure these sites.  Investigate the inclusion of these sites into large-scale municipal land management programmes or adjacent protected/conservation areas to improve management outcomes.	An important mechanism for creating corridors for the movement of species and expansion of existing conservation areas that improves service delivery from these areas.
Land-use zone complementarity	Current passive land-uses already in line with conservation objectives, and many of the sites are under state ownership meaning limited financial obligations,	High	Most land is under state ownership and could be included in municipal land management programmes, providing long-term security to important biodiversity and ecosystem service areas.	High	Direct engagement with line-functions and other landowners to undertake targeted rezoning process,  Inclusion within municipal land management programmes may act as an incentive to alleviate management burden for landowners.	Relatively large increase in the potential conservation area providing additional biodiversity refugia. The majority of the areas fall within the older urban areas of Durban and, therefore, have direct implications for the delivery of key services relating to adaptation (e.g. urban cooling and flood mitigation).
Bio-physical development constraints	Represents the largest spatial footprint of all mechanisms/opportunities. Limited impact on future urban development, and multiples co-benefits should align well with institutional	Moderate	This opportunity is likely to be highly effective in protection of biodiversity, and in societal contributions, particularly in flood prevention and disaster aversion.	High	Feed this information into existing mechanisms to prioritise areas for implementation, and into comments for development assessment processes.  Investigate the opportunities of creating a stand-alone zone that	Several co-benefits linked to adapting to increased flooding, coastal storm surges and sea-level rise. Important in providing altitudinal corridors across the landscape for species movement,

	and social feasibility. These will need to feed into other mechanisms (e.g. rezoning) which impacts technical feasibility, but aspects can be immediately be incorporated into development assessment processes.				extends beyond biodiversity conservation and inclusive of broader municipal goals (e.g. green infrastructure).	
Targeted split zoning	An established mechanism that is technically feasible, but that was used with contrasting success between state and private land. The number of objections received to previous rezoning processes on private land indicated current low social feasibility.	Low (private land)/ High (public land)	A particularly important mechanism for protection of threatened vegetation and the expansion of existing protected and conservation areas, which contribute to biodiversity effectiveness. Inclusion of state-owned sites in municipal land management programmes represented an important mechanism in ensuring management effectiveness. Potential inconsistencies in management approach on private land limited management effectiveness	Moderate (private land)/ High (public land)	<p>Prioritisation of sites adjacent to existing conservation areas.</p> <p>Active engagement with targeted public institutions.</p> <p>Targeted communication strategy for private landowners that includes impacts of intervention on development aspirations, existing development limitations due to the presence of threatened biodiversity, management support, and incentives available.</p>	An important mechanism for creating corridors for the movement of species and expansion of existing conservation areas. that improves the delivery of services from these areas thereby increasing resilience.
Land acquisition	An established programme for strategic biodiversity protection. Budget availability reduced economic feasibility for scaling. Landowner willingness was a factor impacting social feasibility.	Moderate	An effective programme for targeting important sites for conservation, with established management support.	High	<p>Inclusion of cost data into the more robust prioritisation process.</p> <p>Active engagement with tarded public intuitions around potential land donations.</p>	Targeted protection of critical refugia, corridors for species movement, and expansion of existing conservation areas, that enhances resilience.
Traditional Authority Areas	The most important land tenure type for broader conservation objectives.	Low	Large biodiverse areas that would contribute significantly to	High	The biophysically constrained CBA layer should be seen as a priority for integration into TAA land-use	Largely located in the hinterland of the City offers opportunities to protect

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<p>Ineffectiveness of current mechanisms for biodiversity conservation negatively impacts feasibility criteria (technical, economic, institutional, and social).</p>	<p>biodiversity conservation, supply of ecosystem services, and protection of rural landscapes.</p>	<p>planning, and as the basis for the development of a context sensitive communication strategy.</p> <p>Reframing of threatened vegetation as a key asset that could generate funding through an appropriate mechanism (e.g. offset bank).</p>	<p>watershed areas, thereby buffering against extreme hydrological changes. Opportunities to create large refugia areas for species movement.</p>
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## 4.5 Discussion

This paper responded to the global call to increase the area of biodiversity under protection (CBD, 2022) by demonstrating opportunities to expand Durban's conservation estate. Importantly, we identified conservation research gaps in terms of how local governments, and particularly those within important biodiverse regions of the Global South, can contribute to broader biodiversity conservation goals (Wilson et al., 2016). This research also provides foundational information for setting data-informed and realistic annual targets for conservation area expansion, a key requirement of conservation plans (Nilon et al., 2017), and a previously identified gap in Durban's conservation expansion work (Chapter 3).

The diverse land tenure types provided both opportunities and challenges to increase the conservation estate. The value and importance of biodiversity under traditional authority and private land is being recognised as critical to achieving global biodiversity conservation goals (Garnett et al., 2018; Mitchell et al., 2018; O'Bryan et al., 2021). We emphasised the need for the development of a conservation area expansion strategy that increases focus on these tenure types, and to improve and expand the existing conservation areas toolset to have greater impact across these tenure types (Chapter 3). Opportunities identified for government owned land, particularly through the rezoning to compatible land-use zones (e.g. conversion of POS to ECR), represented short term interventions that can advance area-based conservation through local government's key mandate of land-use planning (Allred et al., 2021), and unnecessary heterogeneity in planning schemes (Gurran et al., 2015).

In a comparison between Durban and the City of Cape Town, one of the contributing factors to the differences in amount of land under protection was that Durban had yet to include undevelopable areas with its conservation network (Bux et al., 2021). The considerable overlap

between the biodiversity spatial layers and biophysically constrained land emphasises the importance of including undevelopable land into the conservation estate as it represents the most important opportunity in terms of spatial extent. Firstly, at the city-scale, implications for protecting these sites extend beyond biodiversity and contribute towards climate adaptation and disaster risk reduction (Akasaka et al., 2022; Kimura et al., 2019; Li et al., 2022; Ommer et al., 2022; Wickramasinghe, 2021). Landslides in the cities of Freetown (Cui et al., 2019) and Sao Paulo (Lange et al., 2018) demonstrated the danger of removing biodiversity from steep land. These are important examples for cities like Durban, and other cities of the Global South, that are characterised by undulating topography, vegetated slopes, formal and informal pressure for housing and more frequent flooding events (EThekweni Municipality, 2020; Singh et al., 2022). Given the multiple co-benefits of protecting these sites, an appropriate land-use zone may be required (e.g. Green Infrastructure) to increase the level of protection relative to the protection afforded by land-use planning overlays (NSW National Parks and Wildlife Service, 2017). This approach would promote a more integrated, cross-sector approach to land-use planning, thereby addressing an established barrier to local biodiversity and ecosystem governance (Shih et al., 2020). This type of intervention would need to be supported by appropriate policy advancements, such as China's Sloping Land Conversion Program (Chen et al., 2015) or planning ordinances in Los Angeles (Superfisky, 2023).

Secondly, most mechanisms discussed (e.g. rezoning and land acquisition) are not immediately applicable to TAAs due to the nature of the land governance system in its current form. There have been advancements in response to the call for a more integrated planning system (Sim et al., 2018) through the introduction of a single land-use scheme for the municipality and, more recently, the eThekweni Rural Spatial Framework and Draft Land Use Plan (EThekweni Municipality, 2024). The biophysically constrained CBA layer within TAAs may offer a socio-cultural sensitive product for integrating biodiversity priorities into land-use planning within

these areas. The reasons for this, include: (1) it is associated with land of limited development potential, thereby acknowledging traditional authorities should not be entirely responsible for meeting biodiversity conservation targets at the expense of their own socio-economic ambitions and agency (McDermott et al., 2023); (2) it seeks to acknowledge the natural significance of these areas that may be of cultural significance (Cariño & Ferrari, 2021; Reyes-García et al., 2022); and (3) may provide the necessary land-use security required for the municipality to invest resources into the management of such areas (e.g. invasive alien plants and fire management (Chapter 3).

Finally, the biophysically constrained layers, when used in combination with proposed zoning mechanisms, offer opportunities to operationalise area-based conservation (Chapter 3). Particularly when linked to existing conservation and protected areas, there are associated gains in economies of scale, through: (1) the presence of existing management authorities, reduced edge effects, and higher return on investment (Armsworth et al., 2011); and (2) the protection of ecological processes, consistent with Island Biogeography Theory (Diamond, 1975), through the creation of larger connected systems.

Barriers will, however, need to be overcome to realise opportunities provided through split-zoning, particularly the relative ineffectiveness of the private land focused conservation zone within Durban to date (Chapter 3). This reflection is mirrored by implementation gap for conservation servitudes (Chapter 3) and suggests that there is a more systemic issue with protection of privately owned land (Chapter 3). This implementation gap may be partially explained by the involuntary nature of the conservation mechanism and current lack of suitable financial incentives (Kamal et al., 2014) (Chapter 3). Motivation for private conservation, however, extends beyond financial and include psychological aspects linked to place attachment (Cortés-Capano et al., 2020; Drescher et al., 2017), promoting initial targeting of

land parcels immediately adjacent to existing conservation and protected areas. Effective communication is seen as an important mechanism in advancing public perceptions towards biodiversity conservation, resulting in improved outcomes (Stokes et al., 2010), but this communication needs to be targeted and context specific (Kusmanoff et al., 2020). In this regard, supplementing communication of the intrinsic value of nature (Bekessy et al., 2018), with locally relevant ecosystem services data (Turpie et al., 2017), is important in the promotion of conservation action. The use of biophysical constraints and threatened vegetation types, and associated legislative constraints, should also form a fundamental part of future targeted split-zoning projects to provide landowners with a realistic understanding of potential development footprints, and development mitigation offsets.

The inclusion of land costs in acquisition processes, as we demonstrated, contributes to increasing efficiency of the mechanism and associated conservation outcomes (Loyola et al., 2009; Rodewald et al., 2019), while acknowledging that this does not consider landowner willingness to participate (Guerrero et al., 2010). The opportunities to scale area-based conservation through the traditional approach of land acquisition, however, is limited in comparison to other opportunities, due to financial constraints and availability of suitable land (Armsworth et al., 2006; Proctor et al., 2022), but remains an essential mechanism for the conservation of strategic sites (Armsworth, 2014; Dinerstein et al., 2023). Evolution of this mechanism may be required to maximise effectiveness where budget is a limiting factor. The *purchase, protect, resell* model has been used successfully in several countries and may offer a mechanism to enhance capital budget efficiency (Hardy et al., 2018).

Operationalising the opportunities presented in this paper into meaningful conservation outcomes will differ across land tenure. Including government owned land into existing land management programmes (Boon et al., 2016)(Chapter 3) would represent a business as usual

approach to the incremental conservation gains that have been achieved over the past few decades. Realising the opportunities within TAAs and private land however, would require a shift towards a more inclusive and partnership-based conservation governance system (Armitage et al., 2020). This includes motivated individuals that can drive local conservation (Niemic et al., 2019) to larger NGOs with budgets that can drive area-based conservation through target land acquisition (Eriksen et al., 2021).

Critically, the imbalance in conservation funding between TAAs and formal municipal planning areas represents a significant barrier that needs to be overcome (Walker & Paige, 2024). We highlight elements that may contribute to the necessary framing of conservation interventions, but also that further incentives that extend beyond the current conservation toolbox of the municipality (Chapter 3) are required. Lessons from other countries that have been successful in the protection of important biodiversity on indigenous lands (Leiper et al., 2018; Ruiz-Mallén et al., 2015; Tran et al., 2020) will be important, but will need to be adapted to local context (Gavin et al., 2018). Recent national policy developments in biodiversity offsets (DFFE, 2023b) and the biodiversity economy (DFFE, 2024) offer potential enablers to develop appropriate local policy and interventions on important biodiversity land. The latter places a particular emphasis on increasing area-based conservation through the promotion of sustainable ecotourism activities that may align with closely with the bio-physical constrained CBAs within TAAs, while the threatened vegetation distribution with TAAs may provide the basis for recognition of these sites as potential offset receiving areas. Partnerships with relevant conservation NGOs may again be best placed to bridge local government and traditional authority systems (Acker, 2022; Harada et al., 2022; KimDung et al., 2016).

We identified multiple co-benefits for climate change resilience that can be achieved through the different mechanisms/opportunities. Biodiversity has been identified as one of the key adaptation themes in Durban’s Climate Change Strategy (O’Donoghue et al., 2022), however, it is unclear as to what extent this acknowledgement has led to improved biodiversity conservation outcomes. Similarly, in Durban’s Systematic Conservation Assessment (McLean et al., 2020) there are aspects that are aligned with climate change adaptation responses, but not necessarily addressed in a systematic way. Understanding and developing this relationship to create, *inter alia*, integrated land-use planning mechanisms represents an urgently needed step forward.

In conclusion, this research provides foundational information and insights for operationalising a more context-sensitive conservation strategy that integrates biodiversity protection, local governance systems, and socio-economic realities, thereby enhancing its applicability to other local governments. The opportunities presented will need to be further refined and adapted to be successfully implemented in line with recommended approaches to conservation planning (Adams et al., 2019). Urgency is required in the face of continued biodiversity loss and escalating climate change, calling for these opportunities to be further investigated in parallel to one another.

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## 4.7 Supplementary material

**Table S4.1:** Passive or conservation aligned land-use zones from the eThekweni Municipality's five land-use sub-schemes. Areas, outside of existing conservation areas, of Durban Metropolitan Open Space System (D'MOSS), Critical Biodiversity Areas (CBAs), and Threatened Vegetation Types that fall with each of the respective zones.

<b>ZONING</b>	<b>D'MOSS (ha)</b>	<b>CBAs (ha)</b>	<b>Threatened vegetation (ha)</b>
Admiralty Reserve	16.5	0.4	5.0
Amenity Reserve	152.2	102.8	9.2
Approx. Position of Future Public Open Place	0.7	0.0	0.5
Beach	177.2	61.3	33.8
Beach Amenity Reserve	15.1	1.3	0.4
Coastal Bush	37.9	35.0	38.7
Community Conservation	18.2	18.2	17.1
Conservancy	161.2	88.1	88.4
Conservation	27.2	11.1	0.0
Conservation Reserve	242.7	108.0	44.1
Conservation Zone	0.0	0.0	0.0
Environmental Conservation Reserve	71.7	56.8	25.9
Environmental Management	10.8	4.3	3.3
Future Public Open Space	0.0	0.0	0.0
Hawaan Forest Estate	0.7	3.2	0.0
Nature Reserve	0.0	0.0	0.0
Private Conservation	32.2	2.9	0.0
Private Open Space	344.7	110.9	50.7
Public Open Space	782.7	242.7	88.6
Public Open Space Reservation	1224.5	481.2	117.1
<b>Total</b>	<b>3316.2</b>	<b>1328.2</b>	<b>522.9</b>

**Table S4.2:** Extent of biophysically constrained critical biodiversity areas (CBAs) and threatened vegetation within selected traditional authorities.

<b>Traditional authority</b>	<b>Biophysically constrained CBAs (ha)</b>	<b>Threatened vegetation (Ha)</b>
QADI T.A.	1928	491
NGCOLOSI T.A.	1276	12
PHEPHETHA T.A.	2316	61
QINISELANI-MANYUSWA T.A.	1883	2
KWA KHABAZELA T.A.	734	0
SHANGASE T.A.	2214	429
XIMBA T. A.	2187	29
ILANGA C.A.	813	649
SOBONAKONA MAKHANYA T.A.	744	401
ISIMAPHLA T.A.	2706	903
VUMANGAZI T.A.	769	684
SOBONAKHONA-MAKHANYA T. A.	840	958
TOYANE T.A.	2727	436
MAPUMULO T.A.	1669	216
UMNINI TRUST	210	49
EMBO-TIMUNI	139	125

## CHAPTER 5

### **Synthesis, Conclusions and Recommendations**

In the face of a deepening biodiversity crisis (UNEP, 2024), the Global Biodiversity Framework calls for a ‘Whole-of-Government, Whole-of-Society’ approach to meet this challenge (UN, 2022). This thesis responds to the global call for local government to play an active role in responding to the global biodiversity crisis (Oke et al., 2021).

The purpose of the thesis was to determine, using Durban as a case study, the role a local government can play in contributing towards improved biodiversity outcomes. Through new case-study research, the thesis aimed to contribute to addressing the global policy to local implementation gap (Nilon et al., 2017; Shih et al., 2020), research-implementation gap (Ferraro & Failler, 2024; Knight et al., 2008), and the Global South research gap (du Toit et al., 2021; McDonald et al., 2020; Nagendra et al., 2018). This critical assessment included: (1) an evaluation of the evolution of the City’s flagship Durban Metropolitan Open System (D’MOSS), its role in contributing to avoided biodiversity loss and key factors contributing to biodiversity mainstreaming (Chapter 2); (2) an assessment of local government mechanisms applied in advancing biodiversity outcomes in terms of avoided loss, biodiversity protection, land management, and ecosystem restoration (Chapter 3); and (3) the identification of opportunities to increase the conservation estate and advance biodiversity outcomes (Chapter 4). In this final chapter, I provide a synthesis of key findings and highlight the broader implications for local governments, gaps and limitations of the research and opportunities for future research. Collectively, this study represents the most comprehensive analysis the of the City’s biodiversity conservation work to date, providing an opportunity to discuss key elements required to advance biodiversity outcomes in Durban.

This chapter consists of: (1) a summary of key findings from each chapter; (2) gaps and limitations; (3) implications of achieving biodiversity outcomes at the local government level; (4) recommendations for policy and practice; (5) recommendations for future research; and (6) the conclusion.

## **5.1. Summary of key findings**

### *Chapter 2: Biodiversity planning and mainstreaming*

Mainstreaming biodiversity considerations within land-use planning is consistently emphasised in global biodiversity assessments aimed at policymakers and practitioners (Wilson, 2023). Globally, however, the integration of biodiversity into urban planning remains limited (McDonald et al., 2018). In response to this global policy-local implementation gap, this chapter evaluated Durban's evolution in open space planning over the past four decades, with the aim of identifying crucial elements in advancing biodiversity mainstreaming across the seven iterations of the Durban Metropolitan Open Space System (D'MOSS), and the impact of biodiversity mainstreaming on spatial and land-use decision making. A mixed-methods approach was taken, combining analytical frameworks and process tracing with municipal developments assessment data. Along with my co-authors, I provide evidence of advancements in mainstreaming biodiversity concerns within local government processes, institutional functions, and land-use decision-making.

The role of science has been central to biodiversity mainstreaming with each iteration of the plan demonstrating creativity and conceptual flexibility in responding to urbanisation and governance contexts. This was done with the intention of reinforcing the open space system as a city asset important in ensuring sustainable service delivery. Critically, these approaches have

demonstrated that spatial efficiency in open space plan design was critical in gaining institutional and political support in a City where developable land is limited. This support allowed for institutionalisation, mainstreaming, and legislative advancements across the City's hierarchy of spatial planning products. These findings emphasised that policy development requires continual adaptation to socio-ecological contexts to remain relevant (Gavin et al., 2018). The importance of champions and leadership is emphasised as a key enabler in the identification of strategic direction and the ability to explore and exploit opportunities provided by available policy windows. The institutional alignment of the City's environmental function within the Unit responsible for land-use planning and decision making was a key enabler in addressing the implementation gap that plagues the conservation planning field (Ferraro & Failler, 2024; Knight et al., 2008; Watson et al., 2011). As demonstrated, this has allowed for access to, and influencing of, land-use decision making, which has contributed towards avoided biodiversity loss (Shih et al., 2020). The lack of institutional capacity is one of the most cited barriers to biodiversity mainstreaming in local government (Elmqvist et al., 2013; Manuel et al., 2016; McDonald et al., 2018; Shih et al., 2020; Wilkinson et al., 2013). The institutionalisation of scientific capacity within the municipality's environmental function has been instrumental in contributing toward avoided loss through the development of scale-appropriate biodiversity information, and the application of these data by scientists in development assessment processes.

### *Chapter 3: Local government contributions to improved biodiversity outcomes*

In response to the growing recognition of the critical role that cities and local governments must play in addressing global biodiversity loss, this chapter provided a comprehensive evaluation of Durban's local government-led initiatives aimed at increasing biodiversity protection, management, and ecosystem restoration. Using a mixed methods approach of

analytical frameworks and local government data, my co-authors and I assessed the efficacy of these mechanisms and identified barriers and associated potential enablers to improve conservation outcomes.

The number of mechanisms that have been applied and tested demonstrated the level of engagement and investment by the municipality over the past four decades. This highlights the complexity of local environmental governance in relation to biodiversity planning and management and the absence of a single solution for achieving conservation targets (Gurney et al., 2021; Lemos & Agrawal, 2006). The research revealed key areas of success in avoided loss through the mainstreaming of biodiversity concerns using land-use and spatial planning processes and products (Boon et al., 2016). In addition, important contributions were made to area-based-conservation expansion through tools like targeted land acquisition, rezoning of important public land and nature reserve proclamation (Boon et al., 2016). Critically, large scale poverty alleviation land management programmes have restored key ecological processes and contributed to addressing systemic threats of invasive alien plants that threaten conservation outcomes in fragmented urban landscapes. The socio-economic co-benefits of these programmes, and the successful reforestation programmes, have allowed for political support and scaling, which has in turn resulted in important biodiversity outcomes (van Wilgen & Wannenburg, 2016). A shared feature of the tools that have been successful is that they were utilised by a single department and implemented on government owned land. Despite these successes, several governance barriers persisted that reduced effectiveness: (1) Horizontal barriers across municipal functions in terms of translation of spatial plans to land-use schemes; (2) operational delays caused by cumbersome procurements processes; and (3) potential silos through the development of separate functions involved in the management of biodiversity assets. These barriers will need to be overcome to advance biodiversity outcomes and are further discussed in 5.3.

In contrast to the relative successes highlighted above, tools focusing on private land and Traditional Authority Areas (TAAs) yielded limited returns in terms of biodiversity protection and management, despite such land harbouring considerable biodiversity. Inadequate incentives for biodiversity protection and management were highlighted as key barriers to overcome. Promising tools such as environmental rates certificates and split zoning of private land hold significant promise, and have been successful in other parts of world (Mockrin et al., 2017; Schuster et al., 2018), but require reconceptualisation supported by a clear communication strategy for effective implementation in Durban.

This chapter highlighted that the current toolset employed by local government is largely ineffective in TAAs and calls for greater investment in these areas to address significant governance challenges. The unequal distribution of protected areas relative to household income, brings the issue of equity and justice to the forefront of future conservation work. Addressing this imbalance necessitates *reframing conservation action through the lens of reconciliation and redress* (Armitage et al., 2020). Importantly, to improve conservation outcomes in Durban, greater focus on inclusive conservation will be required, as demonstrated by mosaic governance models (Buijs et al., 2019) of the Giba Gorge Environmental Precinct and certain conservancies that combine government local and active citizenship in the management of priority areas.

#### *Chapter 4: Opportunities for area-based biodiversity conservation*

In response to the Global Biodiversity Framework's ambitious biodiversity goals (UN, 2022), this chapter explored opportunities to increase terrestrial area-based biodiversity conservation in Durban. As with other core chapters, a mixed methods approach was taken, using local government spatial information to determine the distribution of biodiversity features outside of the existing conservation network, and identify opportunities for increasing this network using

spatial congruency analyses. An analytical framework was then applied to analyse feasibility of implementation, potential effectiveness, policy and practice requirements, and co-benefits for building climate change resilience.

Through these analyses, my co-authors and I, determined that TAAs and private landholdings harbour most biodiversity features outside existing conservation areas, emphasising the need for inclusivity in future conservation work. Short term conservation opportunities were identified through the inclusion of complementary land-use zones and unrealised conservation servitudes. Aligning critical biodiversity areas with disaster risk areas offers significant potential for conservation, climate adaptation and disaster risk reduction (Akasaka et al., 2022; Kimura et al., 2019; Li et al., 2022; Ommer et al., 2022; Wickramasinghe, 2021). This information may provide an opportunity to advance mainstreaming within TAAs due to, *inter alia*, the limited potential conflict with developable areas. This emphasised the need for a more coordinated land-use planning approach across municipal sectors to deliver on these multiple co-benefits. Targeted split-zoning to protect threatened vegetation represented one of the most effective mechanisms to deliver these outcomes, and the targeting of properties immediately adjacent to existing conservation areas offered an opportunity to promote effective conservation area expansion.

## **5.2. Study gaps and limitations**

The gaps and limitations, and justifications for recommended approaches have largely been addressed in the individual chapters. A summary of these is provided below:

The use of case studies to generate understanding, and then generalising beyond the local is a contested area of academia (Tsang, 2014). The use of analytical frameworks, as evident in

Chapters 2 and 3, is, however, supported by literature (Flyvbjerg, 2011; Steinberg, 2015; Tsang, 2014), with process tracing representing an important approach in providing evidence to support assertions, with theoretical implications that may extend beyond the boundaries of the case study, and being comparable to large N-methodologies in generalisability (Steinberg, 2015). Furthermore, “*force of example*” is underestimated in the role of case studies and the ability to generalise, which can allow for natural extension of findings beyond the boundaries of an individual study (Flyvbjerg, 2011). The under representation of the Global South in urban biodiversity conservation research (du Toit et al., 2021; McDonald et al., 2020; Nagendra et al., 2018; Rega-Brodsky et al., 2022) further enhances the approach taken in this thesis, and calls for similar research to be undertaken in other cities of the Global South (Nagendra et al., 2018). Further enhancing the generalisability of Durban as a case study is that it shares several similarities with other cities of the Global South relating to: presence of high biodiversity, governance (i.e. decentralized and dual-governance complexity), socio-economic and development pressures, and opportunities for nature-based solutions in response to climate-linked natural disasters (Shackleton et al., 2021).

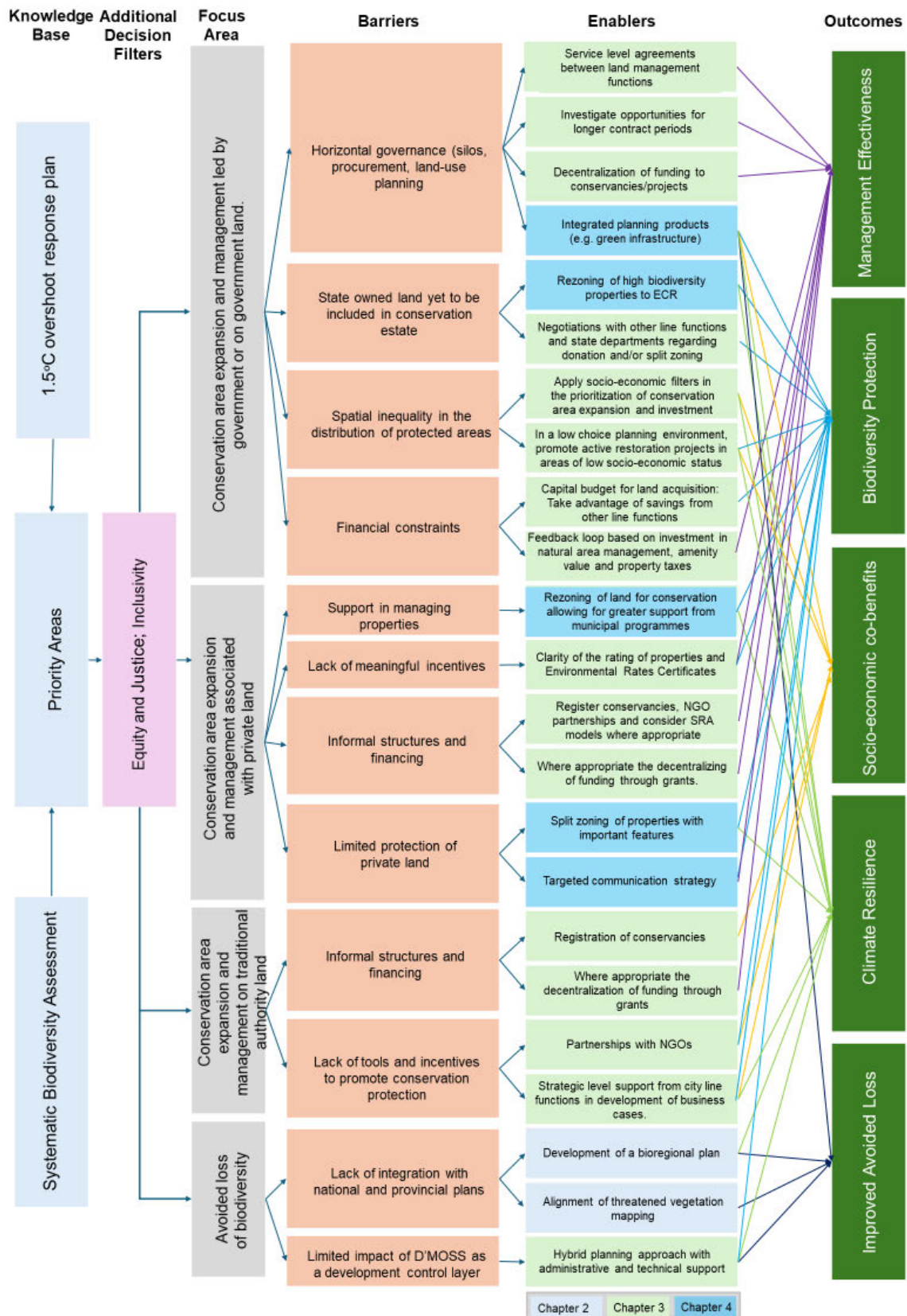
The opportunities presented in Chapter 4 for area-based conservation should be viewed as foundational information to inform action rather than an immediately implementable conservation strategy. The findings from Chapter 4 will need to be supplemented with, *inter alia*, context appropriate stakeholder engagement, in line with recommended approaches for the implementation of conservation plans (Adams et al., 2019). The accuracy of these analyses (Chapter 4) were also limited by the accuracy of the underlying municipal data, particularly the municipal registered parcels and ownership shapefiles that provided information related to property ownership and property value. Ownership information was not available for 5-6 % of the biodiversity features spatial layers used and will need to be addressed for a more complete analysis of opportunities available for area-based conservation expansion

A gap of the overall study related to aquatic systems. Estuaries, rivers, and wetlands are incorporated within D'MOSS and CBAs, but have not been dealt with in a focused way. Threats facing estuaries and rivers are somewhat different to terrestrial systems, with changes to hydrology and water chemistry as a result of, *inter alia*, urbanisation pressures representing a significant threat to the ecological integrity (Linke & Hermoso, 2022). As detailed in *Durban's Strategic Environmental Assessment*, the current ecological condition of rivers and estuaries are largely poor within the municipality (EThekweni Municipality, 2020). Although beyond the scope of this thesis, research is required to understand local government's role in addressing the threats to aquatic biodiversity towards an integrated biodiversity strategy.

### **5.3. Implications for achieving biodiversity outcomes at the local government level**

A key takeaway from this research is the vital role that local governments can, and must, play in relation to advancing biodiversity outcomes at the local and global level (Chapters 2 - 4), and importantly, this extends beyond avoided loss and includes contributions to area-based conservation (Bulkeley et al., 2021) (Chapters 3 and 4). Avoidance of urban areas by National and Provincial conservation authorities (Chapter 3) (Soanes & Lentini, 2019), and limited capacity of Provincial conservation authorities to undertake area-based conservation in line with GBF targets (DFFE, 2023a), further emphasises the need for local governments to empower themselves in this developing governance void (Chapter 3). Equally, this research may provide valuable insights for conservation authorities in their efforts to implement top-down mainstreaming approaches, highlighting the importance of accessing the full suite of local government mechanisms available in advancing biodiversity outcomes (Chapters 3 and 4).

Based on the types of mechanisms applied across contexts (Chapters 2 and 3) and future opportunities (Chapter 4), conservation work can be divided into four focus areas relating to achieving biodiversity outcomes: (1) conservation area expansion and management led by government or on government land; (2) conservation area expansion and management associated with private land; (3) conservation area expansion and management associated with traditional authority land; and (4) avoided loss of biodiversity. Figure 5.1 describes these four focus areas, and the barriers and enablers required to advance biodiverse outcomes. Included in Figure 5.1 are the key inputs required in developing the knowledge base that informs action, and additional filters that should be applied across work areas. These future looking aspects in Figure 5.1, and relevant learnings for local governments from the core chapters (Chapters 2-4), are further explored in the following subsection.



**Figure 5.1:** Integration of outcomes from Chapters 2 - 4 to improve biodiversity outcomes in Durban. Coloured lines represent how enablers feed into outcomes, and are colour coded by outcome. Abbreviations: D'MOSS (Durban Metropolitan Open Space System; NGO (non-governmental organisation; and SRA (Special Rating Area).

### *Role of science and linking the biodiversity and climate change agendas*

Given the rapid rate of urbanisation, particularly in the Global South (Güneralp et al., 2020), and the associated negative impact on biodiversity (Simkin et al., 2022), time is not a luxury that cities have. An important reflection, as highlighted in Chapters 2 and 3, has been the considerable time required to effectively mainstream biodiversity planning and protection within land-use and spatial planning processes (Allred et al., 2021; Manuel et al., 2016; Wellstead et al., 2011; Wilkinson et al., 2013). The legislative and policy environment at national level, informed by global agreements, is more enabling than it was during the early iterations of D'MOSS, but the Durban case study can provide valuable lessons for other cities by identifying critical investment areas that may accelerate mainstreaming (Chapter 2).

Possibly the most important factor in this regard has been the role of science across several areas, viz. investment in the development of scale appropriate information, developing institutional scientific capacity, and improving scientific capacity through academic partnerships (Chapter 2). These are areas considered to be barriers to biodiversity mainstreaming in local governments (Shih et al., 2020), and where Durban has placed specific focus (Chapter 2). An important enabler towards improved scientific capacity has been the successful partnership with a local academic institution (Chapter 2). This support (in different forms) has been constant over the duration of the City's biodiversity work, and has evolved into the Durban Research and Action Partnership (DRAP) that focuses on transdisciplinary research (Cockburn et al., 2016). The development of similar partnerships for cities, particularly those of the Global South, is recommended to enhance the generation of actionable science and scientific capacity (Chapter 2).

The Systematic Conversation Assessment has represented the primary tool informing action for Durban over the past decade (McLean et al., 2020). Although the focus of this thesis has

been on biodiversity, it is important to not lose sight of the fact that biodiversity loss is only one part of the triple planetary crisis facing the planet (UNEP, 2024). Particularly relevant to the work in this thesis is the importance of biodiversity protection, management, and ecosystem restoration, to creating opportunities for climate change adaptation and mitigation. Durban has been recognised internationally for work on climate change adaptation and biodiversity (Nilon et al., 2017; O'Donoghue et al., 2022; Roberts et al., 2012; Shih & Mabon, 2018), but to what extent have these aspects been effectively integrated?

Biodiversity features prominently under the climate adaptation theme of the Durban Climate Change Strategy and Implementation Plan (O'Donoghue et al., 2022), and includes four areas of intended implementation under the programme “Integrate climate change into existing biodiversity management practices”: (1) Conduct research on the impacts of climate change on biodiversity and ecosystems in Durban; (2) Implement recommendations from climate change and biodiversity research; (3) Continue to update eThekweni Municipality's Systematic Conservation Planning processes to include climate change with biodiversity considerations; and (4) Reporting on Durban's Community Ecosystem-Based Adaptation (CEBA) type projects to protect and support ecological infrastructure in Durban's Metropolitan Open Space System (D'MOSS) to enhance protection against projected climate change impacts (EThekweni Municipality, 2022).

CEBA projects, with direct biodiversity outcomes, are well represented in *Durban's State of Biodiversity* report (EThekweni Municipality, 2024a). There remains, however, a significant gap in the generation of actionable knowledge leading to the impacts of climate change on biodiversity at the landscape level (McLean et al., 2020). The near inevitability of overshooting 1.5 °C of global warming (WMO, 2024) represents a significant threat to biodiversity and its ability to provide critical services to society (IPCC, 2022). There is therefore an urgent need,

through the development of a 1.5 °C overshoot climate response plan (Figure 5.1), to begin to advance our understanding of the impacts of this new reality on biodiversity, the role of biodiversity in adaptation and societal resilience, as well as better understand adaptation limits and the irreversible losses that could result (Pörtner et al., 2023). Critically, these data must inform action across the different work areas to ensure that there is a mechanism to support implementation. Mechanisms linked to land-use and spatial planning, such as D'MOSS, will be particularly important in implementation.

### *Identification of co-benefits*

Motivating action at the local government level where biodiversity is often not considered core business (Nilon et al., 2017; Shih et al., 2020) requires reframing action around co-benefits (Smith et al., 2018) and the identification of messaging that resonates with the priorities of political and institutional leadership (Cilliers et al., 2013; Stokes et al., 2010) (Chapter 2). Linking biodiversity protection with service delivery savings, disaster aversion, climate change responses, and human well-being, are examples emphasised in this research that offer opportunities to engage a wider local government audience (Chapters 2 - 4) (Pörtner et al., 2021; Sandifer et al., 2015; Wickramasinghe, 2021), and contribute to addressing horizontal governance barriers (Figure 5.1). The ability to communicate and/or demonstrate co-benefits in line with contextual differences appears to be a key determinant of project success (Kidd et al., 2019; Mansourian et al., 2020). The conceptual flexibility applied over the seven D'MOSS iterations, the large-scale management and reforestation programmes, focus on addressing the unemployment crisis, and the public-private funded nature reserve (see Giba Gorge Environmental Precinct, Chapter 3) are all examples where co-benefits have been evident and directly related to project success (Chapters 2 and 3). In contrast, interventions where the benefits have not been evident have performed poorly (e.g. the conservation zone and

environmental rates certificates) (Chapter 3). This emphasises the need for local government to critically assess tool responsiveness to local contexts, and factor co-benefits into conservation planning, project design and communication strategies (Figure 5.1) (Albert et al., 2021; Kidd et al., 2019; Wyborn & Evans, 2021).

Similarly, and particularly relevant to developing cities of the Global South, the spatial congruency between potential hazards and biodiversity, as evident in Chapter 4, offers an opportunity to directly influence urban planning processes (Figure 5.1) (Wickramasinghe, 2021). Leveraging this congruency allows for planning that can move beyond binary *development vs environment* debates (Dryzek, 2022) that may stifle local government progress in achieving biodiversity outcomes. This approach has several co-benefits that contribute to responsible urban planning, but, importantly, it promotes alignment with established municipal mandates (e.g. land-use planning, disaster, and catchment management) (Shih et al., 2020). The development of a proposed green infrastructure land-use zone (Chapter 4) represents a potentially critical enabler towards a more integrated planning system (Figure 5.1). One of the more positive outcomes of the Conference of the Parties to the Convention on Biological Diversity Sixteenth meeting was increasing recognition that responses to the climate and biodiversity crises need to be more closely aligned (CBD, 2024). This again thrusts local government into the spotlight given the multiple areas of services delivery and co-benefits that nature-based solutions offer (Martín et al., 2020) that can also support ambitious climate change responses.

#### *Governance and move to inclusivity, equity and justice*

Chapters 2 and 3 highlighted the importance of institutional positioning as a key factor in biodiversity mainstreaming and the ability to impact and have influence on spatial and land-use planning decision making. This is an important reflection given that biodiversity functions

within local government are often institutionally orientated towards natural resources management, with limited ability to influence planning processes (Bux et al., 2021; Shih et al., 2020). Through the application and use of several local government tools Chapter 3 has demonstrated the important role that a local government can play in advancing conservation outcomes. This is an important reflection for all spheres of government (Oke et al., 2021). Increasing recognition of Other Effective Conservation Measures (Donald et al., 2019) as contributors to area-based conservation offers recognition of local governments' conservation work, and supports the position that *biodiversity needs every tool in the toolbox* towards achieving global conservation target (Gurney et al., 2021). These findings call for a reframing of local governments' role in biodiversity protection beyond spatial and land-use planning focused avoided loss (Chapters 3 and 4).

Adopting this more active role in conservation requires a degree of creativity and experimentation, especially in the absence of a direct biodiversity conservation mandate for local governments to undertake this work (Nilon et al., 2017; Shih et al., 2020). An example is the GGEP that uses a funding mechanism that was designed with urban improvements in mind, rather than biodiversity conservation, and has been a relative success (Chapter 3). In contrast, the conservation zone and environmental rates certificates have, to date, had limited impact (Chapter 3). These failings should not be ignored, as they provide opportunities to learn and adapt approaches.

Equity and justice, and inclusivity feature prominently within the GBF (CBD, 2022), and are highlighted as critical areas in Chapter 3 and 4 to advance conservation outcomes (Albert et al., 2021; Krishnan, 2021; McDermott et al., 2023; Sims et al., 2022). With most opportunities for scaling conservation outcomes in Durban existing under private and traditional authority tenure, the need to adopt a more inclusive, equitable and just approach to conservation is

evident and should represent a primary lens through which future work is undertaken (Figure 5.1). The current available toolset is largely unsuited for TAAs, calling for the development of new mechanisms to advance biodiversity outcomes (e.g. biodiversity offset bank) (Chapters 3 and 4). Rate of urban transformation is greatest within the peri-urban TAAs (EThekweni Municipality, 2020), and the concern is that unmitigated urbanisation will have a significant impacts of biodiversity (Simkin et al., 2022). Building institutional support for the protection of biophysically constrained CBAs, protection of catchment areas within TAAs, and redefining threatened ecosystems as assets, are all outcomes from this thesis that provide the basis for effective communication, advocacy and mainstreaming (Chapter 3 and 4). Critically, the information provides opportunities to build institutional support through co-benefits alignment (Raymond et al., 2017; Smith et al., 2018), which is an important enabler in advancing inclusive, just and equitable conservation (Raymond et al., 2022; Walker & Paige, 2024).

Formalising the relationships between conservancies and the municipality represents a key enabler (Figure 5.1) towards inclusive mosaic governance models (Buijs et al., 2024). This type of agreement should provide the legislative and institutional basis to provide initial funding support and offers an opportunity to create a more resilient conservation management system that is currently overly reliant on land management programmes with cumbersome procurement processes (Chapter 3) (Figure 5.1). To maximise the effectiveness of these governance arrangements, mechanisms aimed at private land protection require significant revaluation, together with an effective communication strategy (Kidd et al., 2019) (Chapter 3) (Figure 5.1).

The poverty alleviation focused ecological management and ecosystem restoration programmes have been particularly successful mechanisms contributing to biodiversity outcomes and addressing the City's unemployment crisis (Chapter 3). These projects

undoubtedly need to scale, particularly informed by the proposed equality and justice decision filter (Figure 5.1) (Gupta et al., 2024; Raymond et al., 2022). Active restoration is receiving increasing recognition as an important contributor to achieving global biodiversity goals and climate resilience (Strassburg et al., 2020), and, as demonstrated in Chapter 3, represents one of the most effective mechanisms for advancing biodiversity outcomes in terms of policy and practice contribution, socio-economic development and application within TAAs. Critically, active restoration, provides an option to not only to broader biodiversity objectives, but can also be used as a tool to address societal issues of spatial inequality in access to usable green spaces (Chapter 3) (Figure 5.1), creation of green jobs, and sustainable urban planning (Rawat, 2017; Raymond et al., 2017).

Contextual differences may prevent direct replication of all tools in other resource constrained cities of the global South, however, lessons from this research provide important learnings. Land-use planning creativity, identification of socio-economic co-benefits in project design and urban sustainability co-benefits (Chapter 4) identified in this research may offer cost-effective methods for resource constrained cities to advance biodiversity mainstreaming.

### *Conservation finance*

Across the land tenure work areas, financial constraints represent barriers to implementation and scaling of conservation outcomes (Figure 5.1). The GBF highlights the significant conservation financing gap that exists globally, with the majority of this gap attributed to harmful incentives (Chausson et al., 2023). The current relationship between biodiversity and property taxes suggest a similar situation, with vacant land being taxed at a rate higher than other land-uses. The current ineffectiveness of the Environmental Rates Certificate (Chapter 3) places further pressure on biodiversity due to the lack of adequate incentives for landowners.

This calls for a comprehensive review of the rates policy, and engagement with the Real Estate Unit over the effective rating of properties (Figure 5.1).

Linked to service provision and property rates is the need for the natural assets of Durban to receive adequate recognition on the municipal asset register, which currently only reflects 0.6% of the total natural assets in the City (EThekweni Municipality, 2020). Proximity to good condition, well managed natural areas attracted premiums of 2% of property value (Turpie et al., 2017), with similar findings reported in other cities (Crompton & Nicholls, 2020). Investment in the management of natural areas therefore has a direct benefit to landowners, but also to City's financial position because of the increase in property taxes. Understanding this relationship in terms of return on investment, increasingly used in conservation planning (Sacre et al., 2020), may offer an opportunity to motivate for additional conservation budget. Of potentially greater significance in the face of urbanisation and climate change are the savings associated with regulating services and the importance to urban resilience (Baró & Gómez-Baggethun, 2017). An integrated approach that links the proposed green infrastructure zone (Chapter 4) and outcomes of the proposed 1.5 °C overshoot plan would provide more integrated and actionable data to motivate for recognition of natural spaces as assets that require capital and operational budget (Seidl et al., 2024). This type of intervention will need to be supplemented by more regular natural capital accounting (Scorzelli et al., 2023).

A suite of mechanisms, both public and private, have been proposed to close the financing gap for biodiversity (Flammer et al., 2023). Several opportunities have been presented in Chapters 3 and 4, however, the development of offset bank and/or biodiversity credit system would seem the most pressing given the continual loss of threatened ecosystems (Figure 5.1). Legislative and policy advancements in this space (DFFE, 2023b) offer an enabling environment to further explore the implementation of this mechanism. This may provide a catalyst for scaling

conservation outcome within TAAs (Figure 5.1). The greater integration of climate resilience responses into landscape planning may also provide improved opportunities to access climate funding that has been successful in other parts of the continent (ANCA, 2024; Pettinotti & Quevedo, 2023). It is strongly recommended that a detailed study be undertaken on potential biodiversity financing mechanisms for Durban across land tenure types.

#### **5.4. Policy and practice recommendations**

In addition to the policy and practice requirements highlighted in the preceding section and in Figure 5.1, additional opportunities from the Chapters 2-4 are presented below:

##### *Chapter 2: Biodiversity planning and mainstreaming*

- The development of fine-scale biodiversity information has been critical in biodiversity mainstreaming. Particularly relevant to biodiverse, resources constrained cities of the Global South, the development of a fine-scale habitat map offers a cost-effective option to provide foundational data that can immediately interact with urban spatial planning and land-use management systems (Nilon et al., 2017).
- Given that most land-use applications potentially impacting D'MOSS fall outside of provincial and national environmental assessment processes (Chapter 2), the development of a local biodiversity offset policy is recommended (Chapter 2). This will provide additional strength to comments regarding proposed loss of threatened habitats and areas with species of conservation concern.
- The vertical integration on biodiversity information represents a critical part of effective conservation planning implementation and governance (Botts et al., 2019; Huang et al.,

2018; Pressey et al., 2013), To improve the protection of critical biodiversity areas, the development of a bioregional plan for Durban is recommended (Mathipa, 2021).

### *Chapter 3: Local government contributions to improved biodiversity outcomes*

- The inclusion of annual area-based biodiversity conservation targets represents an indicator of the success of city-level biodiversity plans (Nilon et al., 2017). The opportunities presented in Chapter 4 were analysed in terms of feasibility and should therefore provide the basis for setting data-informed and realistic annual targets.
- Evidence of strong scientific capacity within the City is evident in Chapter 2, and while this is essential in the development and application of biodiversity data in land-use and spatial planning, area-based conservation scaling will require extensive landowner negotiations (Cortés-Capano et al., 2020; Niemiec et al., 2019). This calls for the need for a skills audit of the biodiversity function to determine resource gaps.
- To align restoration activities with biodiversity priorities, a greater degree of focus is required on restoring threatened vegetation within coastal forest and grassland systems (McLean et al., 2020).
- Governance silos represents a significant barrier to implementation of conservation plans (Powell, 2010) and urban sustainability (South African Cities Network, 2021). To address the poor management performance of several municipal nature reserves (Patel et al., 2023) there is a need to critically analyse the role and function of the departments involved in natural resource management, and address inefficiencies and capacity constraints through a service level agreement (Figure 5.1)

### *Chapter 4: Opportunities for area-based biodiversity conservation*

- The opportunities presented in Chapter 4 represents foundational data information and insights for operationalising a more integrated and context-sensitive conservation strategy. The opportunities presented will need to be further refined and adapted to be successfully implemented in line with recommended approaches to conservation planning (Adams et al., 2019). It has been seven years since Durban’s Biodiversity Strategy (BMD, 2017) was last updated, providing an opportunity for this research to inform the next iteration.

## **5.5. Recommendations for future research**

Several opportunities for future research are evident from the preceding chapters and are presented below:

### *Chapter 2: Biodiversity planning and mainstreaming*

- The integration of D’MOSS within land-use schemes, development of fine-scale biodiversity information, and active engagement in development assessment processes, has contributed to avoided loss. Measuring avoided loss is inherently difficult (Manuel et al., 2016), and requires dedicated research to advance our understanding of the effectiveness of these interventions.
- Vegetation mapping serves as a biodiversity proxy for systematic biodiversity planning, with national mapping of threatened vegetation mapping receiving additional levels of protection through development assessment processes (Botts et al., 2020). Research is required to better integrate fine-scale information into national products and investigate the rationale for aggregation/disaggregation of vegetation types and possible biodiversity outcomes under different scenarios.

### *Chapter 3: Local government contributions to improved biodiversity outcomes*

- In a resource constrained environment, efficient use of available budget for land management is crucial. The decentralisation of funds through conservancies represents a key opportunity to build resilience in biodiversity management systems and foster inclusion. A comparative study that analyses the budget efficiency, biodiversity, and socio-economic outcomes for different governance models (e.g. conservancies, large-scale poverty alleviation programmes, Special Rating Areas, and traditional protected areas) is recommended.
- The limited impact of tools that focus on private land (i.e. conservation servitudes, conservation zone, and environmental rates certificates) calls for a greater understanding of landowner perceptions towards local government conservation initiatives. Again, this research could be framed against proximity to existing conservation areas under different governance models.
- The proposed hybrid planning system toward a more integrated land-use planning system within TAAs (Sim et al., 2018) offers several opportunities for future research: (1) Understanding the willingness of Ingonyama Trust Board and individual traditional authorities to support such a process; (2) the ability of local government to deploy resources to support planning; and (3) effectiveness of interventions. The implementation of eThekweni Rural Spatial Framework and Development Plan (EThekweni Municipality, 2024) presents an opportunity to frame this research.

### *Chapter 4: Opportunities for area-based biodiversity conservation*

- Co-benefits of biodiversity protection, climate adaptation, and disaster risk are well established in literature (McVittie et al., 2018; Ommer et al., 2022; Smith et al.,

2018), but suffer from a similar research-implementation gap to that present in conservation planning (Arteaga et al., 2023). Motivating for greater protection of these multiple co-benefits may require further Durban-centric research, and specifically the role of the natural resources base in avoided loss associated with the devastating flooding events of 2022 (Singh et al., 2022)

- TAAs harbour the greatest proportion of threatened vegetation outside of protected and conservation areas, representing the most important opportunity for meeting conservation goals. Mapping of these vegetation types has been performed largely at a desktop level, albeit at high resolution. Any conservation initiatives undertaken within these areas will need to understand the impact of traditional practices of livestock grazing on the ecological integrity of grassland systems (Carbutt & Kirkman, 2022; Scott-Shaw & Morris, 2015).
- Informality and the role of the future urban form has not been factored into this research. Opportunities for area-based conservation and border sustainability will require a detailed analysis on current and future informal growth within the EMA.

## **5.6. Conclusion**

This thesis sheds light on the important role a local government can and must play in addressing the biodiversity crisis in line with the GBF's *whole-of-government, whole-of-society approach* (UN, 2022). Through the generation of actionable knowledge it is hoped that this research will: (1) Assist other local governments, particularly those of the Global South, with identifying critical investment areas to advance biodiversity mainstreaming; (2) provide insights for national governments in terms of opportunities to use local government mechanisms to mitigate

biodiversity loss and contribute to area-based conservation expansion; and (3) provide the basis to guide conservation work in Durban.

The triple planetary crisis (UNEP, 2024) and severe levels of inequality (Shackleton et al., 2021) require immediate and decisive action from governments, and particularly local government where these realities play out (Bulkeley et al., 2021). Local governments are uniquely positioned to drive the transformative change required (Bulkeley et al., 2021). Nature based solutions, particularly in resource constrained cities of the Global South, offer pathways to addressing these challenges (Lwasa et al., 2018). Durban has made significant strides over the past four decades in the advancement of biodiversity conservation and climate change adaptation work areas, but these efforts need to be scaled, refined, and integrated to advance urban sustainability, and ensure equitable societal benefits. This thesis uses the learnings from Durban's four-decade long journey in responding to the biodiversity and climate crises to guide future work. This guidance may be equally applicable to other cities of the Global South in the development and acceleration of their response plans.

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