CITY OF CAPE TOWN
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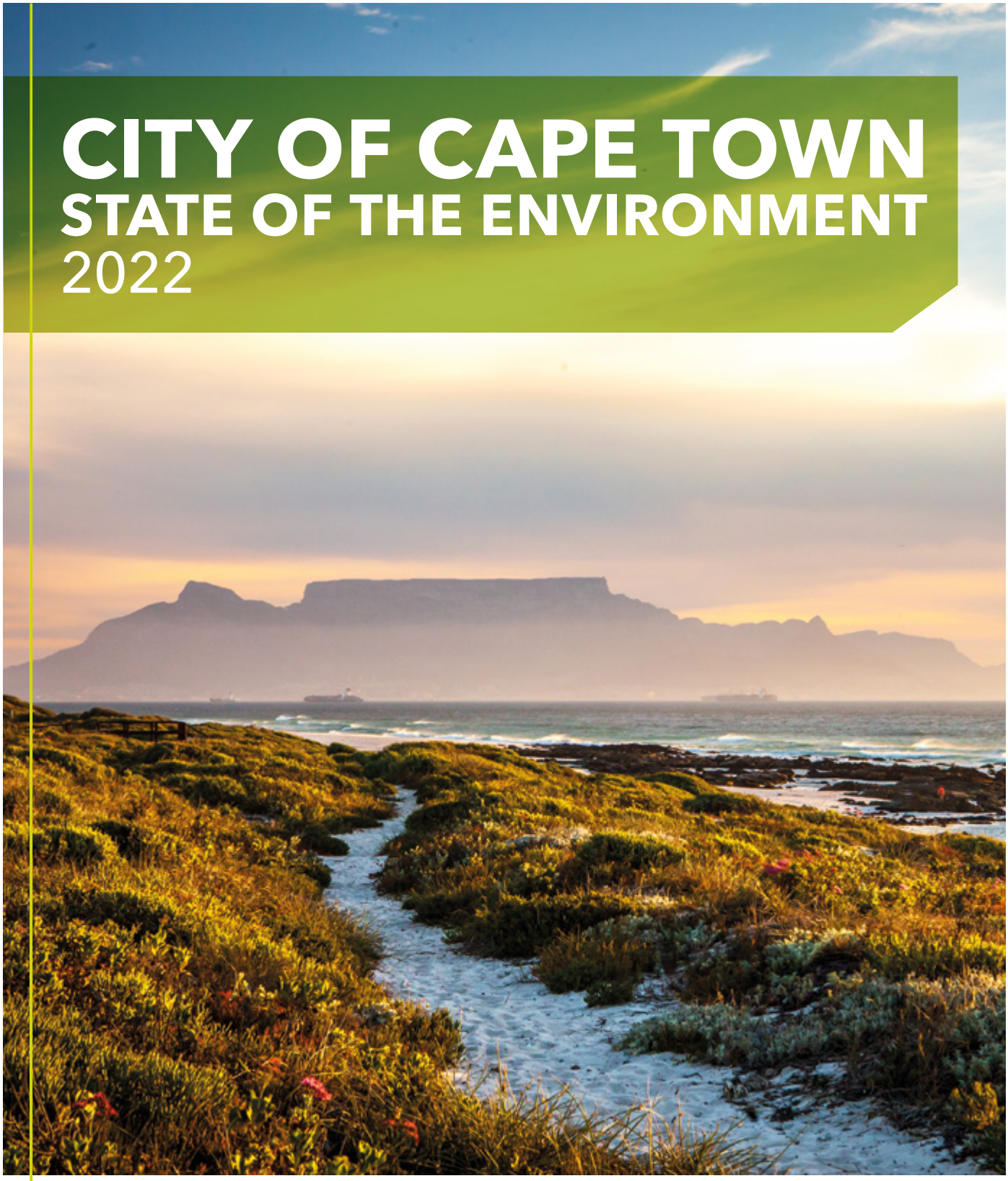
CITY OF CAPE TOWN
STATE OF THE ENVIRONMENT
2022



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FOREWORD

Cape Town is renowned for its natural beauty and it is recognised as the most biodiverse city in the world. The city has an abundance of green spaces, comprising the BioNet, coastline, public parks, and green belts. The City currently manages 20 nature reserves, 14 district parks and 354 greenbelts across Cape Town. There is 307 km of coastline and over 45 000 ha of accessible protected areas (nature reserves). Cape Town also has a diverse cultural heritage.

Cape Town's natural environment belongs to all its citizens, and underpins sustainable development.

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The State of the Environment Report is an essential tool for tracking and measuring progress towards the goal of becoming a more sustainable city. It provides a snapshot of the environment at a particular moment in time, in addition to an analysis of trends over time. The report ensures that City leaders and decision-makers have access to accurate and transparent data and information on a range of environmental issues. This enables us to address environmental problems, based on clear supporting information and evidence.

The city's natural assets provide vital ecosystem goods and services such as clean air and water, food security, climate regulation, and protection from natural and climate change-related hazards such as floods, fires, sea-level rise and coastal erosion.

Furthermore, these assets attract direct and indirect investment to Cape Town, enrich the quality of life of residents, and enhance property values.

Therefore, the City must balance the challenges of supporting local economic development and job creation, extending services, addressing inequality, alleviating poverty and ensuring equitable economic and social opportunities, without eroding the city's natural environment and natural assets.

Since the publication of the last State of the Environment Report in 2018, the City has seen an increase in the frequency and intensity of major shock events and increased climate change impacts such as floods, coastal erosion, extreme heat and fires. While there are positive trends apparent in biodiversity, climate change and solid waste, during this reporting period, trends related to inland water quality and wastewater are of particular concern.

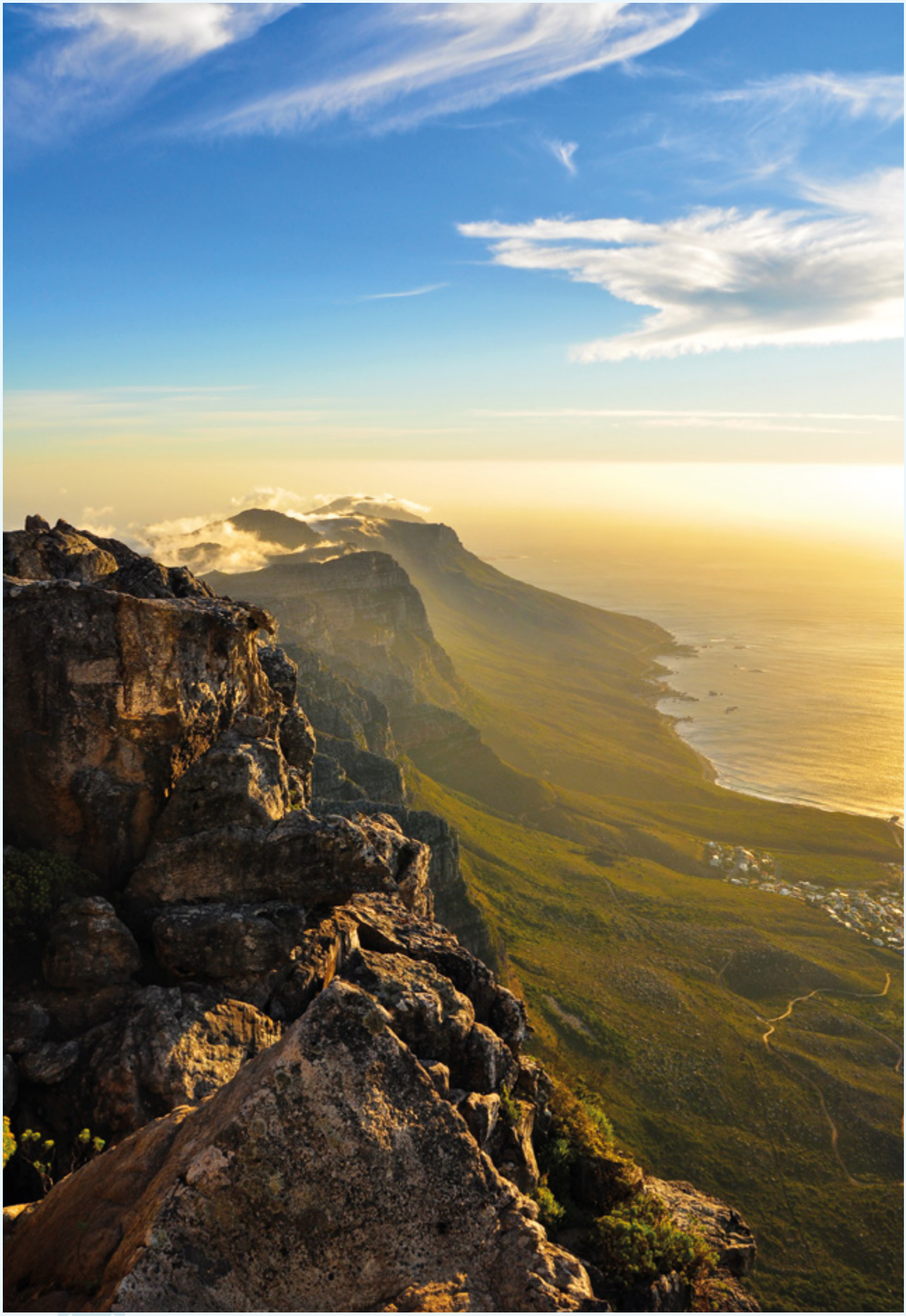
The Covid-19 pandemic and its impacts fundamentally altered the economic, social and development outlook for the city, alongside environmental implications such as increased unlawful land occupation in nature reserves. It has many parallels to the shocks and stresses that the City will continue to manage due to the unfolding climate crisis and connected challenges related to resource constraints and environmental degradation.

The City has a long track record of pursuing sustainable change, improving resilience and responding to major shock events. The City's Environmental Strategy provides decision-makers with an effective policy and governance framework for decision-making, management and operational implementation where the environment is concerned. The strategy adopts an integrated approach to sustainability, which recognises that our economy is embedded within society, which in turn is embedded within the environment.

However, sustainability requires a whole of society approach, with participation from government, the private sector, residents, civil society and academia. The State of the Environment report is a call to all members of society to actively support the realisation of a sustainable city, for the benefit of current and future generations.

Geordin Hill-Lewis

Executive Mayor,
City of Cape Town



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ABBREVIATIONS

AQMP	Air Quality Management Plan
BioNet	Biodiversity Network
CBAs	Critical Biodiversity Areas
CBD	central business district
CCT	City of Cape Town
CCT-IWMP	Integrated Waste Management Policy
CCTs	cross-cutting themes
CCWAs	cross-cutting work areas
CDM	Clean Development Mechanism
CDP	Carbon Disclosure Project
CESAs	c]ritical ecological support areas
CFDS	Cape Flats dune strandveld
CFR	Cape Floristic Region
CIP	conservation implementation plan
City	The administrative body of the City of Cape Town
city	The region of the City of Cape Town
CML	Coastal Management Line
CO_2	carbon dioxide
COD	chemical oxygen demand
DAMS	Development Application Management System
DCCP	Dassenberg Coastal Catchment Partnership
DEA&DP	Department of Environmental Affairs and Development Planning
DFFE	Department of Forestry, Fisheries and the Environment
DMS	Development Management Scheme
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
E. coli	*Escherichia coli*
EDRR	Early Detection and Rapid Response programme
EHRIC	Environmental and Heritage Resources Information Centre
EIA	environmental impact assessment
EPWP	Expanded Public Works Programme
ESAs	Ecological Support Areas
GEF	Global Environment Fund
GHG	greenhouse gas
GI	green infrastructure
GIN	Green Infrastructure Network
GIP	Green Infrastructure Programme
HPOZ	Heritage Protection Overlay Zoning
HWC	Heritage Western Cape
IDP	Integrated Development Plan
IEGS	Inclusive Economic Growth Strategy
IMEP	Integrated Metropolitan Environmental Policy
IUCN	International Union for Conservation of Nature
IWMP	Integrated Waste Management Plan
LAB	Local Action for Biodiversity
LBSAP	Local Biodiversity Strategy and Action Plan
METT	Management Effectiveness Tracking Tool
MPBL	Municipal Planning By-law
MRF	Materials Recovery Facility

MSDF	Municipal Spatial Development Framework
NAAQS	National Ambient Air Quality Standards
NEMBA	National Environmental Management: Biodiversity Act
NEMICMA	National Environmental Management: Integrated Coastal Management Act
NTO	new term of office
NHRA	National Heritage Resources Act
NO_2	nitrogen dioxide
NRM	Natural Resource Management
PASAPs	pollution abatement strategies and action plans
PES	present ecological state
PHRAs	Provincial heritage resources authorities
PM_{10}	particulate matter
PoA	Programme of Activities
PRASA	Passenger Rail Agency of South Africa
PSHB	polyphagous shot hole borer
PV	photovoltaic
RQO	Resource Quality Objective
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SDBIP	Service Delivery Budget Implementation Plan
SDGs	sustainable development goals (United Nations)
SDS	Social Development Strategy
SFAs	strategic focus areas
SMMEs	small, medium and micro-sized enterprises
SO_2	sulphur dioxide
SPLUMA	Spatial Planning and Land Use Management Act
SSEG	small-scale embedded generation
SUDS	sustainable urban drainage systems
TAPs	transversal action plans
tCO_2e	tonnes of carbon dioxide equivalent
TIN	total inorganic nitrogen
UNFCCC	United Nations Framework Convention on Climate Change
VLR	Voluntary Local Review
WCWDM	water conservation and water demand management
WCWSS	Western Cape Water Supply Systems
WFW	Working for Water
WHO	World Health Organisation
WQIP	Water Quality Improvement Programme
WSUD	water-sensitive urban design
WWF	World Wide Fund for Nature
WWTW	wastewater treatment work

OVERVIEW

THE NATURAL ENVIRONMENT IN THE CITY OF CAPE TOWN

A healthy natural environment is a requirement for all life. The magnificent silhouette of Table Mountain is an icon for all of Cape Town's natural resources and cultural heritage assets. Cape Town's natural environment is a common asset belonging to all citizens of Cape Town. These assets provide social benefits in the form of recreational, educational and tourism opportunities; direct and indirect job creation and skills development; a uniquely defined and widely recognised sense of place, identity and heritage; and a range of ecosystem goods and services. The ecosystem goods and services of Cape Town's natural assets provide clean air and water, food security, climate regulation, and protection from natural disasters such as floods, fires, sea level rise and coastal erosion.

Cape Town has been recognised as the most biodiverse city in the world.[1] The City currently manages 20 nature reserves and Cape Town has over 45 000 ha of accessible protected areas (nature reserves). Table Mountain National Park (22 100 ha) is a globally significant natural, scenic, historical, cultural and recreational asset that provides immeasurable value to the city. Cape Town is home to two official World Heritage Sites, as determined by the UNESCO World Heritage Committee, namely Robben Island (cultural) and the Cape Floristic Region (natural), represented by various sites including Table Mountain National Park. Cape Town abuts the Boland Mountain Complex, also a World Heritage Site. Three biosphere reserves are within or abut the boundaries of the city (the West Coast Biosphere Reserve, Kogelberg Biosphere Reserve and Cape Winelands Biosphere Reserve).

The City manages 14 district parks and 354 green belts across Cape Town, accounting for just over 1 349 ha of natural public green space. Cape Town's coastline stretches for approximately 307 km, from near Silwerstroom on the west coast, around the Cape Peninsula and beyond False Bay to the Kogelberg coastal area in the east. Approximately 240 km of coastline is within the City of Cape Town's jurisdiction. Cape Town is also home to a substantial network of rivers and wetlands, with 21 main river catchments. The length of rivers and streams is approximately 1 900 km and the length of canals is approximately 480 km. These freshwater ecosystems perform a dual function. While acting as a habitat for aquatic fauna and flora, freshwater systems also act as a natural infrastructure asset for the management, treatment and conveyance of stormwater and treated wastewater effluent.

Nevertheless, Cape Town faces significant interconnected environmental and socio-economic challenges.[1] These include:

- Rapid urbanisation and urban growth, including population growth and the growth of the formal and informal urban footprint as household size decreases and demand for housing rises, placing pressure on land for development and on finite natural resources
- Limited, and increasingly scarce, resources, in terms of energy and water and the capacity to manage solid and liquid waste
- The pollution of the city's air, open spaces, freshwater and coastal ecosystems
- A unique cultural heritage and sense of place, and the associated challenge of conserving heritage and landscapes in a rapidly growing city
- Excessive pollution events and poor quality of urban rivers and wetlands
- Exposure to risk from natural hazards and climate change, including resource shortages, fires, extreme weather events, drought, floods, severe storms, coastal erosion, sea level rise and extreme heat
- Ageing infrastructure and associated negative impacts on the environment, such as ageing wastewater treatment plants and resulting pollution

events, and poor quality of urban rivers and wetlands, with associated elevated health risks

- An increase in illegal land invasions in protected areas, with associated loss of biodiversity, environmental degradation, water pollution and health risks
- The Covid-19 pandemic, and resultant 'hard lockdown' and job losses, and consequent increase in poaching and other illegal activities, and a significant increase in the pressure of illegal land invasions at many sites

These threats can further disrupt ecological functions, disturbing the delicate balance in biological diversity. Human development has also increased the demand for water, solid waste management and electricity. It is essential for local governments, such as the City of Cape Town, to actively work towards conserving and promoting a healthy environment while ensuring that economic and social development continue in a sustainable manner.

Climate change presents a further challenge, with changing and somewhat unpredictable climatic conditions becoming more evident over time. These changes affect the ability of the environment to provide essential goods and services, negatively affecting development and, most notably, human health.

The city's natural environment underpins Cape Town's economic development. Environmental sustainability is an essential component of ensuring healthy social and economic growth in Cape Town. The City is therefore committed to adopting and implementing the principles and approaches needed to reach this goal.

THE STATE OF THE ENVIRONMENT REPORT

The State of the Environment Report is an essential monitoring and evaluation tool used to identify and report on changes to the city's natural environment and the goods and services it provides. Recording and reporting such changes is a critical step in working towards ensuring appropriate action is taken to reduce risks to the environment and address environmental degradation. This report provides a snapshot of the state of the environment at a particular moment in time, but, more importantly, shows trends in the state of the environment over time. This supports informed environmental decision making.

GOODS AND SERVICES OF THE NATURAL ENVIRONMENT

A study undertaken in 2009 estimated that the value of the goods and services provided by Cape Town's natural assets amounted to R4 billion per annum (within a range of between R2 billion and R6 billion).[2] Cape Town's natural and heritage assets attract direct and indirect investment to Cape Town, enrich the quality of life of residents and enhance property values. Five environmental benefits are used as themes throughout this report to highlight the overarching goods and services the environment provides. This enhances our ability to acknowledge the value of environmental systems and their connection to the way we live our lives.

These themes are:

Aesthetic value: The maintenance or functioning of this aspect of the natural environment provides significant aesthetic value to those who interact with it.

Ecological value: The maintenance or functioning of this aspect of the natural environment significantly affects the ecological integrity of this natural space and the space within it.

Recreational value: The maintenance or functioning of this aspect of the natural environment provides recreational space for those who interact with it.

Human health: The maintenance or functioning of this aspect of the natural environment affects the quality of human health.

Socio-economic value: The maintenance or functioning of this aspect of the natural environment provides socio-economic advantages to those who interact with it, in the form of social or economic development.

[1] Noted by Thomas Elmqvist, leader of United Nation's City and Biodiversity Outlook Project

POLICY LINKAGES AND TARGETS

The City has a long history of strong environmental policy.[2] The City's Integrated Development Plan (IDP) (2022-2027) incorporates a major focus on building a sustainable; climate resilient; resource-efficient; and secure city. The IDP (2022-2027) includes 'Public Space, Environment and Amenities' as a priority. The focus is on "maintaining a quality environment, public spaces and waterways help to make our city healthier, more liveable, more attractive and more resilient". In addition, the new term-of-office IDP includes 'Resilient City' as a foundation that strives for a city "that meets its resource needs sustainably, responds to climate change and is able to withstand disaster events". In particular, 'Objective 9: Healthy and sustainable environment' highlights the City's commitment "to protecting, restoring and managing its natural areas to ensure their long-term sustainability and efficacy, and improve the city's resilience to climate change". 'Objective 10: Clean and healthy waterways and beaches' highlights that interventions to make waterbodies, vleis and rivers cleaner and more publicly accessible are a key priority of the City.[3]

In 2017, the City adopted the Environmental Strategy for the City of Cape Town (the Environmental Strategy). The vision of the Environmental Strategy is:

To ensure that Cape Town's natural and cultural heritage assets are optimised to provide a basis for sustainable economic growth and social development, while ensuring long-term protection and management of these assets and their associated goods and services for future generations.

The City's Environmental Strategy is not the overarching framework for sustainability in Cape Town, but contributes significantly to the environmental component of sustainability. This it does by providing decision makers with an effective policy and governance framework for decision making, management and operational implementation where the environment is concerned. A range of other high-level City policies and strategies support aspects of environmental sustainability, including the Inclusive Economic Growth Strategy (IEGS), Social Development Strategy (SDS), Resilience Strategy (2019), Water Strategy (2019), Climate Change Strategy (2021) and Human Settlements Strategy (2021). Along with the Environmental Strategy, these form part of an overall sustainability model embedded in the City's IDP. A range of other sectoral or thematic policies and strategies directly relate to the environment sustainability, including the following:

- Local Biodiversity Strategy and Action Plan (LBSAP) 2019–2029
- Bioregional Plan (2015)
- Integrated Coastal Management Policy (2014)
- Cultural Heritage Strategy (2005)

Furthermore, the City's Municipal Spatial Development Framework (MSDF) recognises Cape Town's critical environmental assets, its globally important biodiversity and the significance of its coastline. The Biodiversity Network (BioNet) is a key informant of the MSDF and the current MSDF has assigned the correct spatial planning categories to Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). The MSDF considers CBAs and ESAs as per the Bioregional Plan (2015), and all CBAs are assigned as Core 1 and Critical Ecological Support Areas (CESAs) are assigned as Core 2. The coastal edge[3] was also adopted as part of the MSDF and is a demarcated area around the coast that has been positioned to limit urban development beyond this line. This has been done primarily to protect coastal resources and to avoid hazards and financial risks associated with areas at risk of flooding, storm surges and long-term climate change impacts such as sea level rise.

The Environmental Strategy outlines various 'long-term desired outcomes', linked to key environmental challenges that the City faces and which are designed to realise the abovementioned vision. It further identifies 11 principles that aim to 'collectively enable the City to achieve its environmental sustainability vision'. Each of the 11 principles is given effect through a corresponding directive that is intended to inform and guide ways of working across the organisation.

These principles are:

1. Long-term approach
2. Equity and accessibility
3. Economic and social benefits
4. Resilience
5. Ecosystems approach
6. Preventing, minimising and mitigating environmental impacts
7. Resource efficiency
8. Environmentally-sensitive and low-impact urban design
9. Educated and empowered citizens
10. Protected natural heritage
11. Protected cultural heritage

These principles are closely aligned with Agenda 2030 and the Sustainable Development Goals (SDGs). In particular, the principles of the Environmental Strategy align with Goal 11: Sustainable cities and communities, Goal 13: Climate action and Goal 17: Partnerships for the goals.

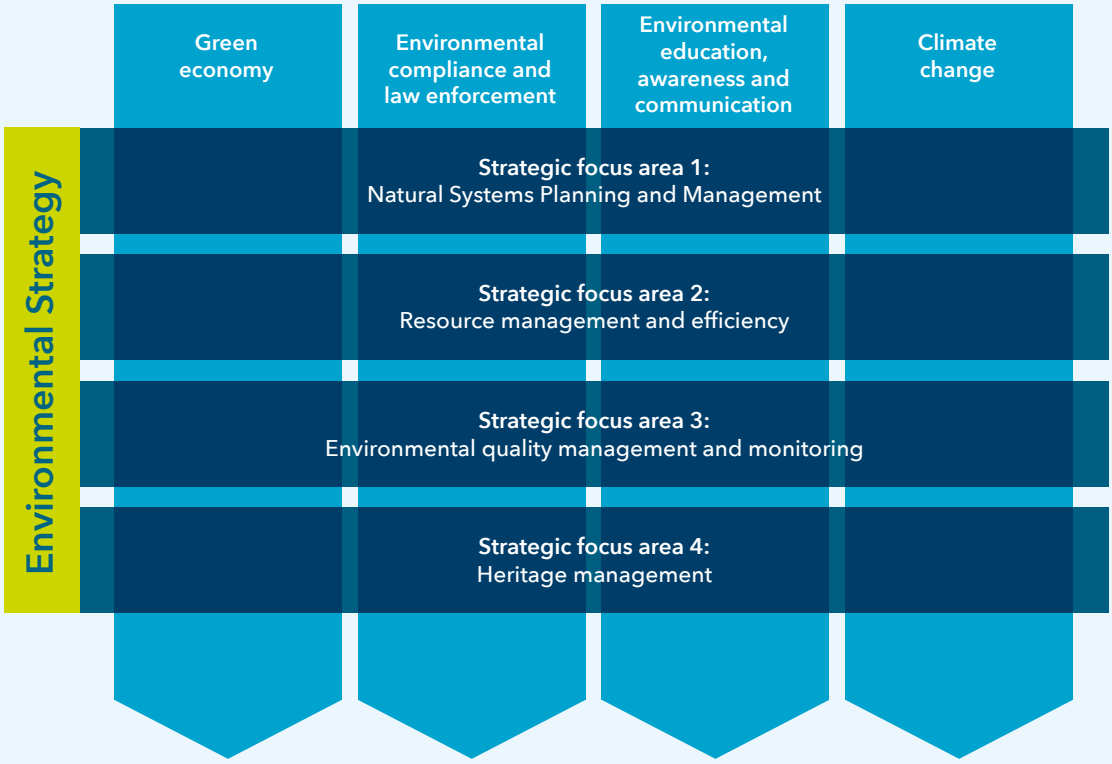
Notably, the Environmental Strategy includes four strategic focus areas (SFAs) and four cross-cutting themes (CCTs) that guide its implementation and also provide a basis for assessing the implementation of the strategy (figure 1).

Alongside the Environmental Strategy, an Implementation Framework was adopted that outlines a comprehensive list of implementation tools that give effect to the principles and directives of the Environmental Strategy. These include by-laws, policies, products, projects, other planning tools and strategies that are aligned with the SFAs and CCTs.

Importantly, the Environmental Strategy commits the City to establishing a monitoring and review system that involves the integration of the Environmental Strategy into other performance monitoring tools, the preparation of annual reports to be submitted to relevant portfolio committees and a five-year review process. The Environmental Management Department has been working in conjunction with the Organisational Performance Management Department to develop a comprehensive monitoring and evaluation framework for the Environmental Strategy. This is intended to, inter alia, identify and develop appropriate baselines, indicators and targets through which the implementation of the Environmental Strategy will be tracked, monitored and reported against.

In addition, it aims to monitor and evaluate progress in the implementation and mainstreaming of the Environmental Strategy and the Implementation Framework and to document progress, challenges, key successes and areas that require support. Although this monitoring and evaluation framework informs this State of the Environment Report, the targets set as part of this process are intended to align with and guide subsequent State of the Environment reports. Future State of the Environment reports, however, will use targets adopted as part of the Environmental Strategy review as a basis for measuring progress. Nevertheless, various existing targets, established in a range of City and national policies, strategies and regulations, are referred to in this report.

FIGURE 1: SFAs AND CCTs OF THE ENVIRONMENTAL STRATEGY



[2] The Integrated Metropolitan Environmental Policy (IMEP) was the first integrated environmental policy adopted by an African city

[3] The City's coastal edge line also duplicates as the City's Coastal Management Line (CML) in respect of the National Environmental Management: Integrated Coastal Management Act, 2008 (NEMICMA)

INDICATORS

The last State of the Environment Report was published in 2019. This report makes use of data collected from 2019–2020, unless stated otherwise. The data in the report are used in accordance with indicators, which set measurement in order to be able to track environmental changes over time. The selected indicators are aligned with the IDP and the City's Environmental Strategy in general, and the comprehensive set of indicators established as part of the Environmental Strategy monitoring and review system in particular. The indicators used or referred to in this report therefore include:

- Indicators used in previous State of the Environment reports
- Performance-based indicators and targets, related to the SFAs and CCTs of the Environmental Strategy, which City departments monitor and report on quarterly in terms of the Service Delivery Budget Implementation Plan (SDBIP) process
- Environmental and waste indicators that the City is required to monitor and report on, to National Treasury, in terms of circular 88
- Relevant IDP Trend Watchlist/Outcome KPIs

The selection of indicators was also guided by international and local experience in this field, scientific research and consultation with key stakeholders. Notably, the City has undertaken an ongoing process of 'localising the Sustainable Development Goals (SDGs)' through, inter alia, localising SDG indicators and targets, and is in the process of preparing a Voluntary Local Review (VLR) in this regard. Where relevant, these indicators and targets are referred to.

Situation improving

Situation deteriorating

No significant change

It is important to note that the indicators provide only a glimpse of a situation at a particular point in time and do not necessarily tell the whole story. However, monitoring indicators over time allow one to draw fair conclusions about trends, while working to ensure that necessary action is taken in a timely fashion.

CHAPTER 1: BIODIVERSITY

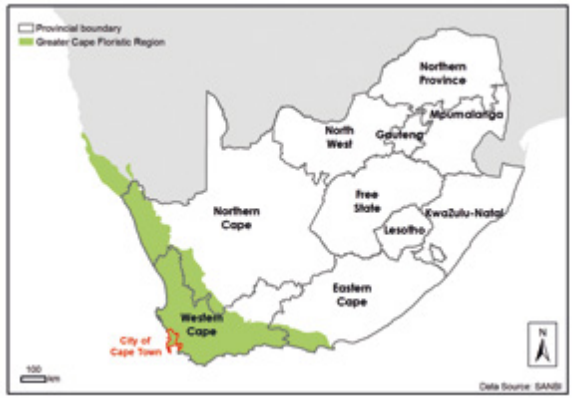
UNDERSTANDING CAPE TOWN'S BIODIVERSITY

Indicators:

- Percentage of indigenous vegetation remaining, by national vegetation type
- Extent of indigenous vegetation within the city, by national vegetation type
- Protected Area Review scores
- Management Effectiveness Tracking Tool (METT-SA) index scores for the City's nature reserves
- Percentage of biodiversity priority areas protected (Circular 88 – ENV 4.2.1)
- Percentage of biodiversity priority areas within the metro (Circular 88 – ENV 4.11)
- Ecosystem/Vegetation type protection level (Circular 88 – ENV 4.2)
- Ecosystem/Vegetation type threat status (Circular 88 – ENV 4.2.1)

Cape Town is abundantly rich in biological diversity and is recognised globally for its natural beauty. Cape Town is recognised as the most biodiverse city in the world. It is located within the Cape Floristic Region (CFR), part of the Greater Cape Floristic Region biogeographical unit, as indicated in map 1. The Core Cape Floristic Region is indicated in map 2. The most biologically diverse of the six plant kingdoms, the CFR is also recognised as being one of the planet's 25 most threatened ecosystems. The region is home to 9 600 plant species, 70% of which are found nowhere else in the world.[4] With such a unique plant kingdom, both within the urban fabric and on the outskirts of the city, the City of Cape Town has the complex task of managing this important natural heritage resource. This rich biodiversity must be conserved and integrated into present and future spatial planning of the city.

MAP 1: GREATER CAPE FLORISTIC REGION



MAP 2: CORE CAPE FLORISTIC REGION

UNDERSTANDING FLORA IN CAPE TOWN

The indigenous vegetation of Cape Town comprises four broad categories: Mountain fynbos, lowland fynbos, renosterveld and strandveld. Fynbos is characterised by plants with small and fine leaves, the dominance of shrubs and Cape reeds. This flora has the ability to thrive in poor soils and seasonally hot and dry conditions.

Over two thirds of the natural vegetation types in the city are classified as endangered or critically endangered.

Over 300 of Cape Town's plant species are threatened with global extinction.

Mountain fynbos

Found on the upper and lower mountain slopes, mountain fynbos has been negatively affected by agriculture and plantation forestry, particularly on the richer granite and shale-derived soils, and by urban development on the lower slopes. There are many plant species within this fynbos ecosystem that are locally endemic and/or threatened. Mountain fynbos comprises nine vegetation types: Peninsula sandstone fynbos, Kogelberg sandstone fynbos, Western coastal shaleband vegetation, Elgin shale fynbos, Peninsula granite fynbos, Boland granite fynbos, Peninsula shale fynbos and Cape winelands shale fynbos. Peninsula sandstone fynbos, Peninsula shale fynbos[4] and Peninsula granite fynbos are endemic to Cape Town. Plants that characterise this vegetation type include proteas (*Proteaceae*) such as the king protea (*Protea cynaroides*), sunshine conebush (*Leucadendron salignum*) and tree pincushion (*Leucospermum conocarpodendron*), Cape reeds (*Restionaceae*), ericas (*Ericaceae*) and other fine-leaved shrubs.

Lowland fynbos

Located on the Cape Flats and coastal plains, lowland fynbos is threatened by land-use changes and increasing urbanisation. Lowland fynbos comprises five vegetation types: Cape Flats sand fynbos, Atlantis sand fynbos, Hangklip sand fynbos, Lourensford alluvium fynbos and Swartland alluvium fynbos. Of these five types, the Cape Flats sand fynbos and Lourensford alluvium fynbos are endemic to Cape Town (table 1). Plants that characterise this type of fynbos include numerous erica species, proteas such as the Cape Flats conebush (*Leucadendron levisanus*), Cape reeds (*Restionaceae*) and bulbous plants of the lily and iris families.

Lowland and mountain fynbos collectively comprise about 80% of the CFR.[5] Historically, Cape Flats sand fynbos was the most widespread vegetation type in Cape Town, but now less than 11% remains, mostly in a degraded state, with only 2% protected.

Renosterveld

Renosterveld is thought to be named after the black rhinoceros historically found in this vegetation. There are four remaining renosterveld vegetation types in Cape Town: peninsula shale renosterveld, Swartland shale renosterveld, Swartland silcrete renosterveld and Swartland granite renosterveld. Peninsula shale renosterveld is endemic to Cape Town (table 1). This vegetation type is characterised by low, small-leaved shrubs that are one to two metres tall, comprising ericoids with a ground layer of grasses.[6] Renosterveld is dominated by the grey renosterbos (*Elytropappus rhinocerotis*), but historically it may have been dominated by grass species such as rooigras (*Themeda triandra*). Renosterveld is rich in shrubs from the daisy family (*Asteraceae*) and bulbous plants, such as orchids, irises and lilies.[7]

Strandveld

Strandveld grows in alkaline, nutrient-poor, coastal sands and dunes and has been considerably affected by coastal development. It is confined mainly to the coastal margins and extends inland only to the dune fields of the Cape Flats and West Coast. Cape Flats dune strandveld (CFDS) is endemic to Cape Town and consists of two subtypes: False Bay CFDS and West Coast CFDS. Plants that characterise this type include sea guarrie (*Euclea racemosa*), blombos (*Metalasia muricata*), bietou (*Osteospermum moniliferum*), annual daisies and numerous succulent vygie species. Strandveld naturally forms a patchwork of bush clumps and open spaces. The

[4] Peninsula shale fynbos was split from the Cape winelands shale fynbos by SANBI in 2018. Peninsula shale fynbos is endemic to Cape Town and is listed as vulnerable.

CFDS vegetation differs from fynbos and renosterveld as it is not fire-dependent,[5] and should burn infrequently,[6] with a fire cycle of typically 20–100 years. Dune slacks are adapted to burn more frequently than dune ridge thickets.

UNDERSTANDING FAUNA IN CAPE TOWN

Alongside its floral diversity, Cape Town has rich fauna. However, many of the city's indigenous animals are inconspicuous and nocturnal, occurring at low densities.

Mammals

The CFR was once home to vast herds of game animals, which is now a characteristic more associated with the savannas in the eastern regions of South Africa. Highly nomadic, these animals would move great distances in search of food, favouring recently burnt vegetation. Renosterveld vegetation types, occurring on nutrient-rich clay and granite soils that support palatable grasses, would have been more densely populated than the nutrient-poor fynbos vegetation types. Most of these game animals were hunted out by early European settlers.

Some 83 mammal species are thought to occur within the city, 16 of which are endemic to South Africa. Many of the mammals in the fynbos biome are nocturnal, which makes them difficult to observe.[8] The City's reserves are home to many mammals, including the Cape leopard, Cape genet, also known as the large-spotted genet (*Genetta tigrina*), small-spotted genet (*Genetta genetta*), honey badger, caracal, Cape fox, bat-eared fox, grey mongoose, striped mouse, rock hyrax (or dassie) and antelope such as the Cape grysbok, steenbok, common duiker, red hartebeest and eland. Chacma baboons are also commonly found within the city, particularly in the Steenbras Nature Reserve and Table Mountain National Park.

Insects and invertebrates

There are thousands of species of insects and spiders throughout Cape Town, although the exact number of invertebrate species is unknown. Pollinating species include flies, moths, bees, butterflies and beetles. Some flowers are pollinated by dozens of different species, whereas others have evolved to rely on a single, highly specialised pollinator.

Two locally endemic butterflies, the unique Cape Flats ranger and Barber's Cape Flats ranger, are on the brink of extinction and urgently need their remaining habitats secured for conservation.

Amphibians

Cape Town's watercourses and wetlands are home to numerous frogs and toads. There are 27 indigenous species within the City's boundaries, five of which are endemic to the city. Two of these endemics – the Table Mountain ghost frog and Lightfoot's moss frog – occur in the Table Mountain National Park. The Cape river frog and the endangered western leopard toad are also commonly found in the city.

The western leopard toad lives and breeds in the low-lying regions of Cape Town, with further populations found along the coast to the Agulhas Plain. These amphibians are endangered because of their confinement to the sandy coastal lowlands of the Western Cape. Also, as a result of urbanisation, their wetland habitats have been affected by drainage, in-fill, pollution and building. Similarly, invasive alien flora species invade their breeding sites, and fauna prey on them.

The western leopard toad is a crucial part of Cape Town's biodiversity as it is an indicator species, which shows a healthy Cape Town biodiversity. Visit the City's website to see ways one can join the effort to conserve these endangered toads (*click here*).

Reptiles

There are approximately 60 species of reptile within the city. Twenty-nine of these are endemic to South Africa and eight are considered to be threatened with extinction.[9] Lizards such as the southern rock agama, the smooth Cape skink and the black girdled lizard are commonly found. Until recently, Cape Town was home to the world's second rarest and most endangered tortoise, the geometric tortoise, which is now locally extinct. The angulate tortoise and the common padloper (also known as the parrot-beaked tortoise) are often seen in the City's nature reserves, and wetlands and streams are home to marsh terrapins.

Birds

Over 400 of South Africa's bird species have been recorded in the Cape Town area; 18 of these are endemic to South Africa and 28 have been assigned Red Data Status.[10] This includes numerous species adapted to suburban gardens and a diversity of waterbirds.

Cape Town is home to six CFR endemic bird species: the Cape sugarbird, orange-breasted sunbird, Cape siskin, protea canary, Cape rockjumper and Victorin's warbler. These species attract many birdwatchers to the city. Other fynbos birds include the red-winged starling, ground woodpecker, Cape and sentinel rock-thrush, Cape grassbird, neddicky, Karoo prinia, pied crow and white-necked raven. The most common birds of prey include the rock kestrel, peregrine falcon, rufous-chested sparrowhawk and jackal buzzard.

Cape Town's coastline is also home to many marine birds. These include the Cape gannet and bank cormorant, which are endemic to South Africa and at risk of extinction; and the African penguin, which is listed as endangered. Various types of gull, tern, wader, cormorant and gannet can commonly be found along the coast throughout the year, while pelagic birds such as albatrosses, shearwaters, skuas and petrels may be seen sporadically from clifftops along the coast.

STATE OF THE ENVIRONMENT

The historical extent[7] of natural vegetation in Cape Town was 2 425 km². There is 914 km² of indigenous terrestrial vegetation remaining in the city (as of July 2018). This indigenous terrestrial vegetation comprises 37,7% of its original historical extent, with 19,95% of that original extent proclaimed or managed. At least 32 km² of the city's natural vegetation has been lost in 10 years (2008–2018). This is cumulatively larger than Table Mountain National Park.

Table 1 lists the percentage of each vegetation type remaining in Cape Town. Map 3, map 4 and map 5 provide a visual representation of the table. The table compares the extent of each remaining vegetation type and the proportion of historical extent. It also indicates how much of this remaining vegetation is currently proclaimed or managed, and the ecosystem status of the existing indigenous vegetation. The ability to conserve the various vegetation types depends on a number of factors, including the location of the remnants, land ownership and competing priorities.

The conservation of endemic vegetation types is a high priority. The City recognises that there are certain endemic vegetation types that are better conserved than others. The most well-conserved endemic vegetation types are the mountain fynbos areas, including the peninsula sandstone fynbos and peninsula granite fynbos. The most poorly conserved endemic vegetation types are the Lourensford alluvium fynbos and Cape flats sand fynbos.

There are currently 210 km² of peninsula sandstone fynbos remaining, or 95,9% of the historical extent. This vegetation type occurs on very steep mountain slopes with the poorest soil, factors that are significant as they do not allow for easy infrastructure development or productive agricultural activity.[11] As a result, 74,3% of this type is managed for conservation or is proclaimed. As is the case for all mountain fynbos areas, this vegetation is important to conserve as a water catchment area, in addition to its unique biodiversity.

A total of 40 km² of peninsula granite fynbos remains, or 42,9% of its historical extent. A significant proportion of the South peninsula granite fynbos subtype is recovering from the impact of pine plantations, and invasive alien species are a major additional threat. Peninsula granite fynbos occurs on gentle slopes with deep, fertile, sandy-loam soils that are well-suited for vineyards and pine plantations. This makes areas historically containing peninsula granite fynbos attractive for agricultural and urban development. However, some of this vegetation type is conserved in the Table Mountain National Park and Kirstenbosch National Botanical Garden and is a very popular vegetation type for recreational activities such as hiking, cycling, dog walking and horse riding. A total of 40% of this is proclaimed, but a lack of fire is allowing invasion by forest species – to the detriment of the species of the peninsula granite fynbos.

The most poorly conserved endemic vegetation types include the Cape flats sand fynbos and Lourensford alluvium fynbos. Currently, 59 km² of Cape flats sand fynbos remains, which is only 11% of its historical extent. Only 2% of this type is proclaimed or is being managed. This vegetation type and its associated soils drain easily and are suitable for housing and urban development. Owing to the suitability of this vegetation for urban activity, urbanisation has considerably reduced its extent and fragmented the remaining habitat. Furthermore, the side effects of urbanisation have had an impact on the existence of the vegetation. For example, mowing, fire

5 Long-lived thicket species tend not to burn. The city's valleys and wetlands tend to have more short-lived plants, especially grasses and annuals, which tend to burn more often

6 Strandveld plants have a much higher proportion of animal-dispersed fruits than fynbos or renosterveld

7 It is important to note that historical extent is based on the 2018 City boundary. As a result, old statistics may not correspond and cannot be adjusted for without GIS analysis

protection, dumping, polluted waterbodies and alien plant invasion are identified threats to this fynbos type.[12]

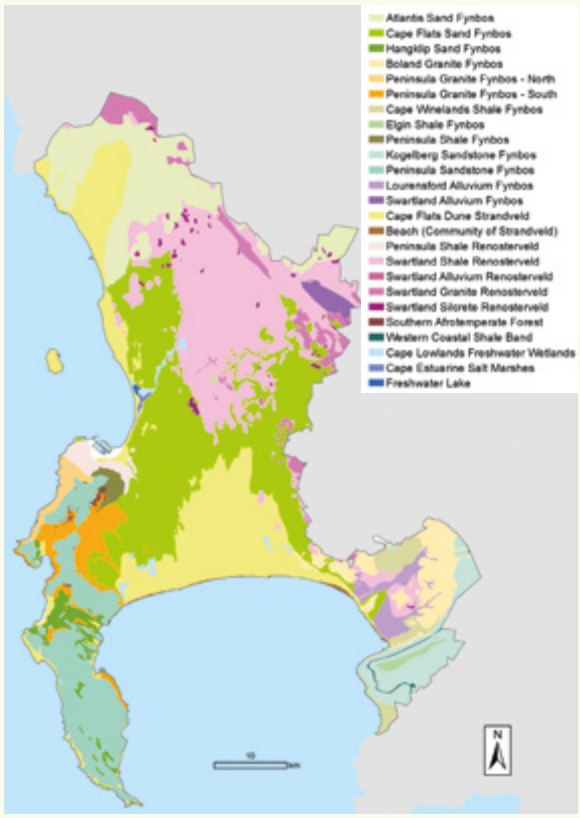
Only 3 km² of Lourensford alluvium fynbos still exists, which is 7,1% of its historical extent, mostly highly degraded. This vegetation type is found in the low-lying areas between Firgrove and Gordon's Bay, including areas of Strand and Somerset West, and extending up the Lourens River Valley. This area, in common with all vegetation types bordering natural remnants, has been irreversibly modified by urban development, agriculture and pine plantations, resulting in this vegetation type being one of the most affected endemic veld types in the city.[13]

To date, no lowland vegetation types have met their minimum national targets in conservation areas. This inability to meet conservation targets is due to historical widespread agriculture and rapid urbanisation.

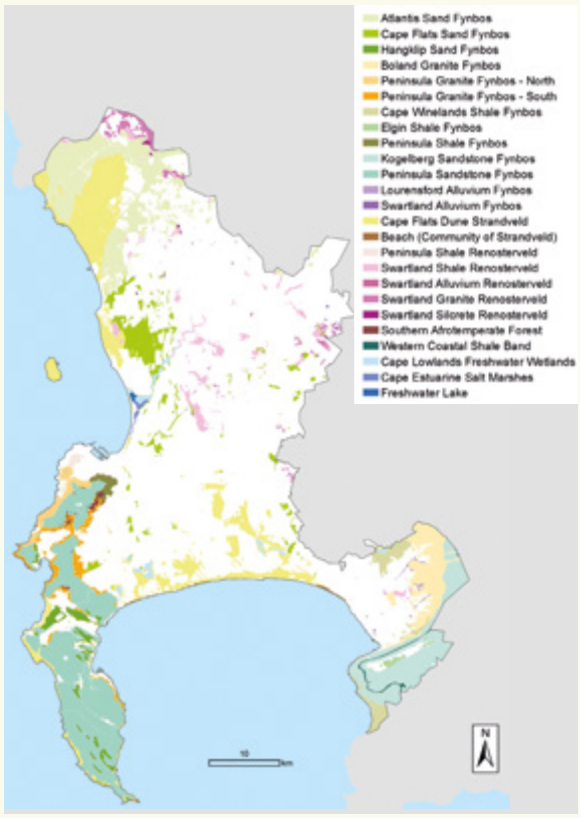
TABLE 1: PERCENTAGE OF HISTORICAL VEGETATION REMAINING

Vegetation type	km² vegetation remaining	% remaining of historical extent	Ecosystem status	CCT protection level*
Atlantis sand fynbos	147	58,7	Critically endangered	Poorly protected
Boland granite fynbos	59	61,5	Vulnerable	Moderately protected
Cape Flats dune strandveld	189	**46,4**	**Endangered**	Moderately protected
***Cape Flats sand fynbos**	59	**11,0**	**Critically endangered**	Poorly protected
Cape Winelands shale fynbos	29	55,7	Vulnerable	Well-protected
Elgin shale fynbos	3	39,4	Critically endangered	Well-protected
Hangklip sand fynbos	18	55,5	Endangered	Well-protected
Kogelberg sandstone fynbos	92	96,6	Critically endangered	Well-protected
***Lourensford alluvium fynbos**	3	**7,0**	**Critically endangered**	Hardly protected
Peninsula granite fynbos	40	**42,9**	**Critically endangered**	Well-protected
Peninsula sandstone fynbos	210	**95,9**	**Endangered**	Well-protected
***Peninsula shale renosterveld**	3	**11,6**	**Critically endangered**	Poorly protected
Southern afrotemperate forest	3	99,4	Least threatened	Well-protected
*Swartland alluvium fynbos	3	11,2	Critically endangered	Not protected
*Swartland granite renosterveld	18	25,7	Critically endangered	Poorly protected
*Swartland shale renosterveld	34	7,5	Critically endangered	Poorly protected
*Swartland silcrete renosterveld	1	13,6	Critically endangered	Hardly protected
Western vegetation	3	99,7	Least threatened	Well-protected

MAP 3: HISTORICAL DISTRIBUTION OF INDIGENOUS VEGETATION IN CAPE TOWN



MAP 4: CURRENT EXTENT OF INDIGENOUS VEGETATION IN CAPE TOWN



The BioNet is the fine-scaled systematic biodiversity plan for Cape Town, and is a key informant in the City's spatial planning products. The BioNet includes all priority natural and semi-natural wetlands and rivers, and indicates which parcels of land are classified as CBAs and need to be conserved to meet national conservation targets.

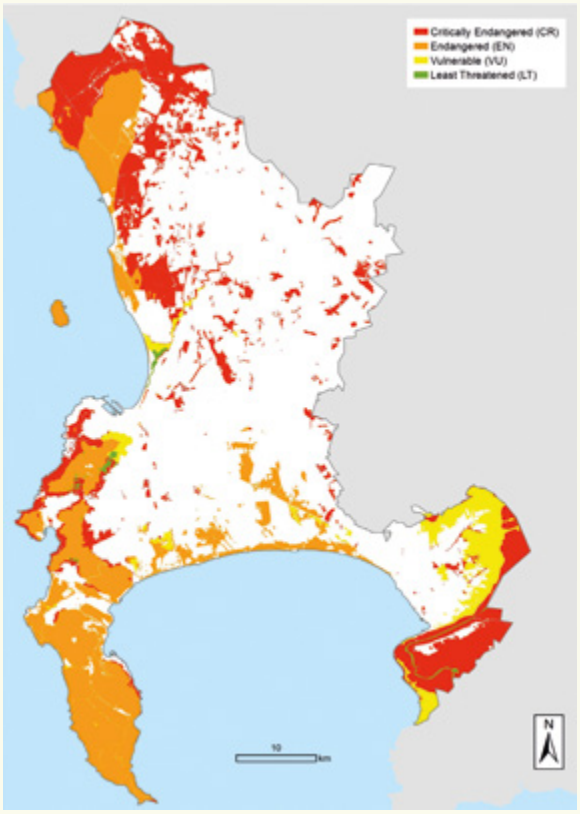
The BioNet covers 85 000 ha (34,18%) of the municipality (248 700 ha). The extent of the BioNet is shown in map 6. The City's protected area expansion targets for the BioNet follow the IDP five-year timelines. The City's target, as per the current IDP (2017–2022) is to protect 65% of the BioNet by 2022. As of June 2021, 65,41% (55 595 ha) of the BioNet is under protection. Accordingly, the 2022 target has already been exceeded, and in fact was fully achieved in December 2019. The total area of land formally conserved within the BioNet has increased significantly over the past decade. In 2009, only 34,12% (29 003 ha) of the BioNet was formally conserved, increasing to 60,81% in 2014, to 64% in 2016 and to the current 65,41% in 2021. A new target has been set: To conserve and manage 66,5%[8] (56 525 ha) of the 2009 BioNet by 2027.

There are 16 City-owned protected areas; 12 of the 16 have been notarised and published in the Provincial Gazette, with another two already notarised but still waiting to be gazetted, which is imminent. The remaining two, namely Durbanville and Harmony Flats, already have adequate status and are recognised as protected areas under the National Protected Areas Act, 2003.

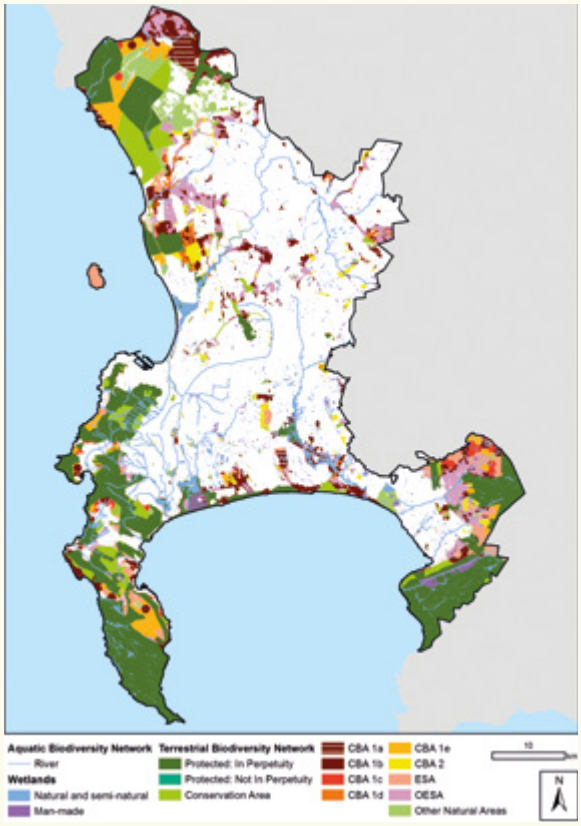
When land is formally 'conserved', it means that the land is proclaimed in perpetuity and managed by the City or another entity such as SANParks, CapeNature, private landowners/managers and parastatals such as Eskom.

[8] This has been adjusted down in response to recent unlawful land occupations and resultant likely deproclamation of Driftsands Nature Reserve, which will decrease the % conserved.

MAP 5: ECOSYSTEM STATUS OF INDIGENOUS VEGETATION IN CAPE TOWN



MAP 6: CITY OF CAPE TOWN'S BIODIVERSITY NETWORK[14]



KEY MANAGEMENT RESPONSES

The City runs a number of programmes to promote the sustainable conservation of fauna and flora, with a key focus on creating jobs and enhancing social benefits. Some key management responses helping to achieve the City's BioNet targets are outlined below.

Dassenberg Coastal Catchment Partnership

The Dassenberg Coastal Catchment Partnership (DCCP) is an ongoing initiative of the City, CapeNature, the World Wide Fund for Nature (WWF), the Wilderness Foundation, the Cape West Coast Biosphere, SANParks, the province's Department of Environmental Affairs and Development Planning (DEA&DP), and the South African National Biodiversity Institute (SANBI). The DCCP is a landscape-scale conservation initiative that spans approximately 34 500 ha. The area is a conservation priority for CapeNature (highlighted in the Provincial Protected Area Expansion Strategy) and was identified as a critical Climate Change Adaptation and Mitigation Corridor in the 2010 WWF-Table Mountain Fund study.[15] It is included in the BioNet and is also acknowledged as a conservation area in the MSDF. The DCCP is prioritised on the basis of having extremely high biodiversity value, with some of the most extensive critically endangered lowland habitat in Cape Town. It comprises the last relatively intact and ecologically functional area of critically endangered and poorly protected Atlantis sand fynbos, as well as critically endangered Swartland shale renosterveld, Swartland granite renosterveld, Swartland silcrete renosterveld and endangered CFDS habitat.

The areas also important for Cape Town's water security as it contains the Witzands Aquifer protection zone. It is also an excellent locality for skills development projects and economic development opportunities. The clearing of alien vegetation alone can create numerous job opportunities. Not only is this an important biodiversity intervention; clearing alien vegetation will also enhance the productivity of the aquifer. Recreation and tourism activities, such as the Mamre Heritage and Wild Flower Show, can be expanded, leading to further recreation and tourism opportunities, such as game viewing, following the possible reintroduction of eland and red hartebeest.

The initiative aims to identify opportunities to secure formal conservation protection for all the land parcels identified within the project area. The ultimate goal is to proclaim all conservation-worthy land in terms of the National Environmental Management: Protected Areas Act, 2003.

Key initiatives during this reporting period have focused on creating a viable ecological link between Dassenberg Hills and the coast and ensuring access to the Witzands dunes for recreation and tourism. This is facilitated through the recently built multipurpose centre, which provides a gateway to the dunes, providing a cash office and facilities.

Atlantis revitalisation scheme – land banking

Over 9 km² of vacant land in Atlantis contain critically endangered Atlantis Sand Fynbos and/or endangered CFDS vegetation and numerous plant species of conservation significance. The mitigation for the loss of this biodiversity requires the identification of an offset area or financial contribution to biodiversity conservation and is therefore an additional cost and deterrent to investment in Atlantis. The NEMA Environmental Impact Assessment (EIA) Regulations require that environmental authorisation be obtained for the clearance or removal of an area of 300 square metres or more of endangered or critically endangered vegetation.

Since 2013, through the Council-approved Atlantis Industrial Incentive Scheme, the City has been proactively acquiring, managing and retaining important biodiversity land outside the urban edge and in the DCCP. This is a mechanism to facilitate development in Atlantis through a conservation land banking mechanism as a form of biodiversity offsetting. This ensures that key biodiversity remnants outside the urban edge are proactively purchased and conserved to compensate for the loss of critical biodiversity to development in the urban edge and the Atlantis industrial area, thereby facilitating new investment opportunities in Atlantis. It is important to note that the loss of the remnant biodiversity in Atlantis can be mitigated at this stage as sufficient high-quality vegetation remains outside the urban edge to meet the national conservation targets for the vegetation types in question.

This scheme is supported by CapeNature and the provincial Department of Environmental Affairs and Development Planning (DEA&DP), which is the competent authority responsible for processing applications for environmental authorisation. This approach facilitates development while ensuring priority land is added to the DCCP conservation estate, securing biodiversity resources and the vital ecosystem services they deliver.

The conservation land bank has been completed, with enough land secured to facilitate the development of all vegetation remnants in the Atlantis industrial and residential areas. To date, the City has purchased 19 properties totalling 1 095 ha, mostly along the Klein Dassenberg hills. As of June 2021, this has been used to facilitate 15 developments totalling 153 ha.

Metro south-east strandveld conservation implementation plan (CIP)

The CIP has identified strandveld biodiversity areas that will serve to offset development for City housing projects such as Pelican Park Phase 2. To date, the CIP has facilitated approximately 6 945 housing units and resulted in the establishment of the Vesuvius Way Conservation Area and Symphony Way Conservation Area. This has increased the area conserved to 2 077 ha (8,1%) of the False Bay subtype, Cape Flats dune strandveld. The Macassar Dunes East Conservation Land Bank was established to further facilitate City housing projects. This innovative approach is being undertaken in collaboration with external conservation partners CapeNature, the province's Department of Environmental Affairs and Development Planning (DEA&DP) and The South Africa National Biodiversity Institute (SANBI).

Protected Area Reviews and the METT-SA audits of nature reserves managed by the City

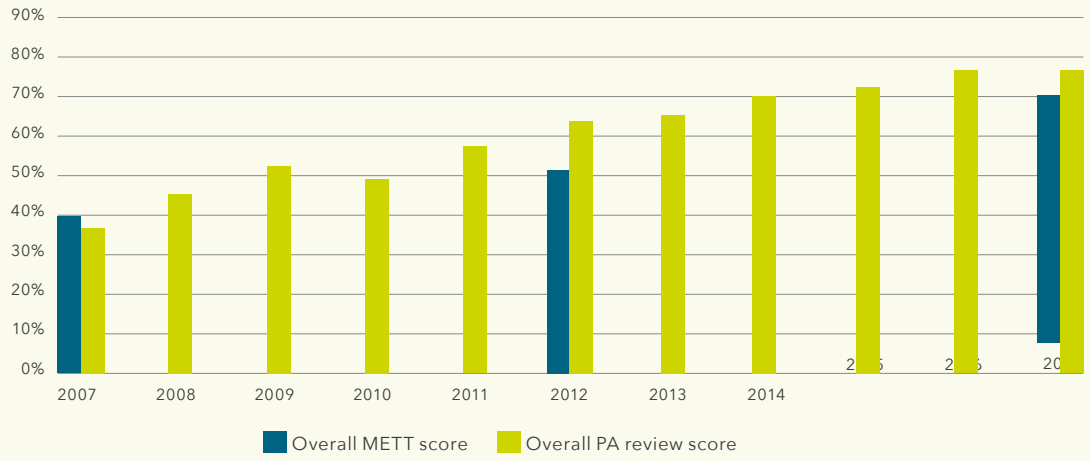
A robust evaluation and audit system is crucial to ensure the effective management of areas designated for biodiversity conservation in protected areas such as nature reserves. The METT was developed by the International Union for Conservation of Nature (IUCN) as a mechanism to facilitate standardised evaluation of the management of protected areas internationally. The use of this tool is now mandatory in projects where the World Bank, WWF and Global Environment Fund (GEF) are funders. It was adapted for use in the local context and named the METT-SA. The purpose of the tool is to identify the interventions required to ensure management effectiveness according to international standards and to identify 'next steps' for aspects of underperformance. The application of this tool is not to compare performance of different sites with each other, but rather to allow organisations to track progress at each conserved area over time.

The City is one of the leading conservation agencies in the implementation of the Management Effectiveness Tracking Tool (METT-SA03), with over a decade of implementation. The first METT-SA audit of the City's nature reserves was conducted in 2007. This process highlighted the need to set lower-level targets for the reserves, many of which were newly proclaimed and managed according to conservation principles. To facilitate the identification of steps with a view to reaching METT standards, an assessment tool, the Protected Area Review (or PA Review), was developed. It is undertaken annually at each nature reserve in order to break up these steps into achievable targets. The City has conducted the PA Review every year since 2007, showing a gradual improvement in scores.

The City conducted METT-SA audits in 2007, 2012 and 2017 and METT-SA03 (version 3) audits in 2018 and 2019, with overall scores of 40% in 2007, 51% in 2012 and 75% in 2016 (figure 2). In both the 2018 and 2019 METT-SA03 assessments, City-managed nature reserves achieved overall 'sound

management' (>67%).[9] This is a slightly decreased score from past years (2007–2017), because the updated tool has twice as many indicators, and requires verification and evidence documents. In 2019/20, heritage level 4 assessments as per the METT-03 process were completed.

FIGURE 2: BIODIVERSITY MANAGEMENT EVALUATION 2007–2017 (CITY OF CAPE TOWN BIODIVERSITY REPORT, 2018)



TREND AND TARGET

Trend:

Despite an increase in land under formal conservation management, the city's biodiversity remains under threat. Inappropriate development (urban sprawl) is the greatest threat to the remaining biodiversity in the city. The high in-migration rate and demand for housing results in more and more land being developed to accommodate formal and informal settlements. Invasive species is the second-most important threat to biodiversity conservation in Cape Town. The Covid-19 pandemic, and resultant 'hard lockdown' and job losses, led to increased poaching and other illegal activities, as well as a significant increase in pressure as a result of illegal land invasions at many sites. Further threats to biodiversity include agriculture, inappropriate fires, mowing, over-exploitation and pollution. The safety and security of staff and visitors to nature reserves is also a rising concern.

Target:

- 65% (55 250 ha) of areas identified in the 2009 BioNet to be under formal conservation management, including proclamation and stewardship agreements, by 2022
- 66,5% (56 525 ha) of the 2009 BioNet to be conserved and managed by 2027

Current: A total of 65,41% of the BioNet (approximately 55 595 ha) is under formal conservation management – 2022 target achieved and exceeded.

POLICY LINKAGES

- IDP 2022-2027:
  - Priority – Public space, environment and amenities
  - Objective 9: Healthy and sustainable environment
- Environmental Strategy (2017):
  - Strategic Focus Area 1 – Natural Systems Planning and Management
- City of Cape Town Bioregional Plan (2015)
- Local Action for Biodiversity (LAB) programme, an ICLEI Local Governments for Sustainability initiative
- LBSAP 2019–2029
- Sustainable Development Goals (SDGs):
  - Goal 15: Life on land
  - Goal 11: Sustainable cities and communities
  - Target 11.4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage
- **See also:** Chapters on *Invasive alien species*, and *Natural public green spaces*

[9] In early 2018, METT-SA03 audits were undertaken for the 16 proclaimed nature reserves and some of the conservation areas (Kenilworth and Westlake). By the end of 2018, all the City's protected areas undertook the METT-SA03 for the first time

CHAPTER 2: INVASIVE ALIEN SPECIES

UNDERSTANDING INVASIVE ALIEN SPECIES IN CAPE TOWN

Indicators:

- Extent of invasive species in the city
- Effectiveness of invasive species clearing operations
- Number of jobs created as a result of invasive species clearing programmes

For the purposes of this report, invasive species are defined as those species that are 'non-native (alien) to the ecosystem under consideration, whose introduction causes or has the potential to cause harm to the economy, environment or human health.[16] Invasive species may be plants, animals or other organisms.

Invasion by alien species is one result of globalisation, a process that allows for the easy movement of people and goods around the world. Species often arrive at different destinations accidentally, although many exotic species are intentionally introduced into gardens or native ecosystems for various purposes. If the introduced species is able to adapt to the climatic and environmental conditions in their new destination, they have the potential to naturalise and become invasive, especially if they are free from pests and parasites in their introduced environment. However, it is important to note that not all introduced species become invasive; only a small percentage become a problem in their new destination.

Plants and animals that are introduced become a problem if they dramatically increase in number, outcompete indigenous species or alter the environmental conditions to the detriment of the local biota. Invasive species generally reproduce rapidly, spreading and invading local ecosystems. This may hold serious implications for water yields, rangeland productivity, biodiversity and associated tourism, human health and fire safety.

Cape Town experiences a number of problems caused by the presence of invasive species. These include:

- Loss of habitat and indigenous species due to being crowded or shaded out by invasive species
- Fire risk, as invasive plants often burn much hotter and for longer periods of time than indigenous plants
- Water loss in an already water-scarce city, as invasive trees and shrubs use a significantly larger amount of water than most locally indigenous plants
- Alteration in nutrient content of soils by invasive species, with negative effects on the indigenous ecosystem.

INVASIVE ALIEN SPECIES

Many different specie types, both plant and animal, are deemed to be invasive in Cape Town. National guidelines set out by the National Environmental Management: Biodiversity Act (NEMBA) categorise the status of invasive species. The City of Cape Town adheres to these categories and addresses them as part of its environmental management responsibilities.

The categories set out by NEMBA and their management actions are outlined in table 2.

Some of the most prevalent and problematic invasive species in Cape Town and their associated NEMBA categories are outlined in table 3.

TABLE 2: NEMBA CATEGORIES

NEMBA categories	Legislated/required management action
Category 1a	Invasive species in this category must be combatted and eradicated. Any form of trade or planting is strictly prohibited.
Category 1b	Invasive species in this category must be controlled and whenever possible removed and destroyed. Any form of trade or planting is strictly prohibited.
Category 2	Invasive species in this category require a permit to carry out a restricted activity. Species covered in this category include commercially important species such as certain pine, wattle and gum species used in forestry.
Category 3	Invasive species in this category may remain in prescribed areas or provinces. Further planting, propagation or trade is prohibited. Plants in riparian areas are, however, classified as category 1d and must be controlled.

TABLE 3: THE MOST PROBLEMATIC INVASIVE TREE SPECIES IN CAPE TOWN

Name	Description	NEMBA category
Invasive alien plants and trees		
Black wattle (*Acacia mearnsii*)	A tree native to Australia. It grows rapidly, crowding out indigenous vegetation, increasing fire severity and depleting water sources.	Category 2
Port Jackson (*Acacia saligna*)	An Australian shrub/tree introduced in the mid-19th century to stabilise sand dunes. It grows rapidly, crowding out indigenous vegetation, increasing fire severity and using large amounts of water.	Category 1b
Pine (*Pinus spp.*)	A fast-growing coniferous tree that invades fynbos and renosterveld areas. It also increases fire risk and severity. It uses significantly more water than native fynbos vegetation.	Category 2 for plantations and windrows, and Category 1b elsewhere
Gum (*Eucalyptus spp.*)	These Australian trees grow rapidly, are highly flammable (increasing both fire risk and severity) and use significantly more water than native fynbos vegetation.	Category 1b in riparian areas, protected areas and fynbos. Category 2 for plantations, woodlots, bee-forage areas, windrows and the lining of avenues.

METHODS OF CONTROL

In response to the threats posed by invasive species, the City has implemented a variety of projects to combat terrestrial and aquatic plants, new and emerging invasive plant species, and invasive animals.

The Cape Town Biological Control Programme introduces natural enemies to reduce the population of the invasive species. The use of biocontrol methods is cost effective and environmentally friendly. This programme has been successful in tackling invasive water weeds, creating jobs for people with special needs, and improving environmental awareness with schoolchildren.

Invasive animals

The City runs programmes that monitor, track and, where possible, eradicate listed invasive animal species. Illegal pet trading and the introduction of invasive alien animals are addressed through specific programmes. Each species has an existing specific control programme or one that is still to be developed.

Terrestrial invasive plants

The Cape Town Terrestrial Invasives Project uses the following control methods, generally referred to as 'integrated control':

- Mechanical – using chainsaws or other machines to fell and cut down invader plants
- Manual – hand-pulling seedlings or cutting down smaller plants with hand tools
- Herbicides – the application of registered herbicides by suitably qualified herbicide applicators
- Biological control (biocontrol) – using natural enemies, including insects, mites and plant pathogens
- Fire – either by burning an entire area or by burning stacks after an initial clearing to reduce fuel loads

Aquatic weeds

The City implements a long-term control programme to combat the problem of aquatic weeds, using a combination of different control methods:

- Manual control – the deployment of trained aquatic weed teams to manually remove aquatic weeds
- Mechanical control – involves the use of heavy machinery such as long-boom excavators
- Chemical control – involves the use of registered herbicides
- Biological control – the introduction of the plant's natural enemies to its habitat

Early Detection and Rapid Response programme

The first line of defence is to prevent the introduction of invasive species – but this is not always possible. The second line of defence is to eradicate recently established invasive species, under the Early Detection and Rapid Response (EDRR) programme of the City's Invasive Species Unit. The EDRR aims to eradicate or contain invasive species before they become too widespread, in which case extirpation measures (the complete removal) become technically and financially impossible. The City recognises that the costs associated with the EDRR management efforts are significantly lower than if these species were not tackled and long-term invasive species management programmes were later required.

The EDRR programme prioritises 25 target plant species and five target animal species that can potentially be eradicated in Cape Town. Cape Town's residents can contribute to managing invasive species by reporting sightings of target plants and animals via the Spotter Network. Residents can become spotters by signing up to the Spotters Network on the Cape Town Invasives website (more information about the EDRR can be found *here*).

STATE OF THE ENVIRONMENT

There are 95 listed invasive alien plant species, including weedy plants and trees, across the 20 nature reserves managed by the City, of which three are category 1a, 29 are category 1b, four are category 2 and three are category 3. In addition, the City controls approximately 54 species that are not listed as invasive alien species but demonstrate invasive traits. These are controlled as part of area-based alien vegetation clearance or as part of the EDRR programme. It is estimated that nearly 9 016 ha of protected areas in Cape Town are in maintenance and/or alien-free, whereas 2 597 ha have extensive or dominant invasive alien vegetation cover. About 3 000 ha of habitat still need to be assessed in detail. The extent of invasive alien vegetation in protected areas is indicated in map 7.

Operations to control invasive alien species have had some notable successes, as indicated in table 4. The effectiveness of control methods is measured in terms of the density of the alien plants remaining after a clearing intervention. If there was a high level of success, the method would score as 'highly effective' or a '4' in table 4. An assessment undertaken in 2016 found that interventions for 24 of the 29 species assessed have reduced the abundance and impact of the alien species, one species intervention has had no impact and four species have not been assessed (or no intervention has taken place).

As indicated in table 4, the control of *Pennisetum setaceum* (fountain grass) has an effectiveness rating of '2'. The effectiveness of manual and chemical methods to control this species has decreased from '4' reported in the State of Environment Report 2018. The inability to control this species is due to its ability to spread rapidly. The spread of this species raises the fuel load by increasing the intensity and frequency of fires.[17] Furthermore, fountain grass poses a threat to native species,which are adapted to less extreme fire regimes.

MAP 7: THE EXTENT OF INVASIVE ALIEN VEGETATION IN THE CITY OF CAPE TOWN'S NATURE RESERVES

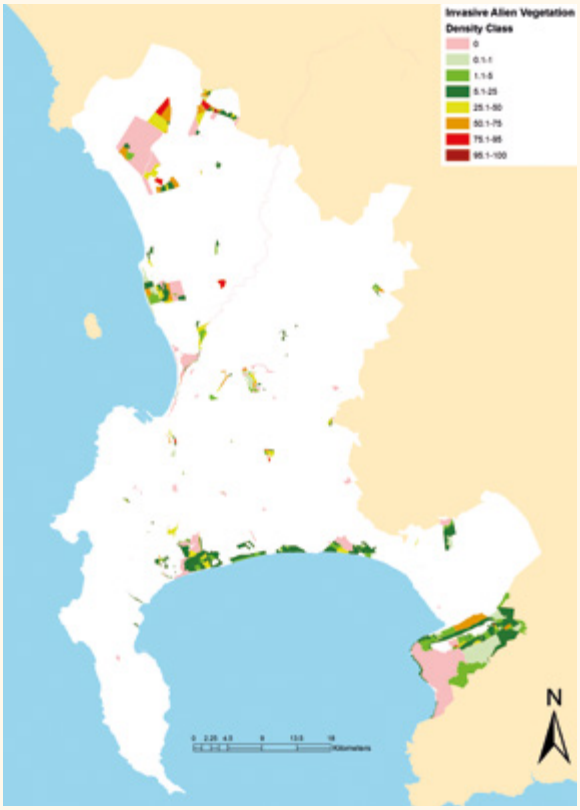


TABLE 4: ALIEN SPECIES ASSESSED FOR CLEARING METHODS IN CAPE TOWN

Species	NEMBA category	Method	Effectiveness
Acacia elata	1b	Manual, chemical, mechanical	4
Acacia paradoxa	1a	Manual, chemical, mechanical	4
Ailanthus altissima	1b	Manual, chemical, mechanical	4
Anredera cordifolia	1b	Manual, chemical	4
Bryophyllum delagoense	1b	Manual	4
Campuloclinum macrocephalum	1b	Manual, chemical	4
Cardiospermum grandiflorum	1b	Manual, chemical	4
Centranthus ruber	1b	Manual, chemical	4
Cortaderia selloana	1b	Manual, chemical	4
Eichornia crassipes	1b	Biological	4
Eucalyptus conferruminata	1b	Manual, chemical, mechanical	4
Genista monspessulana	1a	Manual	4
Hakea drupacea	1b	Manual	4
Iris pseudocorus	1a	Manual	4

TABLE 4: ALIEN SPECIES ASSESSED FOR CLEARING METHODS IN CAPE TOWN (CONTINUED)

Species	NEMBA category	Method	Effectiveness
Lythrum salicaria	1a	Manual	4
Melaleuca hypericifolia	1a	Manual, chemical, mechanical	4
Myriophyllum aquaticum	1b	Biological	4
Nymphaea mexicana	1b	Manual, chemical	4
Pennisetum setaceum	1b	Manual, chemical	2
Pistia stratiotes	1b	Biological	4
Pittosporum undulatum	1b	Manual, chemical, mechanical	4
Rivina humilis	1b	Manual	4
Salvinia molesta	1b	Biological	4
Spartium junceum	1b	Manual, chemical	3
Verbesina encelioides	NL	Manual	4

(2) Effectiveness: Intervention has no discernible impact
(4) Effectiveness: Interventions are reducing the abundance and impact of alien species

KEY MANAGEMENT RESPONSES

Invasive species management programme

The City's invasive species management programme involves the identification, control and management of invasive species. Invasive species control is coordinated by the City's Invasive Species Unit, in consultation with other line departments, namely Asset Management and Maintenance; Water and Sanitation; Recreation and Parks; Human Settlements; Property Management; and Solid Waste Management. The budget for the invasive species work comes primarily from the City's Expanded Public Works Programme (EPWP), other line departments and grant funding from the Department of Forestry, Fisheries and the Environment (DFFE). A three-year contract is in place for the control of invasive aliens, funded by DFFE's Natural Resource Management (NRM) programmes.[10] The City's Invasive Species Unit, in collaboration with DFFE, planned and executed a joint invasive compliance operation. The main purpose of the operation was to engage with all landowners whose properties are loaded with complaints and are a fire, security, and health and safety risk.

The City completed priority invasive species projects in 2019/20. The City has submitted control plans for all its 16 proclaimed nature reserves and submitted two for additional areas managed but not proclaimed. DFFE visited 11 nature reserves to confirm invasive species compliance on the reserves. The unit has received written confirmation from DFFE that the City is compliant in respect of Invasive Species Control Plans for six sites. The site visits had to be postponed for the rest of the nature reserves due to Covid-19. The City was one of the few municipalities countrywide that submitted control plans.

The City's invasive species management programme is also an important job creator. In 2020/2021, 3 973 job opportunities and 53 386 full-time job equivalents were created. This exceeds the annual targets of 3 000 and 250 respectively.

Early Detection and Rapid Response (EDRR) programme

Polyphagous shot hole borer (PSHB)

The polyphagous shot hole borer beetle is the most recent invader in South Africa. Together with its fungal symbiont, *Fusarium euwallaceae*, it can kill highly susceptible plants within a few months. It was first detected in South Africa in 2017 in KwaZulu-Natal during a plant sentinel project. It was later found in Gauteng and the Western Cape (George and Knysna) in 2018. By the end of 2018, no reports of PSHB were recorded in the City of Cape Town.

The distance between the City of Cape Town, George and Knysna, and the everyday interaction (through travel) meant that the possibility was high that PSHB could be found within the boundaries of the City of Cape Town. In 2019, the Invasive Species Unit made a decision to add the PSHB to the EDRR programme. A reporting platform *(https://edrr.capetowninvasives.org.za/shot-hole-borer)* was developed where residents could report trees they suspect are infected with PSHB. This platform was accompanied by a concise description of what the beetle looks like and what symptoms to look for in a tree. Staff dedicated to the EDRR programme have been trained on identifying signs of PSHB in trees. In the same month, reports were received from all over the City of Cape Town; all were verified and were negative, with no sign of the PSHB beetle.

In March 2019, a report on a London plane tree (PSHB reproductive host species) and its fungal symbiont was

received in Somerset West. This was later found to be PSHB. The confirmation was done using DNA sequencing by the Stellenbosch University and was only received in April of 2019. At the same time, a Species Management Protocol was developed mainly from literature from California, USA and Israel where they have been dealing with this beetle before it was found in South Africa. The protocol was shared publicly in May 2019.

Since PSHB was only found in a Somerset West suburb, the strategy was to contain it there through the following:

- Rapid response to reports (website, telephone and email) and verifying such reports
- The daily monitoring and surveying of trees in Somerset West
- Removing (felling, chipping and incinerating) highly susceptible PSHB-affected trees
- An in-depth awareness and education campaign was launched

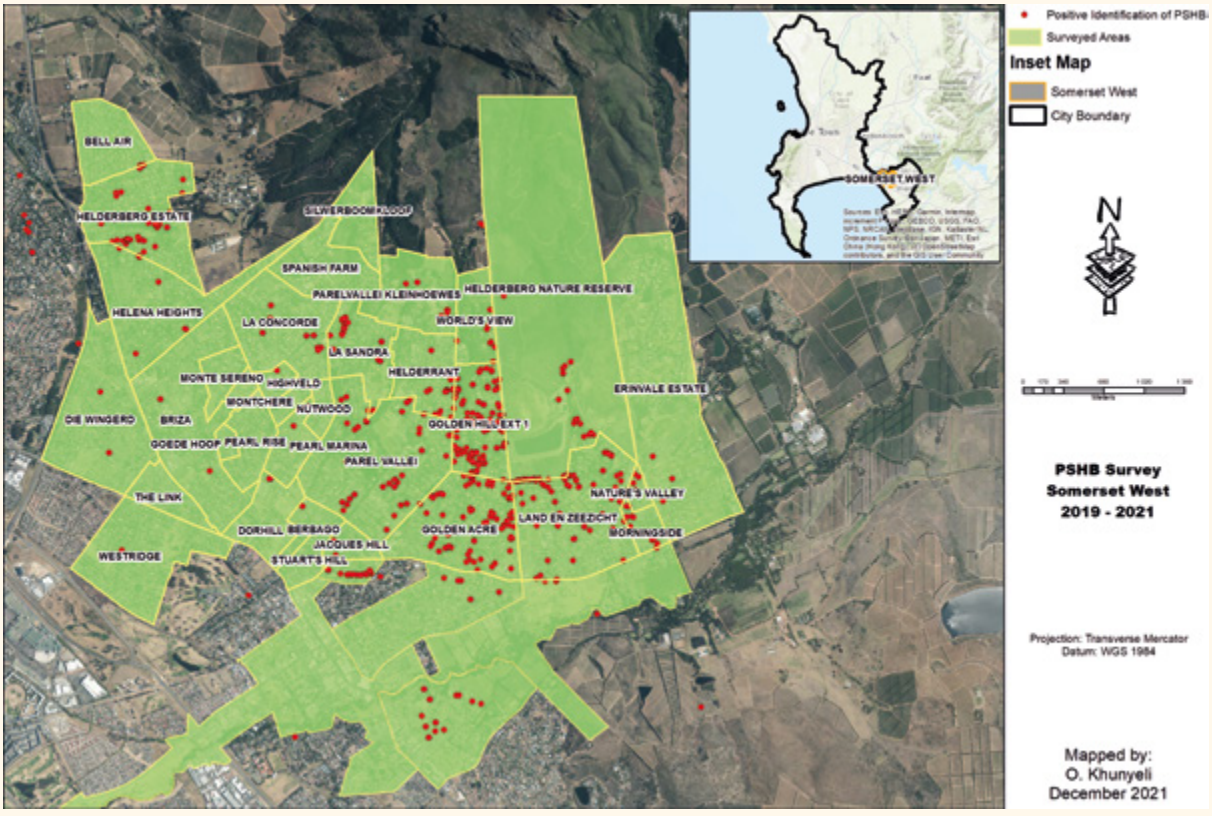
Between January 2019 (project inception) and June 2021, 858 trees were removed. These trees were identified as a result of all the reports received and surveys conducted (table 5).

As part of our strategy for containing PSHB in the Somerset West area, adjacent suburbs were surveyed to firstly establish the extent of the invasion and secondly to identify the highly susceptible reproductive trees. The areas surveyed are highlighted in green in map 8. The map also indicates, with red dots, where trees affected by PSHB have been removed.

The top five PSHB reproductive tree species that are highly susceptible and found in Cape Town are:

- English oak (*Quercus ruber*)
- London plane (*Platanus x eacerifolia*)
- Boxelder (*Acer negundo*)
- Lombardy poplar (*Populus nigra*)
- Japanese maple (*Acer palmartum*)

MAP 8: PSHB SURVEYED IN THE SOMERSET WEST AREA AND ADJACENT SUBURBS



[10] Working for Water and Working for Wetlands

TABLE 5: PSHB STATISTICS

Period	Number of reports received	Number of surveys conducted	Number of infested trees	Number of trees removed
Jan 2019 - June 2020	422	38	692	201
July 2020 - June 2021	301	203	958	657
Total	**723**	**241**	**1 650**	**858**

The Kader Asmal Integrated River Catchment Project

In addition to day-to-day clearing operations of invasive species and the EDRR programme, the City has the established Kader Asmal Integrated Catchment Management EPWP. This interdepartmental, multi-stakeholder initiative is central to the clearing of invasive species and contributes to skills development, green job creation and environmental education. The programme was established in 2012 to honour the late Professor Kader Asmal, a former Minister of Water Affairs who was passionate about creating jobs and conserving water.

The objectives of the programme are to:

- Control invasive alien species through labour-intensive methods
- Restore biodiversity by propagating indigenous plants and revegetating cleared areas
- Mass-rear insects for biological control, which helps to create job opportunities for physically challenged individuals
- Improve infrastructure, such as footpaths and board walks, in nature reserves
- Build small restoration works in rivers, such as gabions and erosion-prevention measures in rivers
- Create a skills development programme with the aim of establishing area teams (green wardens) consisting of a supervisor, and skilled and unskilled labourers. The team has a variety of different skills, with chainsaw operators, herbicide applicators, and revegetation and general labour skills
- Work with communities to roll out a River Ambassadors Programme

The Kader Asmal Integrated Catchment Management EPWP provides significant job creation, skills and training benefits. As of June 2019, the programme had created 106 127 person days of temporary employment (461 full-time job equivalents; 3 318 job opportunities).

In September 2018, the Invasive Species Unit initiated the Kader Asmal Skills Development Programme that ended on 30 June 2021. The objective of the programme was to equip 30 beneficiaries with necessary skills and experience to become more employable or to start their own SMMEs after the three years of the implementation period. The programme employed 53 participants over the three years; of these, 31 participants have successfully exited the programme by means of longer-term or permanent employment within the City of Cape Town or through our stakeholders.

In June 2021, the skills programme won five awards at the EPWP awards ceremony. The programme was awarded Administrative Team of the Year for the Kader Asmal programme; Administrative Team of the Year for the Skills Development Programme; Best Achiever: Exit Strategy for Skills Development Programme; Best Public Employment and Skills Development Programme; and Best EPWP Coordinator: Mashudu Victor Phalanndwa. Owing to the success of the programme, the Kader Asmal Skills Development Programme received funding for another three years. This will include 75 participants and form part of programmes across the Biodiversity Management Branch.

TREND AND TARGET

Trend:

Invasive alien plant and animal species are a significant threat to Cape Town's biodiversity, and reduce the quality of natural green spaces. Fynbos is particularly susceptible to invasion by alien trees, mostly Australian acacia, hakea and eucalyptus, and pines from the northern hemisphere. These trees outcompete the indigenous vegetation and alter ecosystem processes such as fire, nutrient cycling and the hydrological regime. In lowland habitats, alien acacias with huge seed banks dominate. They require herbicide to prevent regrowth post-felling, and clearing is less successful. Pines continue to spread in water catchment areas, significantly reducing run-off into dams. The population of invasive alien house crows increased to approximately 500 in 2020/21, as a result of Covid-19 and restrictions on contractors. The PSHB infestation, which affected mature trees in Somerset West, also received significant media coverage in the past year.
The City's team successfully removed many trees infested with the borer, and continues to monitor and contain its spread.

Target:

The City's targets in relation to invasive alien species are that by 2022:

- A total of 20% of the protected areas (proclaimed protected area layer of 2017 with invasive species baseline of 2016) will be in maintenance phase for woody invasive species control. (Maintenance implies initial clearing and three follow-ups completed)
- Baseline data: Invasion extent will be mapped for alien woody plants for City-owned land on the BioNet
- Invasive aquatic alien plant species will be reduced by 80% (i.e. the 2009 coverage in the city's water bodies)
- Biocontrol will be fully integrated into aquatic weed management in the BioNet, where applicable
- The house crow population will be reduced to below 100 individuals
- All mallard ducks in the City's nature reserves will be actively managed
- Guttural toads will be confined to a limited invasion area in Constantia and Tokai

Current: It is estimated that nearly 4 000 ha of protected areas are woody alien-free, 2 842 ha have extensive or dominant invasive alien vegetation cover and 3 000 ha of habitat still needs to be assessed in detail.[11]

POLICY AND LINKAGES

- IDP 2022-2027:
  - Priority – Public space, environment and amenities
  - Objective 9 – Healthy and sustainable environment
- Environmental Strategy (2017):
  - Strategic Focus Area 1 – Natural Systems Planning and Management
- Framework for a Strategy and Action Plan for the Management of Invasive Species in the CCT (2008)
- City of Cape Town Bioregional Plan (2015):
  - Invasive Species Management (ISM) Project
- LBSAP 2019–2029
- Sustainable Development Goals (SDGs):
  - Goal 15: Life on land
  - Target 15.8: Prevent invasive alien species on land and in water ecosystems
- **See also:** Chapter on *Biodiversity*

[11] It should, however, be acknowledged that the City's protected areas will never be completely free of all alien species

CHAPTER 3: NATURAL PUBLIC GREEN SPACE

UNDERSTANDING NATURAL PUBLIC GREEN SPACE IN CAPE TOWN

Indicator:

- Average distance to travel to natural public green space

Universal access to safe, inclusive and accessible green and public spaces by 2030 is a target included in the United Nations Sustainable Development Goal 11:[18] Make cities and human settlements inclusive, safe, resilient and sustainable. International studies conducted in the last decade confirm the significant benefits of urban green spaces for promoting physical activity, mental health and well-being, and improving air and water quality.[19]

The City recognises the importance of incorporating green spaces into the urban environment for a number of reasons. Socially, public green spaces provide residents with opportunities for nature-based recreational activities, such as walking, hiking, picnicking, birdwatching and boating, while also providing for spiritual, aesthetic and educational needs. In addition, these spaces meet the needs of children to have an open and well-managed environment in which to play. Environmentally, these spaces allow for the conservation of biodiversity and the provision of other ecological goods and services, such as water infiltration and urban cooling. Economically, these spaces contribute towards sustaining Cape Town as an attractive tourism and investment destination.[20, 21]

The importance of public green space is reflected in various City planning documents. The City's MSDF currently recognises Cape Town's critical environmental assets, its globally important biodiversity and the significance of its coastline. The BioNet is a key informant of the MSDF and the current MSDF has assigned the correct spatial planning categories to CBAs and ESAs. The MSDF considers CBAs and ESAs as per the Bioregional Plan (2015), and all CBAs assigned as Core 1 and CESAs assigned as Core 2. A key spatial strategy of the MSDF is to 'manage urban growth, and create a balance between urban development and environmental protection'.

The City's Parks Development Policy (2015) aims to ensure consistency in decision making relating to the development of new parks, the upgrading of parks and the provision of facilities that will meet the needs of communities and safeguard the long-term sustainability of these amenities, while ensuring a satisfied user. The policy also recognises the important role of parks and recreational facilities in the lives of residents and visitors, and aims to provide parks and facilities that are high quality, safe and accessible, attractive, and meet the varying needs of community and special interest groups (such as those who are physically challenged).

The City's Urban Design Policy (2013) envisions intentionally creating open space that is scaled and configured to suit the functions for which it is planned. The functionality of space also includes combining open-space uses, such as Sustainable Urban Drainage Systems (SUDS), playgrounds and allotment gardens, to use space more effectively and to increase accessibility to all facilities.

Through the MSDF and policies such as the Parks Development Policy and Urban Design Policy, the City aims to incorporate public green spaces into urban environments through parks, open spaces, playing fields, walkways, greenbelts, nature reserves and urban gardens. This access to public green space is a key measure of a healthy city.

However, not all green spaces perform the same functions. Public green space is land that consists of a variety of formally managed land types, including nature reserves that are able to support a range of biodiversity; large district parks,[12] greenbelts and river corridors; and smaller

parks that do not necessarily have a significant biodiversity function (although this is dependent on the nature of the space in question). However, these provide recreational space and may provide other valuable ecosystem goods and services. Managed public green space will generally be maintained[13] and often have some measure of basic facilities, such as play equipment, footpaths, toilets, picnic spots, parking areas, on-site staff and security measures, and will generally be maintained. Although unmanaged areas provide important ecological goods and services, these areas do not always provide the same level of service in terms of meeting recreational and social needs and can be identified as undeveloped public open space. This chapter focuses on managed public green space.

Managed public green space can also be categorised in two further ways: natural and semi-natural. Natural public green space includes protected areas (managed as nature reserves by the City, provincial or national government, or private entities), greenbelts and less-developed parts of the coastline. Semi-natural public green spaces include community parks, district parks and more developed parts of the coastline.

Guidelines

The City monitors and aims to improve the average distance to travel to natural public green spaces and uses the English nature guidelines to identify the distribution of natural public green space in Cape Town. These spaces include the coastline, greenbelts, biodiversity areas, and district and regional parks. The use of these guidelines is not prescriptive but does provide a simple means to evaluate the access to natural public green space in the city. The guidelines for managed, public green space are:

- At least one accessible 2-ha site within 300 m of home
- At least one accessible 20-ha site within 2 km of home
- At least one accessible 100-ha site within 5 km of home
- At least one accessible 500-ha site within 10 km of home

In 2014, the City updated guidelines and standards for planning its social facilities and recreational spaces. These spaces can be categorised as semi-natural public green space. These standards are to be used for all new developments and City planning as a strategic guide for space allocation at the neighbourhood, district and metropolitan scale in order to facilitate the improvement of quality of life for all residents. The guidelines provide space allocations for semi-natural public green spaces according to the surrounding residential population and the accessibility to these spaces. They provide standards for district, regional and community parks among other City public open spaces and facilities. The guidelines, however, do not provide standards for natural public green space. This is a result of various factors but is particularly due to the uneven geographical distribution of these spaces.

STATE OF THE ENVIRONMENT

The City's green spaces include nature reserves, the coastline, public parks and greenbelts. The City currently manages 14 district parks[22] and 354 greenbelts across Cape Town, accounting for just over 1 349 hectares of natural public green space. Cape Town has over 45 000 hectares of accessible protected areas (nature reserves). This figure includes Table Mountain National Park (22 100 ha). The City currently manages 20 nature reserves. The Cape Town coastline stretches for approximately 307 km, with 240 km in the City's jurisdiction. Visit the *City's website* to explore all the natural public green spaces and open spaces in Cape Town.

Access to these public spaces is generally good, with the most accessible natural public green space being in the south-west of the city. This is largely due to the total area covered by the Table Mountain National Park, as well as the large greenbelts situated along river corridors in these areas. In the central and northern areas of the city, however, there are some residential areas with little access to natural public green spaces larger than two hectares. Areas that are underserviced with natural public green space may be serviced with community park facilities, which are not included in this report, and some areas require the development of functional public open space to create a sense of place for residents. It must also be recognised that not all residents are able to access natural public green space, even if they are situated relatively close to a public facility. Transport costs, lack of public transport routes to natural public green spaces, and lack of provision for the special needs of children, the elderly and disabled people can all contribute to under-use of natural public green spaces. The location of protected areas of the City, both present and future, is constrained by the location of BioNet remnant vegetation. There cannot be an even spread of protected areas across the entire municipality, based on the remaining extents of vegetation types. Nevertheless, the majority of Cape Town's population resides within about 10 km of a protected area.

[12] Although the biodiversity value of a district park is dependent on the nature of the park in question

[13] This is dependent on the nature of the managed green space; for instance, some greenbelts are maintained but may only have paths

KEY MANAGEMENT RESPONSES

Green infrastructure and protected area expansion

The City is taking numerous steps to ensure access to well-managed natural public green spaces. Key actions aimed at improving access to well-managed natural public green spaces include:

- Prioritising and implementing the BioNet (see chapter on Biodiversity) and expansion of the City's network of protected areas
- Focusing on the coastline as a key recreational natural public green space
- The development and implementation of the City's Green Infrastructure Programme (GIP)
- Adequate management of natural public green spaces in collaboration with the City's invasive species programmes and biodiversity management objectives to ensure sustainable development

Notably, the City is developing and implementing a GIP for Cape Town. The programme is aimed at facilitating appropriate and sustainable urban development within the metropolitan area. This can be achieved through the protection and enhancement of existing environmental assets and the ecosystem services they provide, together with the promotion and creation of new green infrastructure (GI) assets. The GIP incorporates three key elements:

A spatial component comprising a Green Infrastructure Network (GIN). The network is based on the identification of ecosystem services, provided by natural and green open space in Cape Town, such as water purification and infiltration, flood attenuation, coastal zone protection, and recreational and cultural opportunities. Two mapping approaches were used in this regard: GIS-based and expert system-based. For the GIS-based analysis, a subset of selected ecosystem services or thematic areas were identified and defined, and spatial modelling and mapping of these were undertaken, with a focus on highlighting critical landscape features or areas that facilitate the provision of services.[23] The selected ecosystem services or thematic areas considered are: water provision (ground and surface water); flood protection and prevention; coastal protection; recreation; education; agriculture/local food security; tourism and aesthetics; and biodiversity and heritage/cultural value.

The other mapping approach for the GIN was an interrogative district mapping approach that utilised local knowledge of district staff from various City departments, together with information from CityMap Viewer. It identified, via a series of questions and criteria, those areas in the city that can be considered to be GI, by qualifying and quantifying their relative ecosystem service value.[24] The spaces considered were based on typologies identified and selected, using 2018 aerial photography as the base. Land in both public and private ownership was considered. Thirty-two questions, nine general information and 23 based on relevant ecosystem services were developed to interrogate different spaces across Cape Town in order to assess the value of GI in the city. Multiple sessions were held in order to systematically interrogate and evaluate all the green spaces of defined typologies and greater than 1 ha in size in the city.

A GI evaluation tool was created in an Excel spreadsheet and used to capture information and determine the GI value of each space, as well as defining the relative contribution of infrastructural, ecological and social services. The ecosystem service was evaluated using a scoring approach that valued each as providing none, low, medium or high value. Certain spaces were evaluated to have a low actual GI scoring but were highlighted as having the need for and potential to improve the provision of the ecosystem service with some focused interventions. These areas are particularly important for the creation of new GI assets that can enhance the sustainability of Cape Town and improve its resilience to the effects of climate change.

The GIN is being used as an informant for planning and management interventions, and the identification of priority implementation programmes.

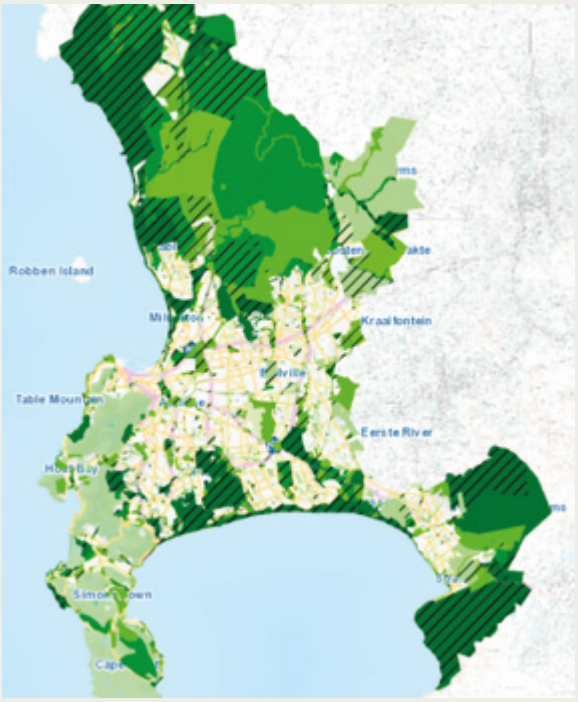
1. A 'toolkit' component that encompasses the integration of GI principles and approaches into City policies and by-laws, and the development of GI Best Practice Guidelines. The former includes a gap analysis to identify opportunities for the integration of GI principles and approaches into existing City policies and by-laws and inputting GI principles and approaches into new City policies and by-laws.
2. Implementation action and projects that support a GI approach. This includes various projects that are associated with GIP such as the rehabilitation of the Asanda Village wetlands and the implementation of the River Ambassadors Programme, in partnership with Nature Connect (previously CTEET), as a pilot programme within the Source to Sea River Corridor initiative. Other notable projects or programmes in support of a GI approach include Liveable Urban Waterways (including the rehabilitation of parts of the Keyser, Grootboschkloof, Spaanschemat, Prinskasteel and Westlake rivers).

City's public parks planning and creating functional natural public green spaces

Alongside the rich natural environmental resources, the City has numerous innovative programmes that aim to create and enhance the functionality of public green space for residents and visitors through, inter alia, the development of public parks that incorporate biodiversity elements. The City currently manages 13 district parks and over 3 562 community parks and gardens, including smart parks. The latter are community-led design parks with unique and alternative design features and construction materials. Overall, the City currently manages 3 017 ha of public parks.

However, more importantly, the City has introduced and developed regional parks in recent years. These parks operate in the same way as district parks, offering similar functions but at a much larger scale. Currently there are only two regional parks: Valhalla Park Family Recreational Centre and Green Point Urban Park. These parks provide both functional passive and active spaces for residents to use and enhance the interaction between biodiversity and the visitor to the park. The natural environments found within the parks are either naturally occurring or artificially re-created through managed landscape architectural features.

MAP 9: INTERROGATIVE DISTRICT MAPPING OF GIN



Public transport and improving accessibility to public green spaces

Improved public transport is recognised as a factor in increasing the accessibility of natural public green spaces. Increased access to public transport for all residents will enhance access to City facilities and other economic, social and recreational activities, and improve access to public green spaces such as parks and other natural spaces.

The proposed expansion of the MyCiTi bus service aims to enhance social integration and reshape the city's urban landscape. The proposed routes include connecting Wynberg and Khayelitsha, Mitchells Plain and Claremont, Khayelitsha and Century City, the Klipfontein Road corridor connecting Mitchells Plain and the city centre, and the Symphony Way corridor connecting Mitchells Plain and Durbanville. Currently, there are MyCiTi bus routes to the Green Point Urban Park, the Company's Garden, Deer Park, Lion's Head, Table Mountain (cableway) and the Rietvlei wetlands, to name a few. Visit www.myciti.org.za to find more recreational spaces in Cape Town that are accessible by bus.

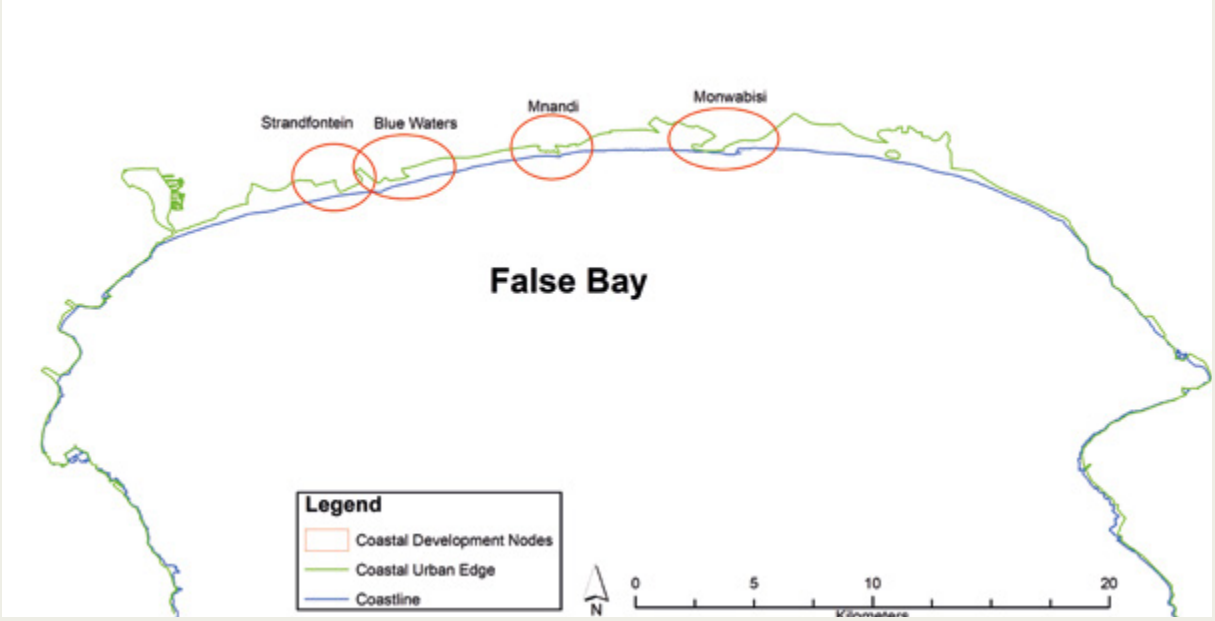
Access to Cape Town's coastline has been categorised into two broad categories, which are scale dependent. The first scale, or macro scale, is at the level of promoting broad-scale socio-economic benefits through connecting communities to the coast by means of nodal growth points. The primary intent of the coastal edge is to, among others, promote sustainable, risk-averse and equitable coastal development and access to Cape Town's coastline.[14] One of the key informants that was used to determine the position of the City's coastal edge, and as it relates to access, is the imperative of promoting restorative justice and social redress due to South Africa's past of separation and exclusion and the persistence of the apartheid spatial planning legacy. In this regard, the coastal edge has identified, and made provision for, nodal coastal development points adjacent to historically disadvantaged and underserviced communities.

The second tier, at a micro-scale level, is at the level of promoting safe and environmentally sensitive access to the City's beaches via designated access points. NEMICMA requires that, when designating coastal access land, a municipality must take into account the type of public access required and the way in which it is intended to be used. On assessing the coast using aerial imagery and through ground proofing, five types of micro-scale access points have been identified in Cape Town:

- Cul-de-sacs enabling desired access to beaches
- Coastal car parks
- Public boat launch sites
- Public coastal roads
- Promenades, coastal pedestrian pavements and beach access walkways

Both these macro- and micro-scale access typologies are being managed in accordance with the principles contained in the City's Integrated Coastal Management Policy (2014), Coastal Management Programme (2015) and Coastal By-law (2020). In addition, planning for and enabling macro-scale coastal access in Cape Town are being guided by the MSDF and District SDFs, alongside other relevant national and provincial legislation.

MAP 10: NODAL COASTAL DEVELOPMENT PROVIDING MACRO-SCALE ACCESS TO THE COASTLINE IN FALSE BAY



TREND AND TARGET

Trend:

The indicator does not change significantly over time but the introduction of two regional parks – Valhalla Park Family Recreational Centre and Green Point Urban Park – has improved access to public green space. However, access remains a challenge in many parts of the city, with the worst access levels affecting residents in the south-east part of the city where the majority of unemployed and low-income households are concentrated.

Target:

There are no formal targets set for natural public green space. However, the 2022 target of 65% of the BioNet under formal conservation has been met and exceeded. Furthermore, the 2014 guidelines and standards for planning City social facilities and recreational spaces are widely incorporated into City planning.

Current: Although on average the proximity of natural public green space is sufficient, the overall trend is that access to public green space remains spatially uneven and continues to be problematic in some areas. There is a need for the City to plan for and create more spatially even green recreational areas and/or to facilitate easier access to the available spaces for the poor and most vulnerable, including special needs groups.

[14] The City's coastal edge line also doubles as the CML in respect of the National Environmental Management: ntegrated Coastal Management Act, 2008 (NEMICMA)

POLICY LINKAGES

- IDP 2022-2027:
  - Priority – Public space, environment and amenities
  - Objective 11: Quality and safe parks and recreation facilities supported by community partnerships
- Environmental Strategy (2017):
  - Strategic Focus Area 1: Natural Systems Planning and Management
- Municipal Spatial Development Framework (MSDF)
- City Parks Development Policy (2015)
- Public Parks By-law (2010)
- City Water Strategy (2019)
- Urban Design Policy (2013)
- Integrated Coastal Management Policy (2014)
- Coastal By-law (2020)
- Resilience Strategy (2019)
- City of Cape Town Bioregional Plan (2015)
- Sustainable Development Goals (SDGs):
  - Goal 11: Make cities inclusive, safe, resilient and sustainable
  - Target 11.7: By 2030, provide universal access to safe, inclusive and accessible green and public spaces, in particular for women and children, older persons and persons with disabilities
- **See also:** Chapters on *Biodiversity*, *Freshwater quality*, and *Coastal water quality*

CHAPTER 4: FRESHWATER QUALITY

UNDERSTANDING FRESHWATER QUALITY IN CAPE TOWN

Indicators:

- Recreational water quality of the City's inland urban waters using thresholds[15]

Interpretation	Faecal coliform (including *E. coli*) CFU/100 mℓ
'Target' – full contact*	≤ 400
'Target' – intermediate contact	≤ 1 000
Acceptable risk – intermediate contact	≤ 2 500
Tolerable risk – intermediate contact	2 501–4000
Unacceptable risk (level 1)	4 001–10 000
Unacceptable risk (level 2)	10 001–100 000

- Trophic tendency of City's inland urban waters[16]
- Compliance with Department of Water and Sanitation standards
- Berg River Resource Quality Objectives (RQOs)
- Recreational water quality (inland): Circular 88 – ENV 5.2
- Number of inland water samples taken for monitoring purposes:[17] Circular 88 – ENV 5.21

Overview of watercourses in Cape Town

The city lies in the Berg-Olifants Water Management Area, which extends north to include both the Berg and the Olifants river catchments, as well as the smaller natural catchments within the City's boundaries. Cape Town is home to a substantial network of rivers and wetlands, including 21 main drainage catchments. There are numerous watercourses in the Cape Town metropolitan city area, some of which originate outside our borders. The length of rivers and streams is approximately 1 900 km and the length of canals and channels is approximately 480 km.

Under more natural conditions, before the start of urban development at the Cape, most of the rivers in the city would have been seasonal rivers that flowed only in the wet season. Many of these would have been associated with wetlands, particularly where several watercourses converged. One example is the general region of today's Paarden Eiland, where the Diep, Black, Liesbeek and Salt rivers once converged, forming expansive marshes.

Perennial rivers were those that rose in the mountains such as the Silvermine and Elsies rivers, rivers off Constantiaberg, and the Liesbeek, Lourens, Sir Lowry's Pass and Eerste rivers. By contrast, most of the rivers that flowed through the vast, sandy Cape Flats were seasonal and often associated with groundwater-fed wetlands, which would have been inundated when the primary aquifer rose above the level of surrounding surface depressions. Today, the hydrology of many of these has

[15] Recreational waterbodies (Zandvlei, Zeekoevlei, Princessvlei, Rietvlei, Milnerton Lagoon): Percentage of sites that are at Target, Acceptable/ Tolerable or Unacceptable threshold level. Where 'Unacceptable' is > 4 000 (i.e. DO NOT split into levels 1, 2, 3)
All other urban rivers/waterbodies not mentioned above (i.e. not formally used for recreation): Percentage of sites that are ≤ 4 000 *E. coli* CFU (i.e. in the 'Tolerable' or better threshold vs those that are > 4 000 CFU (Unacceptable threshold)

[16] Per cent of river sites that are at Target, Poor or Unacceptable level with respect to P; per cent of vlei sites that are at Target, Poor or Unacceptable level with respect to P. Target = oligotrophic to mesotrophic; Poor = eutrophic; Unacceptable = hypertrophic. Inland Water Quality Report/ underlying data in CSRM WQ master database primary source of information

been permanently altered by inflows of piped urban stormwater run-off and treated sewage effluent, which have turned rivers such as the Black, Kuils and Mosselbank into perennial, nutrient-enriched systems. In order to drain water from areas with a high water table, formalised channels were created in areas once dominated by seasonal wetlands. The Big and Little Lotus rivers draining into Zeekoevlei and the Soet system at Strand are examples of this.

Note that the Mitchells Plain catchment does not in fact (historically) include any natural watercourses. Water in this part of the Cape Flats probably infiltrated through the sand or formed shallow wetlands. Today, the area is largely developed. Run-off from the hardened urban surfaces is collected in large artificial detention ponds and conveyed to the sea through stormwater pipes and drains. The city bowl and adjacent Sea Point and Camps Bay areas also do not include any remaining natural rivers. This is because most of the streams that drain off Table Mountain and the Twelve Apostles range have been piped underground or flow through channels and culverts. This water passes into Table Bay and the coastline along the Atlantic seaboard as stormwater. The City's Green Point urban park and biodiversity showcase garden make use of some of this water resource, which supplies its artificial wetlands and streams.

Cape Town's substantial network of rivers and wetlands, indicated in map 11, provides a habitat for aquatic fauna and flora, and acts as green infrastructure for the treatment and conveyance of stormwater and treated wastewater effluent. The City's constructed stormwater infrastructure (roadside gutters, sidewalk inlets, pipes, canals and detention ponds) merges directly with the freshwater and coastal receiving environments. Today, the City's stormwater management system, which manages surface run-off across Cape Town, includes (approximately):

- 6 836 km[18] of stormwater pipes and culverts
- 890 stormwater detention ponds and dams
- 236 stormwater treatment wetlands
- 1 910 km of rivers and streams
- 480 km of canal and channel
- 4 164 natural and semi-natural wetlands, including vleis and estuaries

To manage these connected systems, an integrated management approach is essential for the protection of the environment.

*Explore Cape Town's rivers and wetlands on the **CCT website**. Many recreational activities can be undertaken in these areas, such as picnicking, taking leisurely walks (some areas allow dog walking), hiking and birdwatching.*

Challenges in the management of urban watercourses

Urban watercourses play an important role in a city. Their condition can have a significant impact on human health, property values, security, amenities, flood risk, and maintenance and management costs such as litter and sediment removal.

From an ecological perspective, urban watercourses can be vital corridors of relatively natural habitat in an otherwise sterile urban landscape. In Cape Town's case, they also connect mountainous habitats with the coast. Moreover, urban watercourses provide aquatic habitat and, in some areas, are key for biodiversity.

In Cape Town, which lies in the heart of the Cape fynbos biome, some aquatic ecosystems support plant and animal species that occur only in a restricted area in certain watercourse types, and nowhere else in the world. Sadly, however, many of these ecosystems are highly threatened.

The sustainable management of any watercourse can be challenging, but this is particularly so in urban environments where many of the natural drivers of ecosystem function have changed fundamentally. Factors contributing to reduced ecosystem resilience include canalisation, water abstraction, impoundment, inflows of sewage (including sewer overflows), wastewater effluent and other pollutants, loss of floodplains, alien plant invasion, unlawful land occupation and a general loss of natural biodiversity as a result of all of these factors. All of these factors are compounded by large-scale loss of terrestrial and aquatic natural habitat. Moreover, the ongoing organic and inorganic pollution and littering of Cape Town's stormwater and freshwater systems pose a threat to both biodiversity and human health. These factors also pose problems to human communities and may affect their recreational or aesthetic value, or make them more likely to harbour criminals.

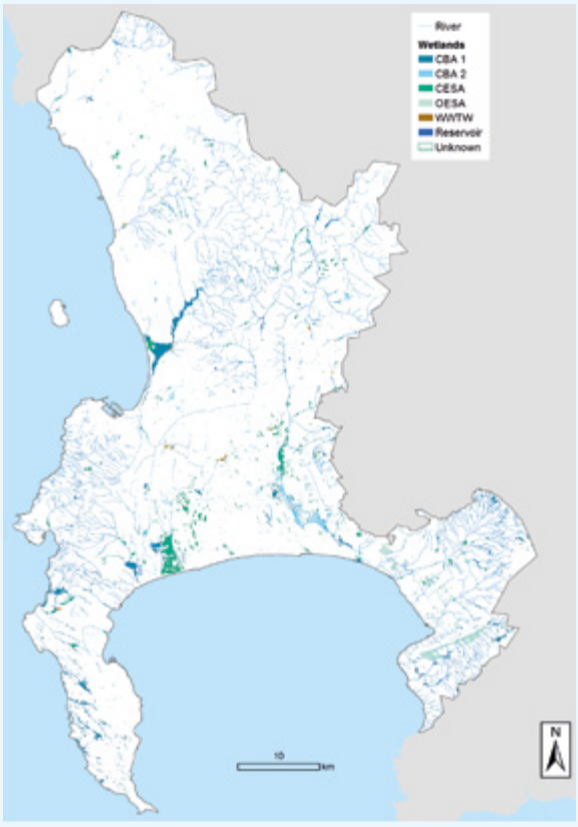
[17] This is a count of the total number of sample sites monitored in the applicable quarter. Reported on this only once previously:

[18] Comprised of the following conduit types and lengths: connections of 402,72 km; culverts of 180,21 km; pipes of 5 925,99 km; stormwater sewer links of 0,98 km; and subsurface drains of 326,16 km.

The City's approach to addressing the complex factors that have an impact on water and water quality in Cape Town requires a multifaceted approach involving multiple line functions and partnerships. Nevertheless, addressing all of these challenges at the same time is not always possible. For example, the need to manage flood risk (such as by channel lining, diversion, removal of vegetation, or construction and maintenance of attenuation ponds) may require interventions that affect biodiversity (such as a loss of riverine habitat or wetland function).

Effective river management and rehabilitation requires a coordinated effort across a range of departments, which can be challenging to achieve. In the City, these stakeholders include the departments of Water and Sanitation (providing drinking water, sewage management, refuse removal, and catchment, stormwater and river management services), Recreation and Parks (managing parks, sports facilities, tidal and municipal swimming pools, beach amenities and public open spaces), Human Settlements (responsible for formal housing and informal settlements), Environmental Management (responsible for nature reserves, including some with wetlands and sections of rivers, biodiversity nodes and the coastal zone) and Urban Mobility (managing roads, road drainage, transit networks and public transport).

MAP 11: CAPE TOWN'S FRESHWATER SYSTEM



In trying to overcome these challenges, the City's Catchment, Stormwater and River Management Branch works closely with other line departments who have an interest in, and influence on, urban catchments to achieve more holistic catchment management. Partnerships with external parties and public interest groups are also recognised as an important tool, and it is hoped that the publication of reports such as these will stimulate more collaboration in this regard.

Water quality and influencing water quality in Cape Town

Under 'natural' or un-impacted conditions, different watercourse types often have different water quality characteristics. For instance, many wetlands or vleis are naturally more nutrient-enriched and possibly have a higher salt content than rivers. This is as a result of nutrient inputs from animals such as birds, and the accumulation of plants over long periods of time.

The concept of 'water quality' considers the combined effects of the physical, chemical and biological attributes of a sample of water on a particular user, and is a measure of its 'fitness for use' for an intended purpose. Consequently, water quality is usually interpreted according to standards or guidelines, developed around the specific effects of water quality on a particular user group or for a particular purpose. For our urban waterways, applicable guidelines are used to evaluate water quality; test results relate to the recreational use of water (e.g. water sports such as sailing, canoeing, windsurfing and paddling), which reflect the effects of different physicochemical constituents on aquatic plants and animals. To consider water quality from a human health and/or ecological perspective, one needs to evaluate a range of physical, chemical and biological attributes of the water. This often requires an integrated understanding of how these constituents interact.

One of the most profound impacts on water quality in Cape Town is that of waste. Treated and untreated sewage has a particularly harmful effect on our watercourses. Under ideal conditions, domestic and industrial liquid waste is conveyed to wastewater treatment works (WWTWs), where it is treated to an acceptable (licensed) standard. It is then either released back into the environment (usually into rivers or the sea), reused in industry and construction or as an irrigation supply. In practice, the management and treatment of human waste is often fraught with problems, particularly in developing countries, including the following:

- The unlawful establishment of informal settlements on land considered unsuitable for housing. This impedes service delivery, which means that residents tend to dispose of their household waste, grey water and sewage directly into the environment, resulting in rapid pollution and degradation of sometimes important seasonal wetlands and rivers
- Repeated sewer leaks and overflows from sewage infrastructure, largely due to by-law contraventions, ageing infrastructure and other factors affecting sewer condition
- Overflows from sewage pump stations that may be

caused by mechanical, electrical or instrumentation failures, maintenance backlogs, foreign objects, generator failures and load-shedding

- Inadequately treated wastewater discharged from WWTWs into rivers. This water contributes to significant nutrient enrichment, low levels of oxygen and high ammonia, which affect river habitat quality and downstream systems such as vleis and other wetlands
- Illegal connections in industrial or residential areas. These allow waste that should be discharged into sewers to be passed into stormwater systems instead
- High levels of illegal waste dumping and inconsistent use of the City's refuse management services. As a result, waste accumulates along roads and open spaces, from where plastics and organic waste often wash into the stormwater system

It is also recognised that the consecutive dry winters (2015–2017) that Cape Town and the surrounding Western Cape experienced had some implications for freshwater quality. However, it was difficult to measure the full extent of the drought on Cape Town's watercourses.

Evaluation of freshwater quality

The City's inland water quality monitoring programme[25] is structured around the collection of data on watercourses, where water quality is a likely cause for concern. Therefore, many of the monitoring points are downstream of WWTW effluent discharge points, and in river reaches in catchments where run-off is likely to be contaminated. Some sampling points are located in watercourses that are used for recreational purposes, which serve to measure these systems' fitness for use. Consequently, this creates an unintended bias in the water quality database towards degraded sites exhibiting signs of pollution. This also creates the misperception that the management authority of recreational waterbodies is responsible and answerable for this pollution.

Over the years, the City has collected various kinds of water quality data on its watercourses (the main rivers and wetlands/vleis) – in some cases, going back to the late 1970s. This has generated an extensive database of sites that represent water quality in main rivers, stormwater or effluent outflows into watercourses, and key wetlands, dams and detention ponds.

A total of 242 water quality sampling sites were evaluated for the Inland Water Quality Report. These comprise 13 canal sites, seven artificial dam or impoundment sites, two detention ponds, two effluent outlet channels, two estuary sites, 158 river sites, five stormwater outlets and 53 vlei, standing water or wetland sites.

Of this historical data set, some 174 sites are currently monitored through the monthly collection of water samples for analysis by the City's Scientific Services Branch at their water quality testing laboratories in Athlone. A range of chemical, algal and bacterial constituents are measured.

The extensive Mitchells Plain area, which is drained by stormwater pipes that discharge into the sea from coastal outlets, has no natural or artificial open channel system. However, this important catchment generates large volumes of run-off from hardened urban areas.

It is important to note that not every catchment in the city is represented in the monitoring programme. Some catchments do not have any monitoring sites. These are catchments that are not necessarily considered problematic from a water quality perspective (such as minor rivers along the Atlantic seaboard), do not have significant river systems (such as the Atlantis catchment) or where natural rivers have been almost entirely piped into the stormwater system (such as the city bowl).

Thresholds used to guide water quality interpretation

Water quality data in the City's Inland Water Quality Report[26] were interpreted based on certain categorical ranges appropriate for the assessment of water, from both a recreational (public health) and an ecological health perspective. This categorical approach is in line with established national procedures commonly used in the assessment and reporting of inland water quality.

Public health risk assessment thresholds for *E. coli* are based on those used in various guidelines, as well as studies such as the Resource Quality Objectives (RQOs) Study for the Berg Water Management Area. These thresholds were further adapted for use in the urban context to identify examples of extreme exceedance. Therefore, the thresholds in table 6 include the *E. coli* target level for full-contact recreation (swimming), acceptable and tolerable levels for intermediate-contact recreation (canoeing, sailing) and a further breakdown of the unacceptable category to allow for a more detailed assessment of *E. coli* contamination often found in urban environments.

For ecological health, the categories range from target (incorporating 'good' and 'fair' conditions) to 'poor', and then 'unacceptable'. The desired minimum water quality category considered appropriate for Cape Town's urban waterways is at the 'fair' lower-threshold break point.

Each of the physicochemical water quality constituents (such as nitrogen, phosphorus, oxygen, ammonia, etc.) analysed in the technical report was assessed in terms of individual thresholds relevant to that particular constituent. These thresholds were then assigned to the water quality categories in figure 3.

TABLE 6: PUBLIC HEALTH/RECREATIONAL USE CATEGORIES USED TO GUIDE THE ASSESSMENT OF MICROBIAL DATA

PUBLIC HEALTH/RECREATIONAL USE CATEGORIES	FAECAL COLIFORM COUNT (INCLUDING *E. COLI*)*
Maximum acceptable risk for full-contact recreation	≤400 cfu/100 mℓ
Acceptable risk for intermediate-contact recreation	≤2 500 cfu/100 mℓ
Tolerable risk for intermediate-contact recreation	2 501-4 000 cfu/100 mℓ
Unacceptable risk - level 1	4 001-10 000 cfu/100 mℓ
Unacceptable risk - level 2	10 001-100 000 cfu/100 mℓ
Unacceptable risk - level 3	>100 000 cfu/100 mℓ

FIGURE 3: RELATIONSHIP BETWEEN CATEGORIES USED TO ASSESS WATER QUALITY FROM AN ECOLOGICAL PERSPECTIVE AND PES CATEGORIES

WATER QUALITY CATEGORIES	INTERPRETATION OF CATEGORIES	PRESENT ECOLOGICAL STATE CATEGORIES*
GOOD	TARGET	A: Natural/no change
		B: Largely natural, with few modifications/small change
FAIR		C: Moderately modified/moderate change
POOR	BELOW TARGET	D: Largely modified/large change
UNACCEPTABLE	UNACCEPTABLE	E: Seriously modified/serious change
		F: Critically modified/extreme change

* *The present ecological state (PES) of aquatic ecosystems is determined by integrating a number of metrics, including instream and riparian habitat quality, geomorphology, flow regime, water quality and biota. In this report, the City has undertaken an assessment of specifically the water quality component of a PES assessment*

STATE OF THE ENVIRONMENT

The Inland Water Quality Report provides a comprehensive analysis of historical and current water quality of Cape Town's major rivers and vleis/dams. It used water quality data for the April 2019 to March 2020 period, which were compared to the historic data set, in particular, data from the previous four years.

Public health/recreational assessment based on *E. coli* levels

E. coli measurements in inland waters are used primarily as an indicator of risk to human health, particularly when a waterbody is used for recreational purposes. Therefore, this parameter is generally considered for all urban rivers and waterbodies where informal, intermediate contact may take place (such as walking through or wading in the water).

More specifically, however, it is also considered in vlei systems with established recreational water sports and/or other water-based activities that may be associated with both intermediate and, at times, full-contact recreation. In Cape Town, these are Zandvlei, Zeekoevlei, Rietvlei, Milnerton Lagoon and Princess Vlei.

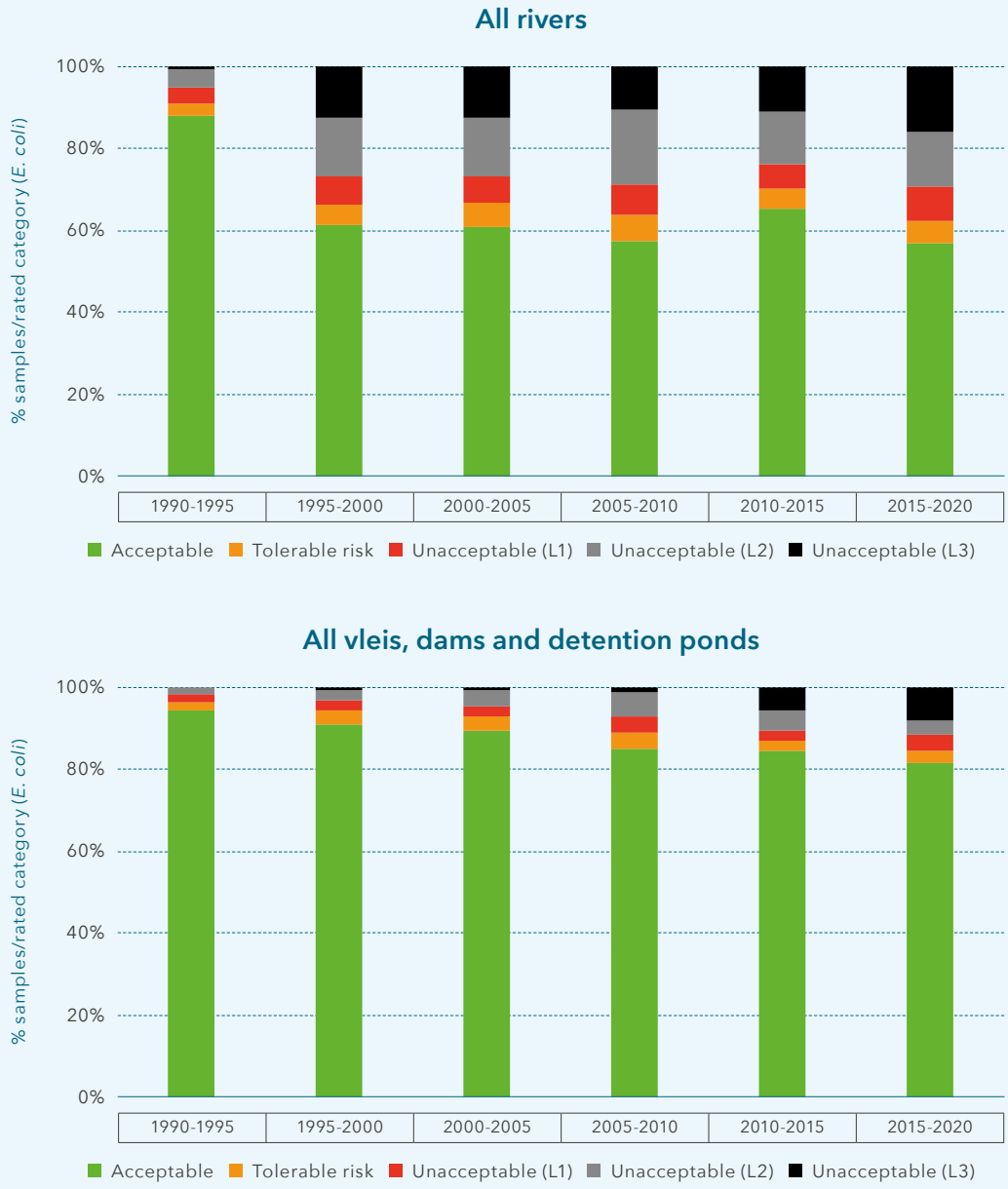
Informal recreational use: All river and vlei/dam systems

Figure 4 indicates the long-term trend in *E. coli* levels measured at all rivers and vleis/dams over approximately 30 years (1990–2020). At both rivers and vleis, the general assessment reveals a decline in the percentage of samples that were at acceptable or tolerable levels for intermediate-recreational contact over the 30-year period.

E.coli contamination patterns in vleis and dams are slightly different from those in rivers, reflecting the capacity of these open, 'standing' water systems for bacterial reduction because of an increased residence time, with prolonged exposure to sunlight increasing bacterial die-off.

Figure 5 and figure 6, in turn, indicate the current state of rivers and vleis/dams for 2019 (i.e. April 2019 to March 2020) compared to the preceding four-year period (2015–2018).

FIGURE 4: LONG-TERM TREND IN *E. COLI* LEVELS AT RIVERS AND VLEIS/DAMS, 1990–2020



Formal recreational activities: Specified recreational vleis

In terms of formal recreational activities, the Inland Water Quality Report provides a detailed analysis of human health risks and concerns at the following five main recreational waterbodies in Cape Town:

- Rietvlei – used for sailing, windsurfing, waterskiing and fishing
- Milnerton Lagoon – used for canoeing, wading and swimming (the latter generally from the beach)
- Princess Vlei – used for baptisms and canoeing
- Zeekoevlei – used for sailing, windsurfing, waterskiing, canoeing and fishing
- Zandvlei – used for sailing, windsurfing, canoeing and fishing

Users of these recreational waters could potentially be exposed to human health risks associated with faecal contamination, as well as potential toxicity from certain types of algal blooms.

Based on an analysis of *E. coli* and algal microcystin toxin

FIGURE 5: COMPARISON OF *E. COLI* DATA FOR 2019 AND 2015–2018 (VLEIS AND DAMS)

data for the past five years, the technical report concludes that most of these five waterbodies have generally been in a condition conducive to at least intermediate-contact recreation. However, Milnerton Lagoon has been subject to periodic and, at times, prolonged contamination by *E. coli*, which suggests exposure to untreated sewage. Rietvlei, in turn, is vulnerable to periodic blue-green algal blooms, some of which have resulted in the production of microcystin toxins at concentrations likely to pose extreme risks to recreational users who come into contact with the waterbody.

Most of the assessed urban vleis are found to be hypertrophic with regard to phosphate. Therefore, the report strongly recommends a focus on measures to reduce sources of nutrient enrichment in all of the recreational waterbodies. Addressing upstream sources of untreated sewage at Milnerton Lagoon in particular is also strongly recommended for this waterbody to remain safe for recreational use. In addition, the report raises concerns that standing waterbodies in other areas of Cape Town may also be used for recreation by the public, even though no regular monitoring of human health risk is being undertaken there – such as the Kuils River in the Khayelitsha Wetland Park area, where local communities participate in kayak polo games and training. Although this site has been subject to ad hoc assessment, the report recommends that it (and any other, similarly used sites) be monitored routinely in future.

However, three of the City's recreational vleis (Zandvlei, Zeekoevlei and Rietvlei) were closed to the public for a number of months during 2021 because of water quality concerns. The closure of the vleis had a significant impact

FIGURE 6: COMPARISON OF *E. COLI* DATA FOR 2019 AND 2015-2018 (RIVERS)

on residents and users of the vleis, including businesses and lease holders.

The three vleis are each affected by pollution entering them from a number of points and diffuse sources upstream. This results in both chronic and ongoing levels of pollution and occasional acute and short-term pollution incidents associated with, for example, failures at sewer pump stations. Various pollutants that enter the vleis are associated with a health risk to recreational users. These include, for example, *E. coli* as an indicator of faecal coliforms present in water. Other secondary pollutants associated with elevated levels of nutrients, such as microcystis and other toxic algae, also affect the vleis.

Water quality changes have an impact on recreational use, including short- and long-term health impacts (waterborne diseases, infections and carcinogenic risk), human safety (compromised visibility, profuse plant growth, microbial and algal growth), aesthetic impacts (changes to odour and colour, discoloration and staining, floating matter, nuisance plant growth) and the previously mentioned economic impacts (damage to equipment, cost of treatment, increased cost due to scaling, corrosion and sediment deposition in distributing systems).

Ecological water quality assessment based on nutrient enrichment levels

Major nutrients (phosphorus and nitrogen)

Plants require various nutrients for healthy growth. These include phosphorus, nitrogen, sulphur, magnesium, potassium and many others, although they are often only required in extremely small amounts. Of these,

nitrogen and phosphorus play a particularly important part in determining the rate of plant growth, and are often referred to as 'growth-limiting' nutrients because of this. In freshwater ecosystems, phosphorus is in fact the actual 'growth-limiting' nutrient, as plants such as blue-green algae (cyanophyte algae) can access nitrogen directly from the air.

Most nutrients are not toxic to aquatic environments, even in high concentrations. Some exceptions include ammonia (NH_3), nitrite and nitrate. However, in high concentrations, nutrients (particularly phosphorus) do trigger excessive plant growth. This changes aquatic ecosystem functioning and structure. It also causes many management problems – including the need for invasive plant clearing, the risk of toxic algal blooms and fish die-offs due to the low oxygen levels caused by decomposing aquatic plants.

Today, most, if not all, of the aquatic ecosystems in Cape Town have been affected by additional nutrient inflows, particularly phosphorus. This is mainly due to anthropogenic causes such as the following:

- Inputs of treated sewage effluent
- Run-off from catchment areas with many backyard or informal settlements, which are subject to poor levels of sewage, solid waste and stormwater servicing
- Illegal discharges into the stormwater system in industrial and commercial areas (fertiliser factories, car washes, markets, informal butcheries and meat markets)
- Run-off from fertilised gardens and parks
- Run-off from agricultural areas in (and in some cases beyond) Cape Town's borders

Trophic state

The nutrient (trophic) state of a freshwater ecosystem allows it to be broadly classified into one of four trophic categories: oligotrophic, mesotrophic, eutrophic and hypertrophic. These are respectively associated with low, moderate, high and extremely high levels of nutrients (mainly phosphorus and nitrogen).

In standing waterbodies such as vleis, these conditions are associated with the following broad habitat types:

- Oligotrophic waterbodies typically have clear water and a rocky or sandy shoreline. Both planktonic and rooted plant growth are sparse.
- Mesotrophic waterbodies are in between oligotrophic and eutrophic, and often share characteristics with both of these trophic states.
- Eutrophic waterbodies are typically shallow with a soft, silty bottom. Rooted plant growth is abundant along the shores and out into the lake, and algal blooms are not unusual. Water clarity is usually poor. If deep enough to thermally stratify (separate into a top and bottom layer of different temperatures), the bottom waters are often devoid of, or low in, oxygen.
- Hypertrophic waterbodies may have similar habitat types to eutrophic systems, but a lack of oxygen in bottom waters is more common. These systems are also prone to blooms of blue-green and green algae.

Consequences of nutrient enrichment: Algal blooms

'Chlorophyll a' is a pigment that occurs in green plants and is one of the primary pigments used in photosynthesis. In water quality assessments, it is used as a measure of algal growth – more specifically of phytoplankton abundance.

Under conditions of nutrient enrichment, particularly phosphorus, chlorophyll a often increases. This normally coincides with an increase in algal growth rates in response to increased nutrients. Interestingly, nutrient-enriched systems with a significant volume of macrophytes (more complex plants than single-celled or filamentous algae, such as pondweed or other plants) are less likely to be dominated by algae or give rise to algal blooms.

The City monitors chlorophyll a in many of its standing water systems (vleis and dams). The Inland Water Quality Report notes that severely elevated chlorophyll a concentrations, which are indicative of bloom conditions, can have a range of implications for waterbody management. They contribute to the accumulation of nutrients at the bottom of the waterbody when the bloom dies, where decomposition can cause anoxic layers to form and from where nutrients can periodically be released into the water column.

Moreover, high concentrations of chlorophyll a can be associated with odour and aesthetic problems. Microcystis, for example, which is the dominant cyanophyte species in some of Cape Town's waterbodies, produces a distinctive foul smell under bloom conditions. Some of these blooms may also produce algal toxins (e.g. microcystins), which can temporarily make a waterbody unsuitable for recreation.

The visible presence of green algal scums is also unpleasant, and persistent bloom conditions in waterbodies can affect property values and the suitability of the waterbody for different kinds of recreational use.

Phosphorus enrichment

The Inland Water Quality Report includes a comprehensive analysis of phosphorus enrichment levels in Cape Town's rivers and vlei/dam systems. In summary, the data analysis shows that phosphorus enrichment is a pervasive issue in most of our catchments, with only the Lourens and Silvermine river systems remaining largely in their target range for this variable. Watercourses that receive treated effluent from WWTWs and run-off from poorly serviced settlements appear to be most affected.

Figure 7 illustrates the levels of phosphorus measured in Cape Town's rivers and waterbodies over the long-term monitoring record. The knock-on effects of this enrichment, which the data suggest is progressively increasing, are apparent in the high concentrations of

phosphates in all of the standing waterbodies assessed.

Most samples fell well within the unacceptable range, indicative of hypertrophic systems. In fact, many samples were more than two orders of magnitude beyond the unacceptable threshold. The waterbodies where phosphorus enrichment is least problematic, albeit still often in the hypertrophic range, are Princess Vlei, Little Princess Vlei, Die Oog, Glencairn Vlei and the Elsieskraal dams. These waterbodies represent catchments that neither receive treated sewage effluent nor are characterised by substantial informal or poorly serviced settlements.

Nitrogen enrichment

Analyses of total inorganic nitrogen (TIN) data suggest that nitrogen enrichment, although problematic, is a less prevailing concern than phosphorus enrichment in Cape Town's catchments (figure 8).

Of the standing waterbodies assessed, nitrogen enrichment is considered problematic only in Wildevoëlvlei and the Mew Way, Edith Stephens and Mitchells Plain detention ponds. Elsewhere, concentrations of TIN generally fall within acceptable limits.

Nevertheless, the data also show that standing waterbodies (along with the rivers or stormwater systems that feed them) are characterised by low nitrogen : phosphorus ratios, which are likely to promote blue-green algal dominance in many of these systems. The least affected systems are Zandvlei, Little Princess Vlei and Princess Vlei, and the trend in all systems is one of increasing phosphorus relative to nitrogen. This is considered likely to increase the possibility of blue-green algae dominating standing water systems and, under certain conditions, giving rise to blue-green algal blooms.

Microcystin toxicity risk

Cyanobacteria (or blue-green algae) are a common and naturally occurring component of most recreational water environments. However, they are of potential public health concern, as some types may, under certain circumstances, produce toxins that can be harmful to recreational water users.

Since microcystin toxin testing is expensive, it is not routinely included in the City's water quality tests. Instead, it is undertaken after specific sample screening for elevated blue-green algal cell counts.

Figure 9 summarises the results of all microcystin tests carried out on Cape Town's main recreational vleis. For interest's sake, this also includes Wildevoëlvlei, since this non-recreational vlei has a history of excessive nutrient enrichment and has seen major interventions to address persistent blue-green algal blooms.

The data show that, despite many of the vleis being prone to high levels of chlorophyll a and possible bloom conditions at times, the frequency at which microcystin toxins were identified in these waterbodies was relatively low. Since 2010, when microcystin toxin testing became a regular response to blue-green algal blooms, only samples from Rietvlei and Wildevoëlvlei have shown concerning microcystin toxin concentrations.

This suggests a significant improvement in Zeekoevlei's water quality over time, considering that it suffered frequent blue-green algal blooms and periods of microcystin toxicity in the early 2000s.

Samples from Rietvlei were in the range associated with extreme risk in 2016, 2017 and 2019, with an additional episode of elevated toxins at medium risk in 2019. Since this vlei is a popular recreational waterbody, such episodes would have been of significant health risk to recreational users exposed to the water. The City implemented measures to limit risk, such as temporarily restricting access to the Rietvlei waterbody. Nevertheless, this was often met with opposition from certain user groups who disagreed that the water quality posed a potential health risk.

In 2009, 2010 and 2017, Wildevoëlvlei periodically showed microcystin levels that were high enough to be of concern in the event that this system was to be used recreationally. As this vlei receives treated effluent from the adjacent WWTW, recreational-use contact with the waterbody is not advised, and residents of the shoreline residential estate partake in non-contact activities only, such as walking and birdwatching.

Of the five main recreational vleis/waterbodies, most have generally been in a condition conducive to intermediate-contact recreation over the past five years. However, Milnerton Lagoon has been subject to periodic and, at times, prolonged *E. coli* contamination, which suggests exposure to untreated sewage. Rietvlei is vulnerable to periodic blue-green algal blooms. Some of these blooms have produced microcystin toxins at concentrations likely to pose extreme risks to recreational users who come into contact with this waterbody.

Since most of the assessed urban vleis are hypertrophic with regard to phosphates, a focus on measures to reduce sources of nutrient enrichment in all of the recreational waterbodies is strongly recommended. Addressing upstream sources of untreated sewage at Milnerton Lagoon in particular is also strongly recommended for this waterbody to remain safe for recreational use.

Water quality in each major catchment monitored by the City

The Inland Water Quality Report provides data on nutrient enrichment (phosphorus) and *E. coli* levels in various rivers, vleis, dams and detention ponds in the inland water quality monitoring programme. The next section provides a brief summary of this information.

FIGURE 7: LONG-TERM TREND IN PHOSPHORUS ENRICHMENT AT RIVERS AND VLEIS/DAMS, 1978–2020

Sout catchment

The Sout and Donkergat rivers lie within the Sout catchment, which has a history of significant phosphate enrichment. It is currently among the worst-performing catchments in this regard. Levels of *E. coli* in the small Sout River[19] system have generally been acceptable for informal recreational activities over the monitoring period 2000–2020. Possible sources of water quality issues experienced in the Sout catchment include irrigation return flows from upstream farmlands; and Melkbosstrand WWTW discharge into the lower Sout River (note that some effluent is reused for irrigation in residential estates).

Diep catchment

Mosselbank, Maastricht Canal, Klapmuts, Kalbaskraal, Groenfontein, Milnerton Lagoon, and the Diep,[20] Sout, Swart, Platklip and Riebeek rivers fall within the Diep catchment. Waterbodies within the catchment include Zoarvlei and Rietvlei. The Diep catchment rivers have a history of phosphorus enrichment, which has further deteriorated in the lower reaches of the Diep River (including the Milnerton Lagoon sites) and the Mosselbank River over the past five years. It is currently among the worst-performing catchments in this regard. In terms of phosphate levels in Rietvlei and Zoarvlei, these were well in the hypertrophic range (i.e. unacceptable). In Rietvlei, this

[19] There is also a Sout River in the Diep catchment

FIGURE 8: LONG-TERM TREND IN NITROGEN ENRICHMENT AT RIVERS AND VLEIS/DAMS, 1978–2020

is likely to drive the development of algal blooms, while the nutrient enrichment of Zoarvlei tends to result in the prolific growth of reeds and other plants such as water hyacinth.

Levels of *E. coli* are often problematic in rivers forming part of both the Diep catchment (including the Milnerton Lagoon section of the Diep River, which is used for canoeing and sometimes swimming) and the Mosselbank catchment. This would make them generally unsuitable for both formal and informal recreational activities.

Levels of *E. coli* in Rietvlei, which is a formal recreational area, were generally acceptable over the monitoring period 1995–2020, and would therefore be suitable for most forms of both full- and intermediate-contact recreation. In Zoarvlei, meanwhile, *E. coli* levels were moderately higher, although it is less likely that informal recreation would be undertaken in this heavily reeded waterbody.

The probability of water quality in Rietvlei meeting the acceptability threshold for recreation is significantly higher than at Milnerton Lagoon. This indicates that contact recreational activities in the lagoon should be avoided until the water quality challenges experienced in the catchment have been addressed.

[20] There is also a Diep River in the Sand catchment

FIGURE 9: THRESHOLD LEVELS IN VLEIS TESTED FOR MICROCYSTIN TOXINS (NUMBERS REPRESENT TEST NUMBERS)

Possible source(s) of water quality issues experienced in the Diep catchment include:

- Agricultural and urban developments in areas of the catchment situated beyond the City's municipal borders (i.e. Swartland)
- Over-abstraction from the Diep catchment, which reduces the ability of the system to function in a healthy state[21]
- Various WWTW discharges into the Mosselbank River (note that some treated effluent from WWTWs in the catchment is reused for farm irrigation)
- Presence of poorly serviced informal settlements in the catchment (e.g. Dunoon and Joe Slovo), as well as backyard dwellings in formal settlements such as Fisantekraal
- Run-off from agricultural areas (livestock feedlots and fertilised fields)
- Potsdam WWTW discharge into the Lower Diep River/ Milnerton Lagoon system
- Run-off from the industrial area of Paarden Eiland (affecting Zoarvlei)
- Long-term inflows from the nutrient-enriched Bayside Canal and, presumably, run-off from the surrounding catchment area, which is periodically contaminated by sewage overflows

Salt catchment

The Elsieskraal catchment rivers include the Elsieskraal and Van Riebeeckshof rivers and Elsieskraal catchment waterbodies (dams), which include Fynbos, Amandel, Welgemoed, Kanonberg, Plattekloof and Doordekraal.

Lower Salt catchment rivers include the Salt River canal, Black, Liesbeek, streams of the eastern slopes of Table Mountain, Vygekraal and the canals of Kromboom, Blomvlei, Jakkalsvlei, Bokmakierie, Langa, Kalksteenfontein and Nyanga.

The Salt catchment has a history of significant phosphate enrichment and is currently among the worst-performing catchments in this regard. The Elsieskraal dams are among the least-concerning Cape Town-monitored waterbodies in terms of orthophosphate enrichment, although they are still in the hypertrophic range.

Faecal contamination is a pervasive problem in particularly the Lower Salt catchment. The majority of *E. coli* values recorded in the past five years have been well within the unacceptable range for intermediate-contact recreation. This indicates that the rivers and canals in this region of the catchment are not suitable for informal recreation. Levels of *E. coli* in the dams located in the upper Elsieskraal catchment tend to be less problematic.

Possible source(s) of water quality issues experienced in the Salt catchment include:

- Elsieskraal: Increasingly urbanised catchment. The river reaches through Bellville are affected by areas

of inner-city homelessness. In general, however, Elsieskraal is neither subject to inflows of treated sewage effluent nor characterised by substantial areas of informal or poorly serviced settlements

- Lower Salt: Borcherds Quarry and Athlone WWTW discharges
- Presence of poorly serviced informal settlements and backyard dwellers in the Salt catchment (e.g. Joe Slovo, Valhalla Park, Kanana and Vygieskraal informal settlements)
- General habitat transformation and associated water quality challenges, which are possibly due to the transformation of natural vegetation, agricultural run-off and the canalisation of rivers (such as the lower reaches of the Elsieskraal River and parts of the Lower Salt catchment)
- High-density residential, commercial and industrial precincts

Sand catchment

Rivers within the Sand catchment include the Sand, Keysers, Westlake, Prinskasteel, Prinseskasteel stream, Spaanschemat, Grootboschkloof, Pagasvlei stream, Mocke, Diep, Brommersvlei stream, Burgersboskloof stream, Wynberg stream, Southfield canal, and Zandvlei outlet channel. Waterbodies within the catchment include Langevlei, Princess Vlei, Little Princess Vlei, Die Oog, Zandvlei, Kirstenhof wetland, Westlake wetland and Psoralea Park wetland.

Over time, a gradually increasing proportion of samples from rivers in the Sand catchment have been in poor and unacceptable ranges for phosphate concentration. A number of vleis in the catchment are similarly affected by gradually increasing phosphorus enrichment, which tends to encourage aquatic plant and algal growth.

Measurements of *E. coli* recorded at river sites in the Sand catchment have deteriorated moderately over the monitoring period, indicating that conditions are not entirely suitable for informal recreational activities. Levels of *E. coli* in Zandvlei, which is a formal recreational area, were generally acceptable over the indicated monitoring period, but has since declined.

Possible sources of water quality issues experienced in the Sand catchment include agriculture in the upper catchment (wine farms) and the fact that it is a moderately to highly urbanised catchment, with high levels of street waste and dumping in certain parts. Although it was not subject to inflows of treated sewage effluent during the reporting period, it has more recently been subjected to sewer and pump station overflows.

Zeekoe catchment

Rivers in the Zeekoe catchment include the Big Lotus River canal, Little Lotus River canal and Zeekoe outlet channel. Waterbodies include the Edith Stephens detention pond, Zeekoevlei, Rondevlei, Moddervlei and the Costa da Gama wetland.

[21] An assessment undertaken by DWS highlights that the system only receives 40% mean annual run-off of what should be coming through the estuary, which reduces the system's ability to flush itself

Although some improvement has been noted over the past decade, there has been a marked increase in the proportion of Zeekoe catchment river sites (i.e. the Big and Little Lotus rivers) in the poor and unacceptable category for phosphates over the monitoring period. This is currently among the worst-performing catchments with regard to phosphorus enrichment. Phosphate levels in Zeekoevlei and the Edith Stephens detention pond are well within the hypertrophic range (i.e. unacceptable). The smaller waterbody of Rondevlei, which has a relatively smaller catchment area, shows lower levels of phosphate enrichment.

Most *E. coli* measurements recorded at the Big and Little Lotus canal sites in the Zeekoe catchment in the past five years fell in the poor and unacceptable categories for intermediate-contact recreation. Although these rivers are not used for formal recreational activities, water quality does affect particularly the northern section of Zeekoevlei itself, where the rivers enter this waterbody.

Most *E. coli* measurements from Edith Stephens for the period 2015–2018 were within the poor and unacceptable ranges for intermediate-contact recreation. At Zeekoevlei, the pattern seems to be strongly seasonal, with *E. coli* counts being worse in winter than in summer. In winter, the estimated probability of exceeding the unacceptable threshold for intermediate-contact recreation approaches 35% in the northern section of the vlei, which is located near the more polluted inflowing rivers, and 15% near the southern shoreline. (At other sampling points, the calculated probabilities of exceeding the threshold remain below 5%).

Possible source(s) of water quality issues experienced in the Zeekoe catchment include:

- Raw sewerage entering the system due to maintenance backlogs of infrastructure and illegal discharging
- The presence of relatively large areas of poorly serviced informal and backyard settlements in the Gugulethu, Philippi and Grassy Park areas
- Run-off from highly urbanised areas with high levels of street waste and dumping
- Edith Stephens: Polluted run-off from the surrounding catchment that enters the pond via the Big Lotus canal during high flows
- Agricultural run-off from the Philippi Horticultural Area
- Cape Flats WWTW discharge into the Zeekoe outlet canal
- Zeekoevlei: Polluted inflowing rivers in the northern portion of the vlei. Improvements in Zeekoevlei water quality over the past decade presumably reflect management interventions. These include the construction of a cut-off drain to divert subsurface flows from the nearby WWTW into the downstream Zeekoe channel, annual drawdowns and efforts to address contamination in the broader catchment.

KEY MANAGEMENT RESPONSES

The state of freshwater quality in Cape Town has seen a gradual decline and the continuing high trophic levels is the result of a number of contributing factors. Similarly, trying to identify the exact reasons for improvements in freshwater quality is incredibly complex, as the City's attention and action relating to freshwater management have increased over time.

Contamination of the city's freshwater systems is primarily due to contaminated urban stormwater and raw sewage from informal settlements, leaking sewers and pump stations. The continuously increasing rate of urbanisation, rapid expansion of informal areas and an increase in backyard dwellings further strain the City's capacity to service and build new infrastructure.

See the Wastewater chapter for information on the general standards used to control phosphorous concentrations.

Water Quality Improvement Programme

The current state of many of Cape Town's waterways is generally poor. Of particular concern is the ambient water quality of the Diep (Milnerton Lagoon), Salt, Soet, Hout Bay, Big and Little Lotus, and the Kuils/Eerste rivers. Specific events, including community concerns about water quality in the lower Kuils River, and the algal bloom in the Milnerton Lagoon in December 2019 and into 2020, have raised public awareness of the issue. Inland water quality is challenging to improve due to pressure from urban development. The City is working towards improving the current state of affairs, and is targeting transformation into a city that could be considered 'water sensitive' by 2040, as stated in commitment 5 of its Water Strategy.

The City has established the Water Quality Improvement Programme (WQIP). This strategic intervention seeks to improve 'ambient water quality', which the United Nations defines as natural, untreated water that is affected by a combination of natural influences, anthropogenic activities and other causes of pollution.

The primary objective of the WQIP is to address pollution and incrementally improve the water quality of the rivers and waterbodies in Cape Town. This will be achieved in accordance with various laws, guidelines and water quality objectives/targets, as well as ensuring sustainability into the future.

The WQIP is designed to do the following:

- Demonstrate the City's ability to respond effectively, and substantially improve ambient water quality in priority catchments by employing a transversal (cross-cutting) project management approach
- Institutionalise and mainstream this transversal approach by establishing appropriate governance arrangements
- Build capacity in the City to deliver on the overall objective, targeting people, resources and partnerships
- Partner with key stakeholders that influence ambient water quality in the City's rivers and waterbodies

The WQIP consists of pollution abatement strategies and action plans (PASAPs) that set out how the City aims to address pollution and poor water quality at a river catchment (or subcatchment) scale. The PASAPs, in turn, cascade down into detailed transversal action plans (TAPs), which contain short- to long-term interventions and projects across various directorates. The TAPs are compiled by task teams comprising key role-players in catchments or subcatchments, and are coordinated by the City's Catchment, Stormwater and River Management Branch.

The WQIP will initially focus on the following priority catchments, which the City has identified as facing significant water quality challenges. The technical report has confirmed that these catchments are indeed among the most challenged from a water quality perspective:

- Diep River (Milnerton Lagoon)
- Soet River
- Salt River
- Kuils/Eerste rivers
- Hout Bay River
- Big and Little Lotus rivers (Zeekoevlei)

In line with its intention to become a 'water-sensitive city' and as per the framework of the Inland and Coastal Water Quality Improvement Strategy, the City has a number of ongoing projects in place to improve water quality. These include an increase in maintenance for clearing litter and dumped material from stormwater systems, improving aquatic weed and algae management measures, improving informal settlement servicing, managing databases to include downstream water-quality criteria and eliminating sewer-to-stormwater cross connections, to name a few.

The City is in the process of implementing its Liveable Urban Waterways (LUW) programme, led by the Catchment, Stormwater and River Management Branch. Various programmes being implemented by the Environmental Management Department also support a water-sensitive city and liveable urban waterways, such as the Kader Asmal Integrated Catchment Management Programme and the River Ambassadors programme.

The City promotes the concept of water-sensitive urban

design (WSUD), which includes the focused management of stormwater using established urban watershed and SUDS management tools.

Efforts to address water pollution are being intensified. The City has drastically stepped up the upgrading of wastewater treatment works, assisted by loan funding, and are constantly working to reduce sewer overflows, improve solid waste collection/cleansing, and identify and prosecute offenders. Approximately R11 billion has been budgeted for upgrades to wastewater treatment plants over the next 10 years. Eleven plants will receive capacity upgrades, and six will benefit from wastewater treatment process upgrades. Planning processes are also being revised to provide incentives for design features such as integration of stormwater with water reuse and conservation, reducing stormwater run-off and improving water quality through use of SUDS best practice in developments.

Furthermore, the City has partnered with a number of entities, including other spheres of government, neighbouring municipalities, businesses, agriculture, community groups and non-governmental organisations, to ensure the improvement of freshwater quality. The City has also partnered with national government and the Western Cape Provincial Government to supplement City enforcement agencies in order to manage water pollution. The City has implemented the national 'Adopt-a-River' programme to encourage communities to adopt and clean dirty rivers. The City participates in initiatives such as the Western Cape Wetlands Forum, with the aim of fostering wetland protection and promoting related research.

TREND AND TARGET

Trend:

In general, Cape Town has experienced deteriorating trends in inland water quality due to a range of contributing factors, including rapid urbanisation, informal and unlawful land settlement, and illegal dumping. Sewer blockages/overflows and faults with some wastewater treatment facilities remain a significant concern in relation to water quality. The biggest water quality issue experienced in most of the routinely monitored systems is elevated phosphorus, which drives eutrophic and hypertrophic conditions. Phosphorus enrichment makes receiving waterbodies such as vleis vulnerable to excessive plant growth, which requires ongoing maintenance and, at times, poses human health risks due to the presence or risk of microcystin toxins.

That said, however, it is noted that not all of Cape Town's watercourses are highly contaminated. The monitoring data do point to a few rivers where water quality is affected to a much lesser degree. These include the Silvermine River and Lourens River systems. Other rivers, such as the Sand catchment rivers and Hout Bay River, are moderately to highly contaminated in their lower reaches only.

From a human health perspective, as represented by *E. coli* data, the analyses suggest that Cape Town's five main recreational waterbodies have generally been in a condition conducive to at least intermediate-contact recreational activities over the past five years, despite often high levels of *E. coli* in the rivers and channels that feed them. However, all three of the recreational vleis (Zandvlei, Zeekoevlei and Rietvlei) were closed to the public for a number of months during 2021 due to water quality concerns.

The risk of unacceptable levels of *E. coli* is highest in the Milnerton Lagoon, which has been subject to periodic and, at times, prolonged contamination. This indicates exposure to untreated sewage, assumed to derive mainly from the large informal and backyard-dominated settlements in the catchment upstream (such as Dunoon and Joe Slovo). Occasionally, compromised final effluent discharged from the Potsdam WWTW may also affect water quality in the system, but operational and capital improvements are addressing this.

POLICY LINKAGES

- IDP 2022-2027:
  - Priority – Public space, environment and amenities
  - Objective 10: Clean and healthy waterways and beaches
- Environmental Strategy (2017):
  - Strategic Focus Area 3 – Environmental Quality Management and Monitoring
- Water Strategy (2019)
- Resilience Strategy (2019)
- Inland and Coastal Water Quality Improvement Strategy (2011)
- Inland Water Quality Monitoring Programme
- Liveable Urban Waterway Programme
- Green Infrastructure Programme
- Management of Urban Stormwater Impacts Policy (2009)
- Stormwater Management By-law (2005)[22]
- Wastewater and Industrial Effluent By-law (2013)
- Floodplain and River Corridor Management Policy (2009)[23]
- Recreational Water Use By-law (2018)
- Sustainable Development Goals (SDGs):
  - Goal 6: Ensure access to water and sanitation for all
- **See also:** Chapters on *Invasive alien species*, *Natural public green space*, *Coastal water quality*, *Wastewater*, and *Solid waste*

[22] Provides for the regulation of stormwater management and regulates activities that may have a detrimental impact on the City's stormwater system, including natural receiving water systems

[23] Aims to safeguard human health, protect natural aquatic environments and improve recreational water quality

CHAPTER 5: COASTAL WATER QUALITY

UNDERSTANDING COASTAL WATER QUALITY IN CAPE TOWN

Indicators:

- Percentage adherence to the South African Water-Quality Guidelines for Coastal Marine Waters
- Recreational water quality (coastal): Circular 88 – ENV 5.1
- Number of coastal water samples taken for monitoring purposes: Circular 88 – ENV 5.12

Cape Town's coastline stretches for approximately 307 km from Silwerstroomstrand on the Atlantic side to Kogel Bay on the east side of False Bay. It is among the most ecologically diverse and productive coastal environments in the world and contributes significantly to the city's economy. An economic assessment of the contribution of Cape Town's coastline to its GDP estimates the value to be approximately R40 billion per annum (±10,7% of GDP/annum).[27] Cape Town's beaches are world-renowned for their beautiful landscapes, offering opportunities to use an accessible natural environment.

Ensuring the protection of important ecosystems on the city's coastline and public health in the case of coastal water pollution requires effective water quality monitoring.

Coastal water quality

Coastal water quality is affected by two broad classes of pollution, namely point-source and non-point-source pollution. Point-source pollution comes from discrete, easily identifiable sources such as marine outfall discharges and effluent discharge from wastewater treatment works and industries directly into the sea. However, pollution from non-point-sources is considered to be of greater concern in many coastal cities, as these sources are less easy to identify and difficult to control or manage because they originate from a wide range of sources. Non-point sources of pollution include overflows from sewage pump stations, challenges with load-shedding at pump stations, sewage system failures, illegal discharges into the stormwater system, post-rainfall urban stormwater run-off from roads and built-up areas, and run-off and discharges from agricultural areas. During 2020, the City's Water and Sanitation Department cleared approximately 122 000 sewer blockages across Cape Town. Approximately 75% of these cases were the result of misuse of the sewer system.

Coastal water quality is significantly influenced by rainfall patterns. Increased stormwater flow in the winter washes significant quantities of pollutants (deposited within the catchment during the preceding dry period) into rivers and the coastal environment. In the summer months, when rainfall is minimal, lower levels of pollutants are found in coastal waters, with spikes only occurring after occasional 'unseasonal' rainfall events.

In 2019 and 2020, the City published the *Know Your Coast, 2019*[28] and *Know Your Coast, 2020*[29] coastal water quality reports. The reports provide an overview of results of the City's coastal recreational water quality monitoring programme, and forms the basis for this chapter.

Effects of pollution

Polluted coastal water may detrimentally affect the health of people swimming, surfing and diving in coastal waters and near-shore marine ecosystems. Furthermore, human contact with bacteria and other pathogenic organisms present in the water may cause gastrointestinal illnesses and dermatological problems. Water quality may also have a higher range of other potentially harmful pollutants that have the ability to detrimentally affect delicate near-shore coastal ecosystems.

To safeguard human health, water quality is assessed by comparing the number of enterococci in the water

samples and measured against the South African Water-Quality Guidelines for Coastal Marine Waters, Volume 2: Guidelines for Recreational Use (2012). These guidelines, determined by the then national Department of Water Affairs and Forestry, provide standards for the maximum number of indicator organisms (such as faecal coliforms including *E. coli*) that can be present in water used for full-contact recreational activities, such as surfing and swimming. The minimum grade for South African coastal waters for recreation is 'sufficient/fair' (table 7).

The South African Water-Quality Guidelines for Coastal Marine Waters allow the rating of water quality using the results of (at least) fortnightly sampling over a period of 12 months. The City rates annual water quality for the period 1 December to 30 November.

TABLE 7: RISK CRITERIA FOR RECREATIONAL USE OF COASTAL WATERS IN SOUTH AFRICA (SOURCE: *KNOW YOUR COAST*, 2019)

Grade	Estimated risk of illness per exposure*	Enterococci (cfu**/100 mℓ)	*E.coli* (cfu/100 mℓ)
Excellent	< 2,9% gastrointestinal (GI)	< 100 (95 percentile)	< 250 (95 percentile)
Good	< 5% GI illness risk	< 200 (95 percentile)	< 500 (95 percentile)
Sufficient/Fair	< 8,5% GI illness risk	< 185 (90 percentile)	< 500 (90 percentile)
Poor	> 8,5% GI illness risk	> 185 (90 percentile)	> 500 (90 percentile)

** Exposures are defined as 10 minutes of swimming with three head immersions*
***Colony-forming unit*

STATE OF THE ENVIRONMENT

Adherence with coastal water quality guidelines can be explained by understanding the geographical and climatic factors of the coastline, and the social geography of the surrounding residential areas of the coastline, among other factors such as infrastructural development.

Geographical and climatic factors result in certain areas being susceptible to developing poor water quality. False Bay is particularly sheltered due to its large bay area. Low wind speeds and weak currents, particularly in winter, result in reduced mixing and circulation in the sheltered area of False Bay. This is particularly marked along the Strand to Gordon's Bay coastline, Fish Hoek and Simon's Town. Reduced mixing and circulation in these areas result in stagnation and the trapping of poor-quality water close to the shoreline.

The area bordering the False Bay coast is the most densely populated, with both formal and informal settlements occupying the majority of all available land. The density of these areas, coupled with ageing stormwater and sewage infrastructure, results in these systems being overloaded, with cross connections and ultimately increased pollution levels. This social and infrastructural reality influences the amount of pollution flowing into the coastal system through river and stormwater systems. Contributing catchment areas are small and the bordering urban environment is densely populated, leaving little room for water quality improvement before outlet into the sea.

Atlantic coast

Water quality along the Atlantic coast is monitored at 28 recreational nodes and 17 coastal monitoring points. For the reporting period of 2020 along this section, water quality at 19 (79%) of the recreational nodes (figure 10) met the minimum requirement for recreational use in 2020 (eight were rated 'excellent', three 'good' and eight 'sufficient'). Five (21%) of the recreational nodes were rated as 'poor'. These were Lagoon Beach, Three Anchor Bay, Camps Bay tidal pool A, Bakoven bungalows and Hout Bay Beach.

At the coastal monitoring points, water quality at 11 (69%) of the points along the Atlantic coast also met the minimum requirement for recreational use in 2020 (three were rated 'excellent', two 'good' and six 'sufficient'). At five (31%) of these sites, water quality was rated as 'poor'. It should be noted that sampling at coastal monitoring points is deliberately situated near potential sources of pollution. The intention is to establish the extent of the impact of these pollution sources and can therefore be expected to reflect poorer water quality at times in these locations.

The results for the reporting period of 2020, if compared to the reporting period of 2019 (figure 11) at recreational nodes on the Atlantic coast reveal that at seven locations water quality improved. These were Small Bay, Llandudno Beach, Scarborough Beach, Beta Beach, Maiden's Cove tidal pool 1 and 2, and Camps Bay. At two locations, water quality remained 'poor'. These were Lagoon Beach and Three Anchor Bay. At three locations, water quality regressed to the 'poor' category. These include Camps Bay tidal pool A, Bakoven bungalows and Hout Bay Beach. This is an increase from three beaches (12%) in 2019 to five beaches (21%) rated as 'poor' in 2020. One recreational node (Cosy Bay) is not included in the evaluations as a result of too few data entries because of the Covid-19 lockdown.

At the coastal monitoring points, 40% of the results from the monitoring sites were classified as 'poor' in 2019. In 2020, 31% were rated as 'poor'. This is an improvement of almost 10% from 2019.

When the data are viewed and analysed over the last five years (2016–2020), it shows that there has been a marginal but continual water-quality improvement at seven recreational nodes, especially at beaches along the eastern and western shore of the Cape Peninsula (Maiden's Cove tidal pool 1 and 2, Camps Bay, Camps Bay tidal pool B, Beta Beach and Llandudno Beach) and at one beach along the northern Atlantic coast (Small Bay). Overall, there is a pattern in the reduction in the number of discrete spikes, but variability remains present. Although Three Anchor Bay remained poor, this was a consequence of discrete spikes in poor water quality as opposed to consistently poor results.

No clear trends were evident between the reporting years at most of the other recreational nodes, either showing little change or varying randomly over this period. Although there was a reduction in results of 'poor' water quality by almost 10% at the monitoring points, the variable trend also persists.

False Bay coast

Along the False Bay coast, water quality is monitored at 33 recreational nodes and 21 coastal monitoring points. For the sampling period of 2020 in False Bay (figure 12), water quality at 15 (56%) of the recreational nodes along the False Bay coast complied with the minimum requirement for recreational use (six tested 'excellent', one 'good' and eight 'sufficient'). Twelve (44%) of the recreational nodes were rated as 'poor'.

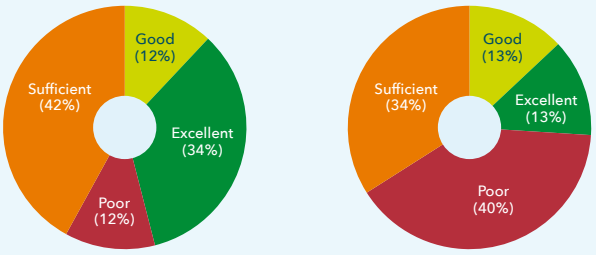
At the coastal monitoring points, water quality at five (25%) of the points in False Bay also met the minimum requirement for recreational use in 2020 (four were rated 'excellent' and one as 'sufficient'). At 15 (75%) of these sites, water quality was rated as 'poor'.

The results for the reporting period of 2020, if compared to the last reporting period of 2019 (figure 13) at recreational nodes, reveal that at six locations water quality improved. These were Frank's Bay, Simon's Town Long Beach, St James tidal pool, Muizenberg Station, Strandfontein tidal pool and Gordon's Bay. At eight locations, water quality remained in the 'poor' category. These were Fish Hoek, Muizenberg Pavilion, Sunrise Beach, Monwabisi Beach, Macassar Beach, Strand Beach, Strand Pavilion jetty and Strand Harmony Park. At four locations, water quality regressed to the 'poor' category. These were Boulders Beach, Clovelly, Mnandi Beach west and Mnandi Beach east.

At the coastal monitoring points for 2019, 55% of the results from the monitoring sites were classified as 'poor'. In 2020, 75% were rated as 'poor'. This is an increase of 20% in 'poor' water-quality ratings at monitoring sites from 2019 to 2020.

At eight locations (Frank's Bay, Simon's Town Long Beach, Glencairn Beach, Muizenberg Station, Strandfontein, Strandfontein tidal pool, Monwabisi tidal pool and Gordon's Bay), water quality has shown a gradual improvement over the five-year rolling period (2016–2020). Although water quality remained 'poor' at Fish Hoek, Macassar Beach, Strand Beach, Strand Pavilion and Strand

FIGURE 10: ATLANTIC COAST – DISTRIBUTION OF THE 2020 COASTAL WATER QUALITY RATINGS

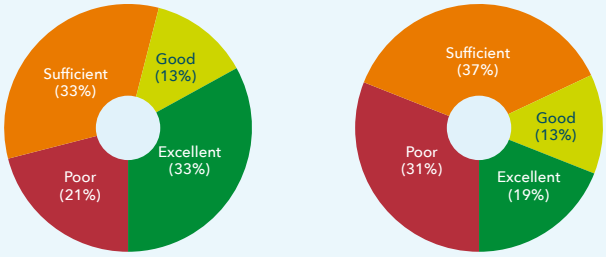


RECREATIONAL NODES

COASTAL MONITORING POINTS

Source: Know Your Coast, 2020

FIGURE 11: ATLANTIC COAST – DISTRIBUTION OF THE 2019 COASTAL WATER QUALITY RATINGS



RECREATIONAL NODES

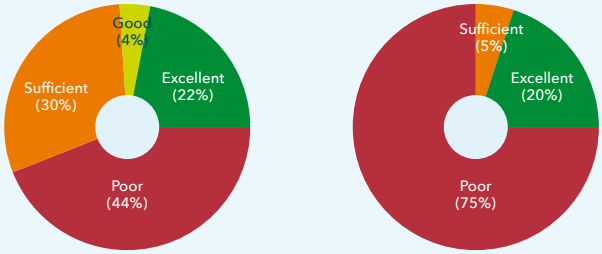
COASTAL MONITORING POINTS

Source: Know Your Coast, 2019

Harmony Park over the last few years, there were fewer spikes in 2020 for these locations as compared to 2019. Accordingly, although they remain 'poor', the drop in discrete spikes is encouraging in that it suggests that water quality is improving as opposed to being consistently poor at these locations. Water quality at the remaining sites either showed little change or varied randomly.

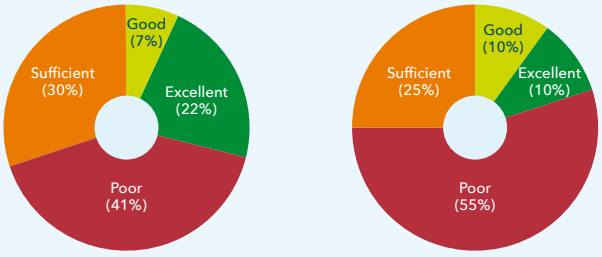
** Updated (2021) data is available in the 2021 Know Your Coast report.*

FIGURE 12: FALSE BAY COAST – DISTRIBUTION OF THE 2020 COASTAL WATER QUALITY RATINGS



Source: Know Your Coast, 2020

FIGURE 13: FALSE BAY COAST – DISTRIBUTION OF THE 2019 COASTAL WATER QUALITY RATINGS



Source: Know Your Coast, 2019

KEY MANAGEMENT RESPONSES

Coastal water quality monitoring

In 2019/20, the City initiated online biweekly reporting of coastal recreational water quality updates via the City's *web portal*. In the same year, the City published the first edition of the *Know Your Coast, 2019* coastal water quality report. The report provides an overview of the results of the City's coastal water quality monitoring programme, together with an abbreviated summary of the findings of the Blue Flag monitoring programme. It reflects the outcome of over 10 000 sample bacterial tests from 90 sites,[24] with results from recreational nodes as well as coastal monitoring points (near stormwater outlets or known problem areas). The report details possible explanations for poor results, and outlines current and planned upgrades to the wastewater systems. The second report, *Know Your Coast, 2020* was published in April 2021. Going forward, the report will be released in the first quarter of each year, presenting the results from the preceding year. It is hoped that this annual review, along with the biweekly data updates, will empower residents, visitors and tourists alike and serve as a platform for a new partnership between the City, Capetonians and visitors to improve the city's coastal water quality.

Policies, strategies and transversal management

Coastal water quality is affected largely by land-based activities. Ensuring a high standard of water quality is a complex task that requires the involvement of many City departments. Continued efforts aimed at reducing pollution levels in freshwater bodies are required. The City's Inland and Coastal Water Quality Improvement Strategy addresses the complexity and interconnectedness of the city's water system and provides key management frameworks to address these issues. These efforts include, but are not limited to, ensuring adequate environmental education to inform communities of the detrimental effects of littering, continued efforts and increased investments in WWTWs, improving informal settlement servicing and eliminating sewer-to-stormwater cross connections. The key management responses outlined in the Freshwater quality chapter will also significantly benefit coastal water quality.

Water quality influences the accessibility of beaches for residents and visitors. The City recognises that Cape Town's coast is a common asset that must remain accessible to all. In 2014, the City implemented the Integrated Coastal Management Policy. This policy envisions exceptional quality of the Cape Town coast. The City intends to optimise the value of the coast and protect

[24] For the reporting period of 2021, monitoring sites were increased to 99

it as a common asset through a framework of effective governance, decision making and management in the best interests of the city and its people.

The City has committed itself, in its new Water Strategy (2019), to transition to a water-sensitive city by 2040 that integrates the urban water cycle, builds resilience and protects Cape Town's sensitive natural ecosystems. This is an ambitious undertaking, and one that will require the support from all Capetonians as it will only succeed if we change our behaviour and share the responsibility in doing so. Although this is a long-term undertaking, there are a number of actions that the City can and will take in the short-term towards improving quality of service. The need to establish a Coastal Water Quality Committee to meet on a quarterly basis has also been identified.

Coastal educational materials and resources:

The City undertakes continuous coastal education and awareness-raising activities, and produces a range of resources to ensure informed and empowered citizens. Useful resources include:

- Bin It. Don't Block It campaign
- Sewer blockage awareness campaign video
- Conserving our coast
- Coastal sewage spill response protocol

Monitoring and managing the broader coastal environment

Coastal dynamics

The dynamics of sandy beaches being influenced by waves, wind and currents are an integral part of the coastal system. The movement of sand can result in erosion or an inundation of sand in coastal areas, with some areas having more sand than would naturally occur without human interference. The movement of sand in this manner influences not only beach ecosystems, but also affects the quality of the beach-use experience. The City has plans and projects in place to mitigate these issues and rehabilitate coastal systems. These are addressed in the Integrated Coastal Management Policy (2014) and in City-led projects focused on invasive plant control and *dune rehabilitation.*

For more information, visit the CCT website and read the City's booklet *Beaches: A diversity of coastal treasures.*

Blue Flag status

The Blue Flag programme is an annual international award that is given to beaches that maintain a standard of excellence in the areas of water quality, safety, amenity, environmental education and management. The City strives to ultimately achieve this eco-label for all of its beaches. Table 8 provides a historical overview of the status of Blue Flag beaches along Cape Town's coast.

In accordance with the international Blue Flag standards, each beach has to submit at least five samples per season, no more than 30 days apart. It is important to note that the Blue Flag season is only from 1 December to 31 January for most of the beaches. For more popular beaches (i.e. Camps Bay, Muizenberg and Strandfontein), Blue Flag season continues until 31 March. With a season of four months, a sample must be taken every month in addition to a pre-season sample, and this equates to five samples per year. However, the City exceeds this sampling regime, by obtaining weekly or biweekly samples necessary for the beaches that only have a two-month season. There are various programmes in place at each of the beaches to ensure the safety, cleanliness, amenities and environmental standards of a world-class beach.

To find out more about the Blue Flag status, browse through the *Blue Flag website*. Cape Town has 10 of the 48 Blue Flag beaches in South Africa.

Making the most of your coastal environment

- Read up on the City's partnership with Shark Spotters and understand the beach shark-spotting system by visiting the *CCT website* and the *Shark Spotters website.*
- Marine life along Cape Town's coast is being over-exploited by poaching and over-fishing. Learn more about national legislation on recreational and commercial licensing to fish on the *CCT website.*
- Become an advocate for the coastal environment by removing your own waste after beach visits and joining a coastal clean-up group such as Clean C and Clean-up South Africa.
- Make informed sustainable decisions on which fish you eat and/or catch by following the *SASSI guidelines*.

TABLE 8: HISTORICAL OVERVIEW OF THE STATUS OF BLUE FLAG BEACHES ALONG CAPE TOWN'S COAST

Beach	Years in programme	Blue Flag status awarded				
		2016/17	2017/18	2018/19	2019/20	2020/21
Silwerstroomstrand	9	✔	✔	✔	✔	✔
Melkbosstrand	5	✔	✔	✔	✔	✔
Clifton 4th Beach	18	✔	✔	✔	✔	✔
Camps Bay Beach	14	✔	✔	✔	✔	✔
Llandudno Beach	11	✔	✔	✔	✔	✔
Fish Hoek Beach	5	✔	✔	✔	✔	✔
Muizenberg Beach	16	✔	✔	✔	✔	✔
Strandfontein Beach	13	✔	✔	✔	✔	✔
Mandi Beach	17	✔	✔	✔	✔	✔
Bikini Beach	17	✔	✔	✔	✔	✔

TREND AND TARGET

Trend:

Overall, and at a citywide scale, there have been no significant changes in coastal water quality across Cape Town. Recreational beaches rated as 'poor' in 2020 are mainly a result of three or fewer results of high bacterial counts as opposed to consistently high counts in bacterial readings.

Target:

A total of 95% of coastal water-quality monitoring points will adhere to coastal water quality guidelines (80th percentile guideline).

POLICY LINKAGES

- IDP 2022-2027:
  - Priority – Public space, environment and amenities
  - Objective 10: Clean and healthy waterways and beaches
- Environmental Strategy (2017):
  - Strategic Focus Area 3 – Environmental Quality Management and Monitoring
- Inland and Coastal Water Quality Improvement Strategy
- Coastal Water Quality Monitoring Programme
- Management of Urban Stormwater Impacts Policy (2009)
- Stormwater Management By-law (2005)[25]
- Wastewater and Industrial Effluent By-law (2013)
- Floodplain and River Corridor Management Policy (2009)[26]
- Integrated Coastal Management Policy (2014)[27]
- City Coastal By-law (2020)
- Recreational Water Use By-law (2018)
- Sustainable Development Goals (SDGs):
  - Goal 14: Life below water
- **See also:** Chapters on *Natural public green space*, *Freshwater quality*, and *Wastewater*

[25] Provides for the regulation of stormwater management and regulates activities that may have a detrimental impact on the City's stormwater system, including natural receiving water systems

[26] Aims to safeguard human health, protect natural aquatic environments and improve recreational water quality

[27] Envisions management of the coast as core city infrastructure, valued and protected as an asset for current and future generations

CHAPTER 6: WATER USE

UNDERSTANDING WATER USE IN CAPE TOWN

Indicators:

- Bulk water treated and supplied (megalitres)
- Daily water use per capita (litres)
- Amount of water reuse

Water is a fundamental element of human life. Many cities, including Cape Town, were founded as a result of the availability of water sources. The city was established as a halfway station to provide fresh water, vegetables, fruit and meat for trading ships. The remnants of these activities are preserved within the Company's Garden and the Stadsfontein Vault houses (one of Cape Town's original water springs). Today, Cape Town has a population of over four million people.

Cape Town's water is supplied from a system of dams – referred to as the Western Cape Water Supply Systems (WCWSS) – located around Cape Town and managed by the national Department of Water and Sanitation (DWS). The water supply system is currently heavily dependent on rainfall, although alternative supplies are currently in development. About a third of the water in the WCWSS is used by agricultural customers outside of the City of Cape Town, and 7% by other urban areas (smaller towns).

The city's supply of water is a collaboration between the City's Water and Sanitation Department and the national DWS. The DWS supplies Cape Town with water from three major dams: Voëlvlei, Theewaterskloof and Berg River. In addition to the water supplied by the DWS, the City

FIGURE 14: CUMULATIVE WEEKLY USAGE CITY OF CAPE TOWN (MILLION M³/A)

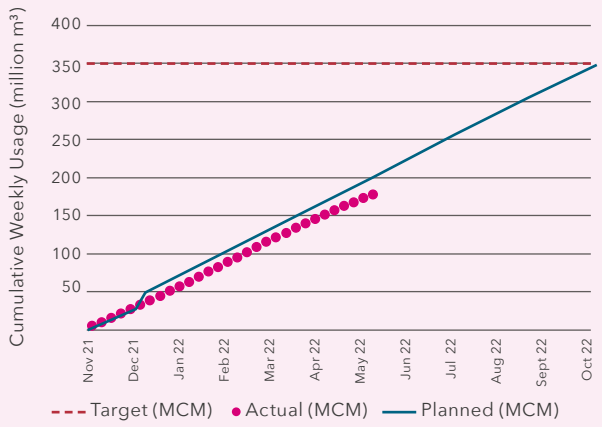
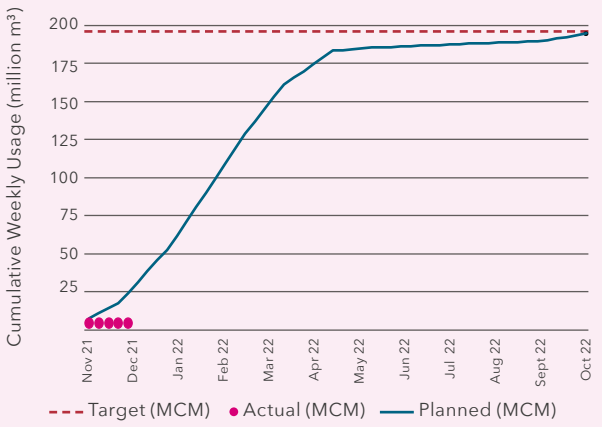


FIGURE 15: CUMULATIVE WEEKLY USAGE AGRICULTURE (MILLION M³/A)



manages the following infrastructure for water supply:

- Three major dams: Wemmershoek, Steenbras Upper and Steenbras Lower
- Eight smaller dams: Hely-Hutchinson, Woodhead, Victoria, Alexandra, De Villiers, Kleinplaats, Land-en-Zeezicht and Lewis Gay
- Twelve water treatment works
- Twenty-five large (bulk) reservoirs
- Over 450 pump stations
- Seventeen wastewater treatment works (sewerage works) and six smaller facilities

To get more information on how the City delivers water to you, *watch this video* from the City's website.

The City strives to deliver a high-quality water supply, and has won numerous awards, including:

- Multiple Blue Drop awards, indicating that Cape Town has some of the best drinking water in the country
- A Platinum award for excellence in the Blue Drop award system over a number of years
- Multiple Green Drop awards for the high-quality standard of wastewater treatment operations
- Excellent operating systems, recognised at the 2013 Water Sector Awards on Water Conservation and Water Demand Management
- Winning the Adaptation Implementation category at the 2015 C40 Cities awards in Paris, France, ahead of more than 200 applications from 94 cities across the world.

Guidelines for water use

The World Health Organisation (WHO) recommends a minimum of 7,5 ℓ per capita per day to meet the essential requirements of health and hygiene. A larger quantity of about 20 ℓ per capita per day is required to take care of drinking, basic hygiene needs and basic food hygiene, with more needed for activities such as laundry, bathing and showering. In South Africa, the Water Services Act, 1997, stipulates a daily minimum per capita supply of 25 ℓ. The WHO estimates that households with optimal access (piped water within the home) use between 100 and 300 ℓ per capita daily, whereas households with intermediate access (i.e. a single tap in the house or yard) use approximately 50 ℓ per capita daily.

The City's 2009–2014 Integrated Metropolitan Environmental Policy (IMEP) Environmental Agenda envisioned a target of providing 180 ℓ of water per capita daily. This was based on a history of high water demand. The aim was to reduce the amount of water used in high-income households and to ensure that lower-income households have increased access to water.

The City's aim is to supply all residents with water, and to educate users about conservation techniques and the need to use water sustainably. The City provides indigent households with a monthly minimum free allocation of 6 000 ℓ of water (up to 15 000 ℓ for registered indigents) and informal settlements with free water. Previously, all households received 6 000 ℓ free. The tariff for residential customers for the 2020/21 financial year is outlined in table 9.

TABLE 9: CAPE TOWN WATER TARIFFS AS PER WATER RESTRICTIONS, INCLUDING VAT, FOR 2020/21

Water steps	Level 0	Level 1	Level 2	Level 3	Emergency level
Step 1 (0 ≤ 6 kℓ)	R17,37 Free for indigent households	R17,92 Free for indigent households	R18,86 Free for indigent households	R22,63 Free for indigent households	R27,76 Free for indigent households
Step 2 (> 6 ≤ 10,5 kℓ)	R23,87 Free for indigent households	R25,49 Free for indigent households	R30,07 Free for indigent households	R36,43 Free for indigent households	R45,10 Free for indigent households
Step 3 > 10,5 ≤ 35 kℓ)	R32,43	R36,19	R45,45	R55,25	R68,63
Step 4 (> 35 kℓ)	R59,85	R79,46	R113,06	R228,03	R392,97

STATE OF THE ENVIRONMENT

Water availability

Dam inflow records dating back to 1928 reflect that 2017 was the driest year on record (figure 16). Dam inflows in 2015 and 2017 were respectively the lowest recorded, with below average inflows persisting until at least 2019.

As is reflected in the WCWSS storage record (figure 17), however, dam levels have recovered well, despite lower-than-average rainfall between 2015 and 2019. This is by virtue of continued suppressed reliance on the municipal water supply, and a reduction in consumption by the agricultural sector, outlasting the easing of water restrictions (see charts below) and the return of normal rainfall post-drought.[30]

Although there is general agreement that temperatures are likely to increase, there is uncertainty about the potential impact of climate change on rainfall, particularly in the mountain catchment areas. The City's modelling as reflected in the Water Strategy assumed a reduction in annual water availability of approximately 15%, in line with regional planning initiatives. Further research suggests allowance should also be made for an increase in multi-year droughts. Findings based on three different climate change scenarios suggest the following:

- Reductions in the median annual run-off
- A relatively high probability of water availability reductions of between 18% and 27% by 2050
- Sizeable reductions in run-off in the 'wetter' years, but much smaller reductions in the 'drier' years

The graph in figure 18 sets out various possible demand scenarios and if planned, augmentation will be able to service demand. The estimated impact of climate change has been incorporated and it is assumed that only 50% of alien infestation will be cleared by 2040. System yield could markedly increase if climate change is not as severe as projected, or if alien vegetation is cleared more quickly. A more in-depth analysis of the potential impacts of climate change is contained below. The figure that augmentation projects are likely to be able to keep pace with are low to medium demand scenarios (currently the case), with light restrictions likely necessary if demand increases more drastically. The economic impacts of the imposition of the lockdown on the country have not yet been factored in, but it is expected this would have a negative effect on water demand.

For an interpretation of the graphic, an increase in system yield in around 2006 was a result of the commissioning of the Berg River Dam. Since then, water availability from this system has declined as a result of increases in invasive alien vegetation outside of the City's mandate. Water availability is projected to continue declining due to climate change and competition for use of the WCWSS from the agricultural sector and competition for resources from other growing municipalities. Figure 19 indicates annual water treated and provided by the City.

FIGURE 16: ANNUAL INFLOW INTO CAPE TOWN'S DAMS OVER THE 90 YEARS FROM 1929 TO 2019 (MILLION M³/A)

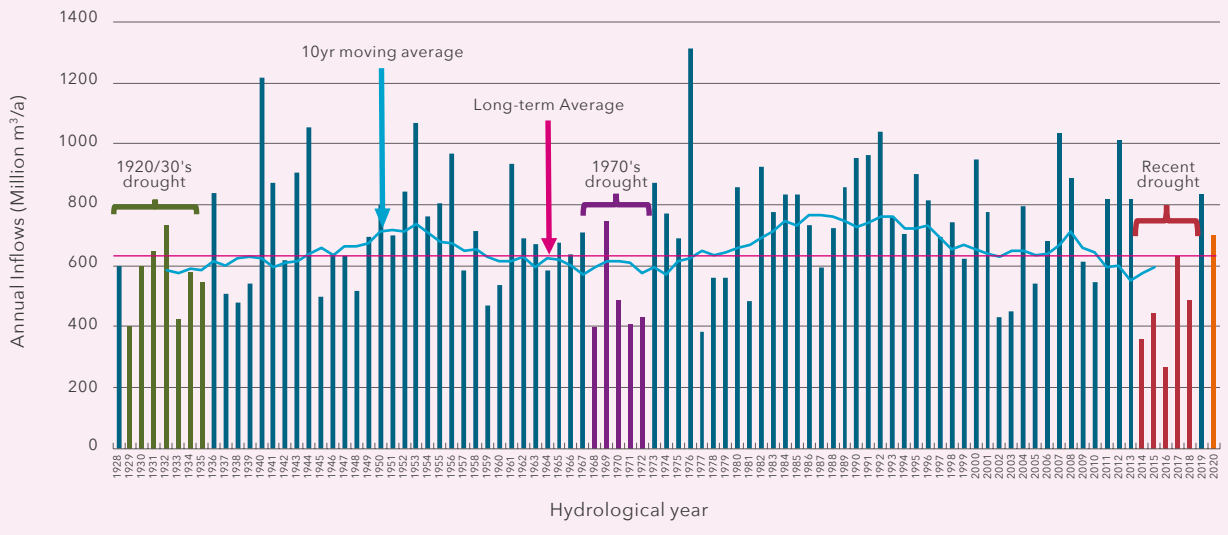


FIGURE 17: WCWSS STORAGE RECORD (2008–PRESENT)

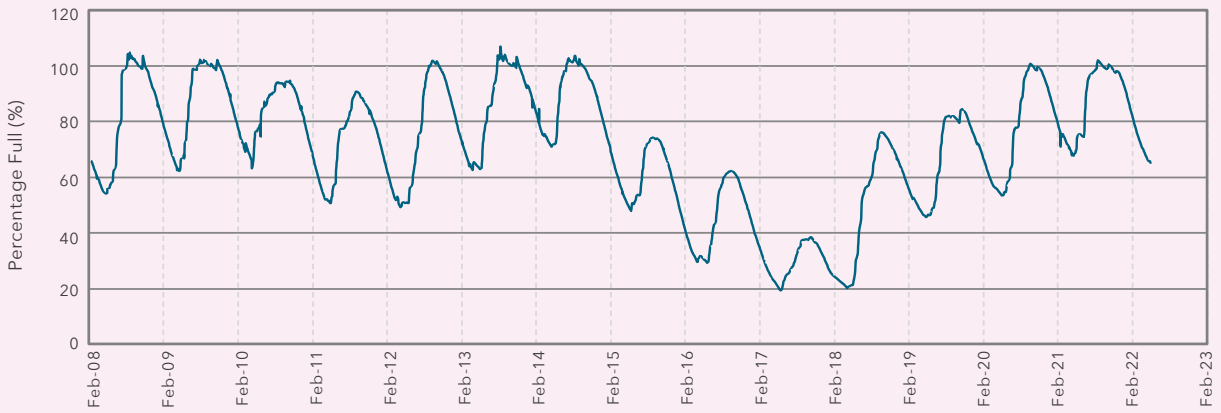
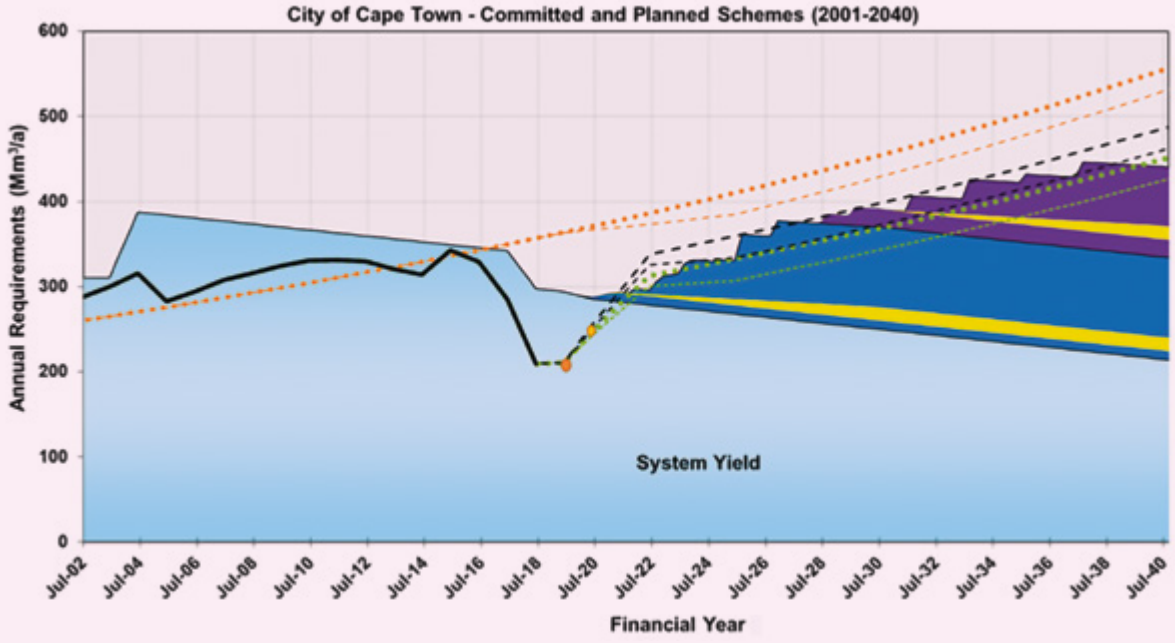


FIGURE 18: CITY OF CAPE TOWN – COMMITTED AND PLANNED SCHEMES (2001–2040)



Water use

Cape Town's water use has remained relatively stable since the mid-1990s, despite a rapidly increasing population, and was significantly reduced as a result of the severe drought. Although total annual water use peaked in 2015, at 357 865 mℓ,2018 saw a sharp decline in total annual water use, at 195 970 mℓ.

However, as highlighted in figure 21, since 1996 Cape Town's daily water use per capita (per calendar year) has shown a steady decline, reaching a peak of 312,46 ℓ per capita per day in 1999. In response to the water crisis, water use per capita reached its lowest point since 2016, at 112,20 ℓ per capita per day. Daily water use per capita increased in 2019 (122,45 ℓ daily water use per capita) and 2020 (137,62 ℓ daily water use per capita), but it is still well below pre-water crisis levels of 222,15 and 148,29 ℓ per capita per day in 2015 and 2016 respectively. Figure 20 highlights the overall water use trend from 2010 to present, whereas Figure 14 and Figure 15 shows cumulative weekly usage of water between November 2019 and October 2020, of Cape Town and agriculture, respectively.

Currently there are no drought-linked water restrictions

[28] Details on water restrictions to be applied at various levels of water scarcity can be found at www.capetown.gov.za/thinkwater

in place. The average daily water use per capita in 2020 was around 137,62 ℓ, compared to ver 220 ℓ before the drought.[28]

Public awareness resources can be found on the CCT website in English, Afrikaans and isiXhosa. These outline water system management, water by-laws, leak prevention and more.

There is also increased consumer awareness of water saving, with improved maintenance of household plumbing by fixing leaks and installing more water-wise toilets, taps and showerheads. The water restrictions implemented during 2016 and 2017 also contributed to reduced water use.

Water reuse

Between 2009 and 2016, the City steadily increased the reuse of water. As indicated in figure 22, water reuse peaked in 2016 at 21 759,48 Mℓ reused. However, there has been a gradual decline in water reuse in 2018, 2019 and 2020, at 20 906,16 Mℓ, 16 898,19 Mℓ and 14 008,54 Mℓ, respectively.

FIGURE 19: ANNUAL WATER TREATED AND PROVIDED BY CCT, 1996–2020

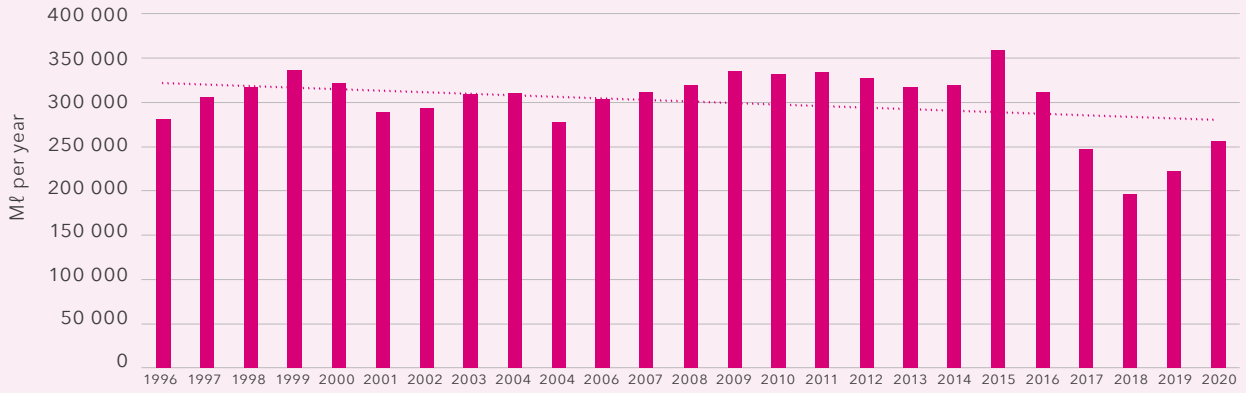


FIGURE 20: OVERALL WATER USAGE TREND IN Mℓ/D (2010–PRESENT)

WCWSS means Western Cape Water Supply System
MℓD means million litres per day
More information on Water Saving and Restrictions is available on the City of Cape Town's "ThinkWater" website

FIGURE 21: DAILY WATER USE PER CAPITA 1996–2020 (PER CALENDAR YEAR)

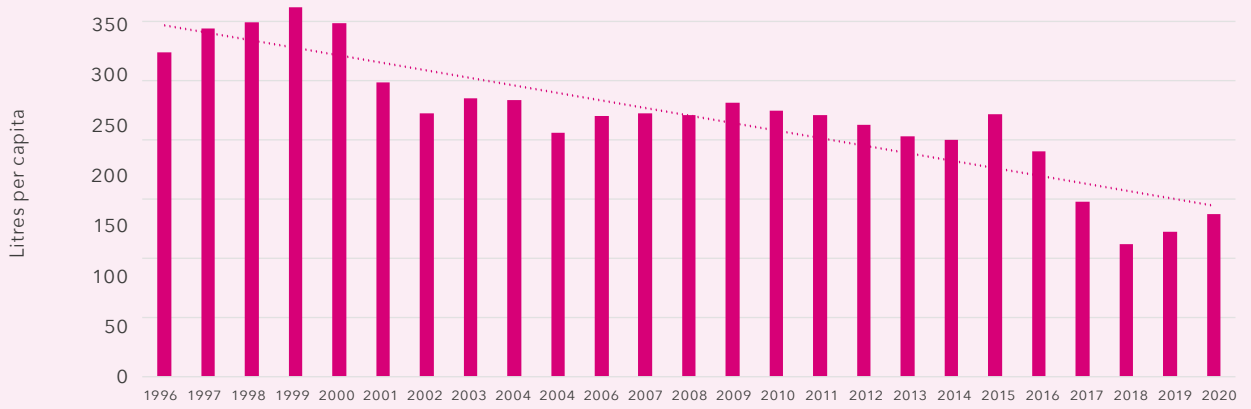
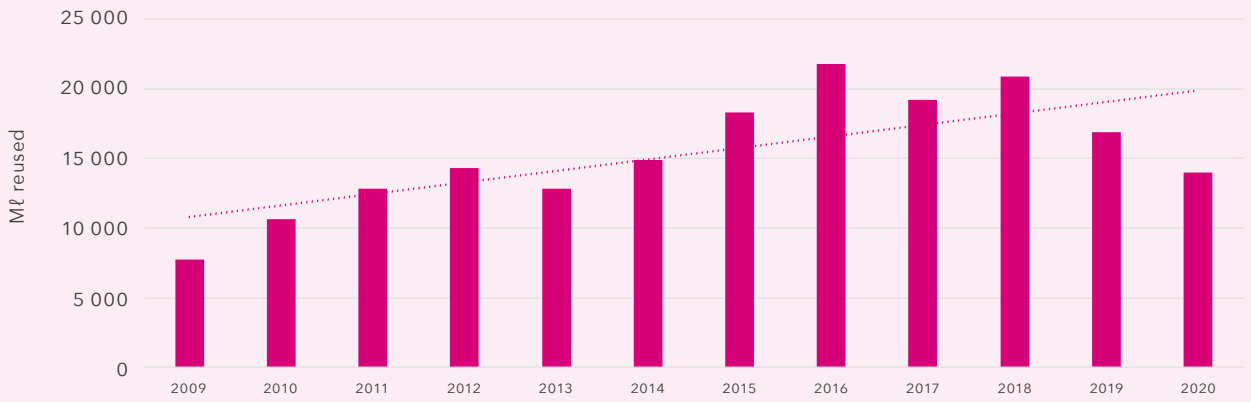


FIGURE 22: MEGALITRES OF WATER REUSED 2009–2020 (PER CALENDAR YEAR)



KEY MANAGEMENT RESPONSES

The City has the responsibility of ensuring water security in the face of the challenges of increasing population, unpredictable weather conditions and natural water scarcity. The City has implemented mechanisms to ensure these challenges are faced and the needs of all residents are met.

The City offers water-saving tips on the *CCT website.*

Water augmentation schemes

It is estimated that water augmentation programmes initiated by the City during 2018 will further reduce the City's reliance on surface water (dams) from 96% to 75%.[31] These schemes include groundwater abstraction, the reuse of wastewater and desalination. While these schemes are in development, continued suppressed consumption is creating an effective buffer against drought. More information on timelines for the implementation of water augmentation schemes can be found at *https://www.capetown.gov.za/general/cape-town-water-strategy*.

A key deliverable in the next few years is the diversification of water resources, including increased abstraction of groundwater from various aquifers. To ensure sustainability, the Cape Flats aquifer will be artificially injected with 40 Mℓ/d advanced treated water (sourced from the Cape Flats Wastewater Treatment Works) through a total of 41 injection boreholes to store water and to create barriers to prevent the ingress of sea water or pollutants from potential point sources. By October 2020, six of 41 recharge boreholes had been drilled. Refurbishment and expansion work being undertaken (2017 to 2021) at the Atlantis-Silwerstroom

aquifer includes recharge infrastructure. The suite of refurbishments aims to yield a total of 25 Mℓ/d.

Water conservation and demand management

The City is implementing a revised Water Conservation and Water Demand Management Strategy.[29] The strategy aims to minimise water losses and promote efficient water use by focusing on the technical and behavioural aspects of saving water. These include public awareness, water use efficiency, stepped water tariffs to encourage water savings, free-of-charge plumbing repairs for low-income households, the training of 'community plumbers' (who are unemployed individuals from disadvantaged communities), the promotion of alternative water sources, and a range of technical interventions to minimise water losses from the reticulation system. The technical interventions include improved asset management and pressure management, pipe replacement programmes, leak detection and improved meter management. These generate additional water savings of up to 70 Mℓ/day.

Treated effluent schemes

Water use is being supported by the production of treated effluent from wastewater. This is discussed in further detail in the Wastewater chapter. After initial supply to users, the wastewater or sewage is treated at wastewater treatment works. After treatment, some of the treated effluent is safely disposed of and a growing portion is reticulated via a separate pipeline network to be reused for irrigation on sports fields, and in agriculture and industry. This reduces the use of municipal drinking (potable) water for activities other than essential health and hygiene purposes, such as drinking, cooking and bathing.

For the 12 months up to June 2020, 15 7070,56 kℓ of treated effluent has been supplied to customers. This is close to an average of 50 Mℓ of water per day for the year. The reuse of wastewater is being progressively scaled up.

Given the current success of this service, the City is looking to expand the treated effluent reticulation network to other areas of the city, with the Athlone, Bellville and Macassar areas being most likely to benefit as there is a greater demand in these areas and, in most cases, fewer infrastructure requirements.

Invasive alien vegetation clearing (catchment management)

Over 200 ha of pine and eucalyptus plantation have been cleared in the Wemmershoek and Steenbras Dam catchments since 2019. This alien vegetation clearing has an estimated yield of 55 Mℓ/day.

Managing water with restrictions

The City is continuously working on creating a more resilient and water-wise city. The City's water restrictions act as a management tool to enable Cape Town to adapt to the change in climate and mitigate the consequences of a water crisis. Water restrictions assist every resident, visitor and business on how to lower water consumption. Each person needs to be water conscious and forward thinking, as Cape Town is already located in a water-scarce region and the effects of climate change are difficult to predict. The City plans to implement three restriction levels, and to provide for an emergency response if needed. When recovering from a drought, the approach to lifting restrictions will be more conservative than the rules for implementing higher-level restrictions. Restriction levels will be reviewed annually.

TREND AND TARGET

Trend:

Overall water use has decreased. The average daily water use per capita in 2020 was around 137,62 ℓ, compared to over 220 ℓ before the drought.

[29] In 2007, the City implemented a Water Conservation and Water Demand Management (WCWDM) Strategy after the success of earlier programmes

POLICY LINKAGES

- IDP 2022-2027:
  - Priority – Basic Services
  - Objective 4.1. Water and sanitation: Excellence in Water and Sanitation service delivery programme
  - Objective 4.4. Water and sanitation: Water resilience programme
- Environmental Strategy (2017):
  - Strategic Focus Area 2 – Resource Management and Efficiency
- Water Strategy (2019)
- Water By-law (2010) and the Water Amendment By-law (2018)
- Water Conservation and Water Demand Management Strategy (2007)
- Water Service Development Plan
- Western Cape Water Supply System Reconciliation Strategy
- Water Services Act, 1997
- National Water Act, 1998
- Sustainable Development Goals (SDGs):
  - Goal 6: Ensure access to water and sanitation for all
- **See also:** Chapters on *Wastewater*, and *Climate change*

CHAPTER 7: WASTEWATER

UNDERSTANDING CAPE TOWN'S WASTEWATER SYSTEM

Indicator:

- Percentage compliance with DWS standards for final effluent

Being able to meet the city's water and sanitation demands requires a sound and efficient wastewater management system. Wastewater is defined as any water that enters the sewerage system that is then conveyed to a wastewater treatment plant to be treated. This water includes wastewater that is produced by bathing, showering, washing clothes and dishes, flushing toilets, and industrial and commercial effluent. Treating this water before reintroducing it to the environment is required by the National Water Act, 1998 (NWA). This is essential in order to maintain human and environmental health as the quality of wastewater discharges can drastically affect ecosystems, human well-being and the economy. Therefore, the City follows national standards for sanitation and performs wastewater treatment in an environmentally sound and hygienic manner.

Treated effluent and the treatment of some of the by-products can be highly valuable resources, and can be recycled and reused in various ways. However, wastewater management can also be challenging. Wastewater management is linked to the entire water system of the city, which has 20 000 km of pipes and sewer reticulation network.

The treatment and reuse of wastewater are recognised as a vital component in adapting to Cape Town's limited water supply in the face of drought, rapid urbanisation and population growth.

Wastewater is treated in various ways due to it containing different pollutants and contaminants, such as bacteria and other pathogens, organic compounds and organic matter, synthetic chemicals, nutrients and heavy metals. The regulation of what pollutants or contaminants enter the wastewater system is vital as some substances can adversely affect treatment processes. Furthermore, wastewater can contain high levels of nutrients such as nitrogen and phosphorus. High concentrations of these compounds can lead to the excessive growth of algae and water plants, creating an imbalance in aquatic ecosystems known as eutrophication. If left untreated, wastewater also contains high levels of bacteria, viruses and helminths (worms) that can cause the spread of disease.

Cape Town's wastewater treatment works

The City operates 16 activated sludge works, one trickling filter works, three marine outfalls, four rotating bio-contractors, two pond system wastewater treatment works (commonly known as sewerage works) and six smaller facilities. Wastewater undergoes a closely monitored treatment process before being safely discharged into rivers, canals, vleis, underground water bodies (aquifers) or the sea.

The treatment of wastewater includes the following steps:

- Preliminary treatment: Screening to remove large materials such as rags, paper, plastic and leaves, and grit removal to remove sand, grit, small stones and broken glass to prevent damage to pumps and other equipment
- Primary treatment: A physical process to remove solids and thereby reduce the organic load on the downstream treatment processes. Settling of solids by gravity in a primary settling tank is the process most often implemented as primary treatment
- Secondary treatment: A biological process, through solar and other energy, bacteria, algae and a variety of aquatic biota, to remove organic matter, nitrogen and phosphorous. Other organic chemicals may also be

broken down

- Tertiary treatment: Polishing (removing any remaining nitrogen and/or phosphorus) and disinfection of the treated effluent. Chlorine, ozone or ultraviolet light can be used for disinfection, removing any remaining pathogens before the treated effluent is discharged

The outputs of this treatment process are as follows:

- The majority of treated effluent is released into rivers, canals, vleis or the ocean (as stipulated in each treatment works discharge licence, which is issued by the national DWS) and is absorbed into the environment.
- A portion is reused by industry and for watering golf courses and sports fields, as it is much cheaper and more environmentally sustainable than using potable water.
- Screenings and grit are disposed of at hazardous landfill, as per legislation.

Sludge or bio-solids removed from the purification process, depending on its classification, is either used or disposed of. 'Activated' sludge is dewatered and applied to suitable agricultural land, and 'primary' sludge is dewatered and disposed of at hazardous landfill sites.

Standards for treated wastewater discharge

The City of Cape Town uses wastewater purification specifications set by the DWS and DFFE. Currently, purification specifications were authorised through regulation 991, which was a Department of Water Affairs (DWA) (now DWS) authorisation. These prescribed standards are intended to ensure that wastewater has a minimal impact on the natural environment and on the health of anyone who may come into contact with it. The City monitors the quality of treated wastewater on a weekly basis to ensure compliance with DWS standards.

Physical parameters

Parameters	Description
Suspended solids	Suspended or floating particles in wastewater are referred to as suspended solids and include a range of particles, such as sediments, food particles, detergents and human waste. Water with a high suspended solids loading will tend to have a murky/turbid appearance, which affects light penetration and therefore also photosynthesis. Suspended solids could negatively affect filter-feeding organisms, whereas solids that settle out may smother aquatic plants and animals.
pH	This is a measure of how acidic or basic water is. Water can be acidic (below pH 7), neutral (pH 7) or basic (above pH 7). The pH of water greatly affects all organisms in waterbodies as they function best within a given range. Wastewater pH levels are predominantly affected by chemicals and detergents used by households and industries.
Conductivity	This is a measure of water's capability of passing electrical flow. This ability is directly related to the concentration of ions in water. The more ions present, the higher the conductivity of water and the higher the salinity is.

Chemical parameters

Parameters	Description
Ammonia	Ammonia is produced by interaction between bacteria and nitrogen compounds present in wastewater. This pollutant contributes to the eutrophication of receiving waters, and is toxic to both plants and animals.
Chemical oxygen demand (COD)	COD is the measure of the amount of oxygen in water that is consumed for the oxidation of organic compounds. It provides a good indication of the amount of organic pollutants in water. The oxidation of large quantities of organic matter in water results in a significant reduction in dissolved oxygen levels, which could in turn result in respiratory distress in aquatic organisms.
Orthophosphate	Orthophosphate is a readily bio-available form of phosphorus that is often found in wastewater. Detergents are a significant source of phosphates in wastewater. Phosphorus is a key pollutant of concern in receiving waters, as it contributes to eutrophication (excessive nutrient loading) and associated prolific growth of problem aquatic plants and potentially harmful algal blooms. Orthophosphate was not included in the original wastewater treatment regulations but has since been included.
Nitrates and nitrites	The presence of high levels of nitrites in waterbodies can be detrimental to aquatic organisms. It is therefore important to ensure that nitrite levels in treated wastewater are kept to regulatory standards. Nitrates in wastewater are usually a result of human sewage and industrial process waste. Nitrates and nitrites were not included in the original wastewater treatment regulations but nitrates have since been included.

Microbiological parameters

Parameters	Description
E. coli	*E. coli* is a bacterium that is commonly found in the intestines of warm-blooded animals, including humans. The presence of *E. coli* in water is indicative of pollution by faecal matter. Although *E. coli* itself is not necessarily harmful, it is often used as an indicator of the presence of other pathogenic organisms in contaminated water, and is therefore important in determining guidelines for recreational water quality.

STATE OF THE ENVIRONMENT

This State of the Environment Report reports on 23 WWTWs and three marine outfalls.

In 2009, the DWS implemented the Green Drop rating system for WWTWs based on best practice as well as required standards. This system monitors the overall performance of the country's WWTWs using numerous criteria, including the results of wastewater quality tests and the implementation of best practice in processes, maintenance, monitoring and reporting. The Green Drop rating system is also prioritised by the City's Inland and Coastal Water Quality Improvement Strategy. Since the introduction of this monitoring tool, there has been a steady increase in Green Drop status.

Overall compliance

As at July 2020, the City's wastewater plants were 81,66% compliant with DWS standards. This highlights a decline in compliance of 3,19% from 2016 (overall compliance level of 84,85%) and approximately 6,34% decline from 2015 (overall compliance level of 88%), as shown in figure 23. Achieving this level of overall compliance is based on some WWTWs receiving very high compliance results and others having low compliance with standards.

In 2018, 10 treatment works achieved an overall compliance over 90%, five sites achieved between 80% and 89%, four sites between 70% and 79%, and four sites had overall compliance levels of between 50% and 69% (figure 24). The lowest overall compliance level in 2018 was Simon's Town, with 47% (also the lowest in 2016, with 56%). Simon's Town has struggled to comply with standards for COD, ammonia, *E. coli* and nitrates/nitrites, and also scored poorly with regard to orthophosphate. Simon's Town has generally had lower compliance in the past, usually scoring between 60% and 70%. Simon's Town is a trickling filter plant, which has old treatment technology and is not designed to treat to the current regulatory standards.

The highest-scoring treatment works in 2018 was Wesfleur-Domestic, with 100% overall compliance. Wesfleur-Domestic has achieved compliance levels of over 90% since 2009.

FIGURE 23: AVERAGE COMPLIANCE OF ALL WWTWs TO DWS STANDARDS, 2009–2018

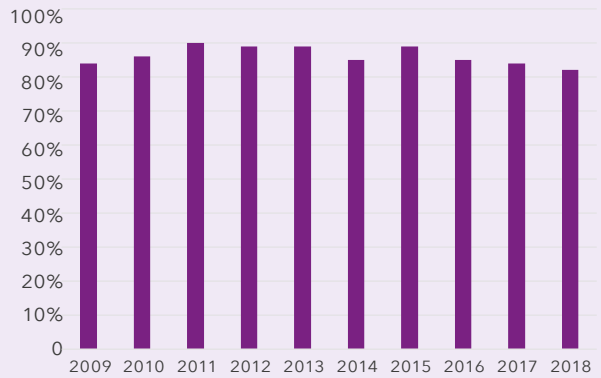
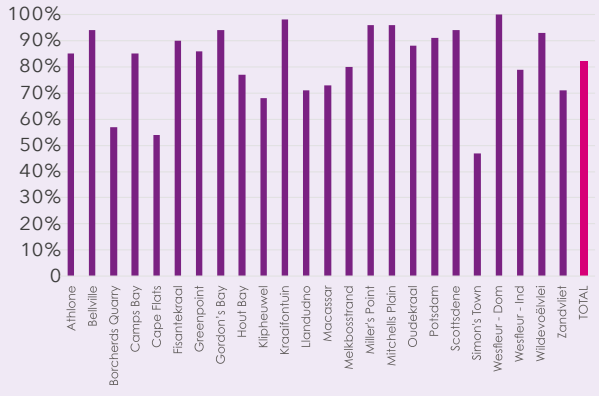


FIGURE 24: COMPLIANCE WITH DWS STANDARDS, 2018



Suspended solids

Compliance with suspended solids standards are shown in figure 25 and figure 26. Average compliance across the city was 79% in 2018, which was an improvement from the compliance achieved in 2017 (75%). Five WWTWs had full compliance of 100% in 2018: Gordon's Bay, Kraaifontein, Millers Point, Potsdam and Wesfleur – Domestic. The number of WWTWs with 100% compliance varies each year, with only a few treatment works maintaining their 100% standard over various years. The lowest-scoring WWTW in 2018 was Borcherds Quarry, with 29% compliance. The site was undergoing an upgrade during the mentioned period.

pH

Compliance with pH standards is shown in figure 27 and figure 28. Levels of pH have been acceptable over the past 10 years, with every year scoring an average of 96% and above. In 2018, 15 sites had 100% compliance.

FIGURE 25: AVERAGE COMPLIANCE OF ALL WWTWs WITH DWS STANDARDS FOR SUSPENDED SOLIDS, 2009–2018

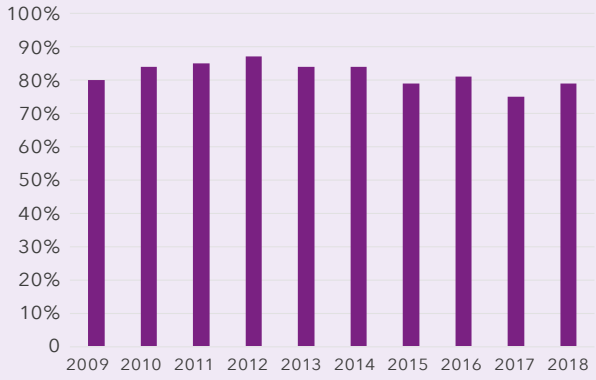


FIGURE 26: COMPLIANCE WITH DWS STANDARDS FOR SUSPENDED SOLIDS, 2018

FIGURE 27: AVERAGE COMPLIANCE OF ALL WWTWs WITH DWS STANDARDS FOR PH, 2009–2018

FIGURE 28: COMPLIANCE WITH DWS STANDARDS FOR PH, 2018

Conductivity

Compliance with conductivity standards is shown in figure 29 and figure 30. Over the past decade, average annual compliance with conductivity standards has been above 90%. In 2018, only two treatment works did not achieve compliance above 96%, namely Melkbosstrand (62%) and Wesfleur – Industrial (35%). The influent conductivity increased during the drought period and this affected the compliance for the mentioned works.

Chemical oxygen demand (COD)

Compliance with COD standards is shown in figure 31 and figure 32. Compliance has ranged between 70% and 80% over the past decade. This does not meet the standards deemed acceptable by the City, with the COD standards steadily decreasing since 2014. In 2018, 10 WWTWs achieved compliance levels above 90%, six scored between 60% and 89% and the remaining six scored below 60%.

FIGURE 29: AVERAGE COMPLIANCE OF ALL WWTWs WITH DWS STANDARDS FOR CONDUCTIVITY, 2009–2018

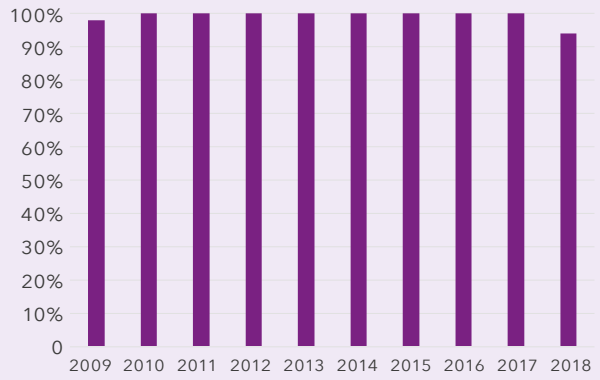


FIGURE 30: COMPLIANCE WITH DWS STANDARDS FOR CONDUCTIVITY, 2018

FIGURE 31: AVERAGE COMPLIANCE OF ALL WWTWs WITH DWS STANDARDS FOR COD, 2009–2018

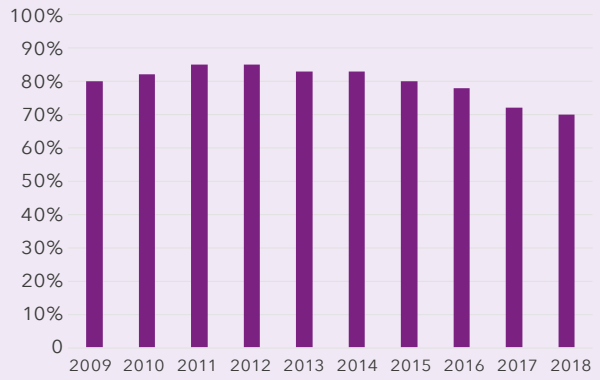
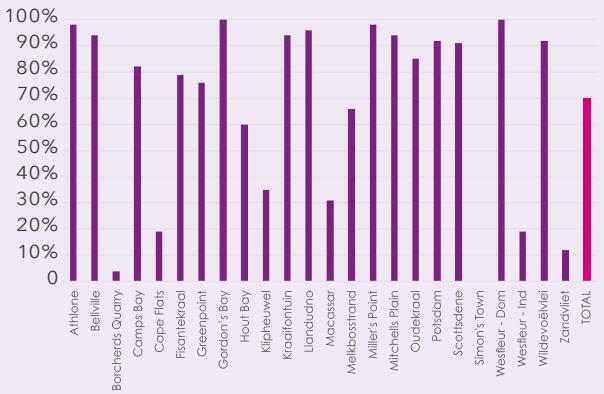


FIGURE 32: COMPLIANCE WITH DWS STANDARDS FOR COD, 2018



Ammonia

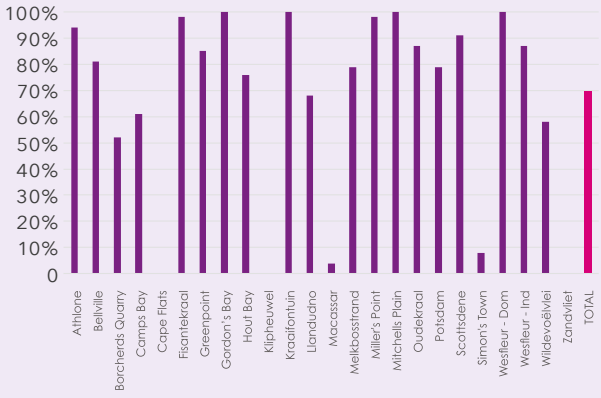
Compliance with ammonia standards is shown in figure 33 and figure 34. Cape Flats, due to infrastructure challenges, had 0% compliance; Macassar, because of organic overload, had 4% compliance; and Simon's Town, as a result of current treatment technology, had 8% compliance.

Orthophosphate

Compliance with orthophosphate targets is shown in figure 35 and figure 36. The compliance levels have been steady since 2011, with acceptable levels of above 90%. Notably, before 2011, orthophosphate compliance levels were increasing incrementally each year. In 2018, the average compliance was 91%. This encouraging

FIGURE 33: AVERAGE COMPLIANCE OF ALL WWTWs WITH DWS STANDARDS FOR AMMONIA, 2009–2018

FIGURE 34: COMPLIANCE WITH DWS STANDARDS FOR AMMONIA, 2018



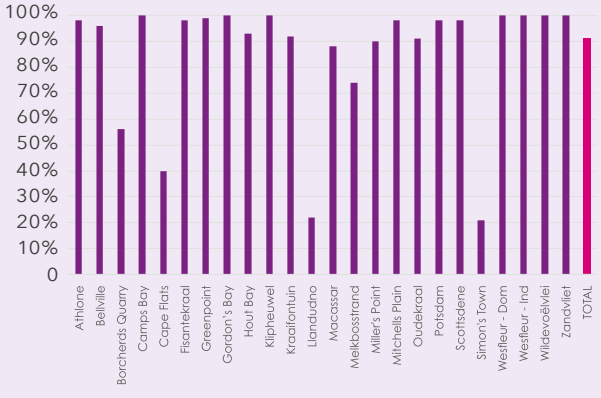
compliance standard is evident across all WWTWs, with 18 sites achieving compliance of above 90%. Simon's Town and Llandudno had the lowest compliance (21% and 22% respectively) in 2018.

Nitrates/Nitrites

Compliance with nitrate/nitrite standards is shown in figure 37 and figure 38. Compliance with these standards over the past 10 years has been relatively stable, mostly between 80% and 89%, whereas 2011 and 2015 achieved

FIGURE 35: AVERAGE COMPLIANCE OF ALL WWTWS WITH DWS STANDARDS FOR ORTHOPHOSPHATE, 2009–2018

FIGURE 36: COMPLIANCE WITH DWS STANDARDS FOR ORTHOPHOSPHATE, 2018



higher compliance levels of 89% and 88% respectively. The year 2018 had an average compliance of 78%. Simon's Town has consistently had very low compliance levels of below 10% in the past 10 years; this is due to the current treatment technology.

E. coli

Compliance with *E. coli* standards is shown in figure 39 and figure 40. The average compliance with *E. coli* standards over the past 10 years has varied. There was a notable decline in compliance levels between 2013 (79%) and 2014 (69%), with compliance increasing again in 2015 (79%) and remaining at similar levels in 2016 (79%) and 2017 (80%). In 2018, only two WWTWs achieved 100% compliance, namely Wesfleur – Domestic and Kraaifontein. The three lowest compliance levels were at Simon's Town (55%), Cape Flats (19%) and Borcherds Quarry (17%).

FIGURE 37: AVERAGE COMPLIANCE OF ALL WWTWS WITH DWS STANDARDS ON NITRATE/NITRITE, 2009–2018

FIGURE 38: COMPLIANCE WITH DWS STANDARDS FOR NITRATE/NITRITE, 2018

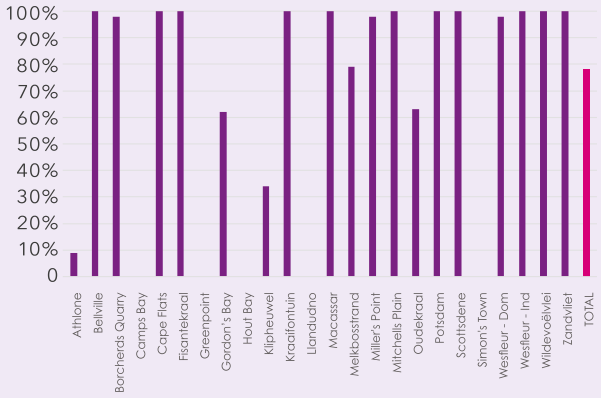


FIGURE 39: AVERAGE COMPLIANCE OF ALL WWTWS WITH DWS STANDARDS ON *E.COLI*, 2009–2018

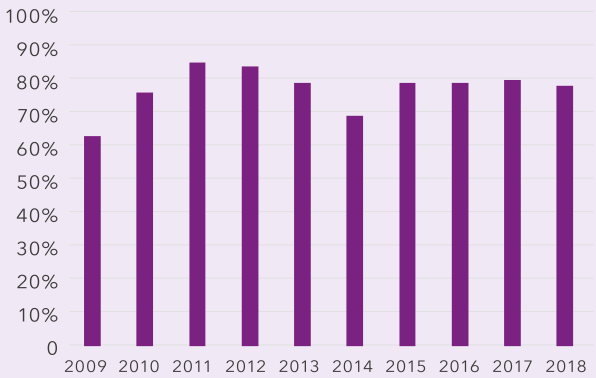
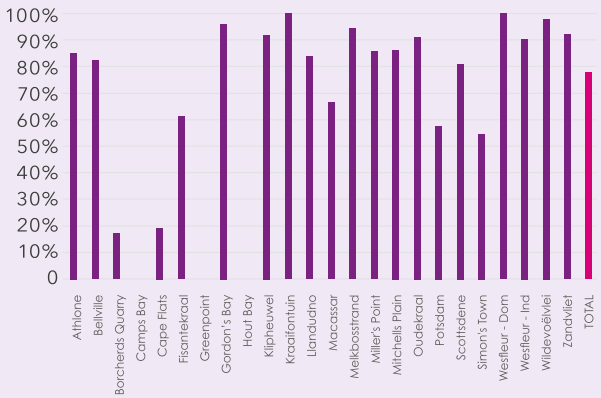


FIGURE 40: COMPLIANCE WITH DWS STANDARDS FOR *E. COLI*, 2018



KEY MANAGEMENT RESPONSES

Effluent discharged from industrial sites, and non-compliant and polluted trade effluent, has a negative impact on wastewater treatment processes. This results in poor-quality effluent being discharged into Cape Town's rivers. The City has gradually increased the size and efficiency of its inspectorate to enforce the recently consolidated and rewritten Water, Sanitation and Effluent by-laws. However, cooperation from consumers remains a challenge.

The opening of the Fisantekraal treatment works in 2012 has been an infrastructural highlight. This WWTW uses state-of-the-art ultraviolet disinfection and is a 'zero discharge' plant that enhances the reuse of water for irrigation purposes. Although Fisantekraal has the most advanced technology, there are 12 other WWTWs that are equipped to produce treated effluent suitable for reuse. These include Potsdam, Bellville, Cape Flats, Athlone, Macassar, Kraaifontein, Scottsdene, Wesfleur, Mitchells Plain, Melkbosstrand, Gordon's Bay and Parow. Water treated for reuse is used for irrigation and industrial purposes. There are more than 160 treated-effluent consumers, including schools, sports clubs, golf courses, farms, industry and commercial developments with large water features. In addition, the City uses this water for irrigating parks and flower beds along the integrated rapid transport routes.

The rehabilitation of urban waterways has been prioritised in the City's Water Strategy, and with this in mind, capital budgets have increased significantly.

As highlighted above, approximately R11 billion has been budgeted for wastewater treatment plant upgrades over the next 10 years. Eleven plants will receive capacity upgrades, and six will benefit from wastewater treatment process upgrades.

Help the treatment works

Residents, businesses and visitors can help look after the environment and treatment works in the following ways:

- Do not flush foreign matter, chemicals, toxic chemicals, paints, oils or fats down drains and toilets.
- Report illegal discharges or other by-law contraventions, including restaurants that have insufficiently maintained grease traps.
- Wipe leftover food off plates and place food scrapings in the bin or compost it – do not flush it down the drain.
- Check your property for illegal stormwater connections from the stormwater to the sewerage system – gutters and downpipes should not drain into the sewerage system, as extra rainwater can overload the sewerage system.

Public awareness videos can be found on the *CCT website.* These outline water system management, water by-laws, leak prevention and more.

TREND AND TARGET

Trend:

Average overall compliance with DWS standards has been above 80%, with a gradual decline in compliance from 2015.

Target:

Compliance with DWS standards.

Current: As at July 2020, the City's wastewater plants were 81,66% compliant with DWS standards, a slight decline from overall compliance in 2018 of 82%.

POLICY LINKAGES

- IDP 2022-2027:
  - Priority – Basic Services
  - Objective 4.1. Water and sanitation: Excellence in Water and Sanitation service delivery programme
  - Objective 4.4. Water and sanitation: Water resilience programme
- Environmental Strategy (2017):
  - Strategic Focus Area 2 – Resource Management and Efficiency
- Green Drop Audits
- Water Services Development Plan
- Water Conservation and Water Demand Management Programme/Strategy (2007, updated 2014/2015)
- Water By-law (2010) and the Water Amendment By-law (2018)
- Treated Effluent By-law (2010)
- Wastewater and Industrial Effluent By-law (2013)
- National Water Act, 1998
- Sustainable Development Goals (SDGs):
  - Goal 6: Ensure access to water and sanitation for all
- **See also:** Chapters on *Water use*, *Freshwater quality*, and *Coastal water quality*

CHAPTER 8: CLIMATE CHANGE

UNDERSTANDING CLIMATE CHANGE IN CAPE TOWN

Indicators:

- Carbon emissions by sector
- Carbon emissions by source

Carbon dioxide (CO_2) and other greenhouse gases (GHGs) are significant components of the atmosphere that help to moderate the earth's temperature by retaining heat. Life on earth is dependent on these gases, but once these levels become too high in the atmosphere, it becomes problematic. Having a high concentration of GHGs in the atmosphere causes climate change, a result of the greenhouse effect.[32]

Human activities that release carbon emissions is the leading cause of climate change.[33] Climate change is increasingly becoming more evident, causing globally and locally rising sea levels, hotter average temperatures, decreased rainfall and an increasing number of extreme weather events. These changes to our climate have caused significant economic, social and environmental impacts and are projected by climate models to become worse over time.

Globally, cities are increasingly taking action to reduce their CO_2 emissions in order to increase efficiency and resilience, and contribute to global climate change mitigation efforts. Climate change mitigation activities focus on both reducing carbon emissions, as well as improving the ability of carbon sinks – such as natural vegetation – to function and sequester carbon. Many everyday activities, such as driving and using electricity, emit carbon due to reliance on energy from the burning of fossil fuels. It is important that businesses and residents reduce their reliance on fossil fuels to help cities transition towards a carbon neutral economy.

Alongside mitigation measures, cities in South Africa and around the world are working to implement climate change adaptation measures. Climate change adaptation aims to increase the resilience of these cities to climate change impacts and ensure they are prepared for the anticipated changes in climate. These adaptation measures include, but are not limited to, the upgrading and maintenance of infrastructure (both engineered and green); protection against and response to extreme weather events; and integrated responses to the projected effects on human and ecosystem health, food systems, livelihoods and social development, biodiversity, coastal management and the economy.

Both mitigation and adaptation projects fundamentally seek to develop a more sustainable and resilient urban system. Consequently, potential positive interaction between mitigation and adaptation actions are being actively promoted and maximised in Cape Town.

The City's first City Climate Change Policy was adopted in 2017 and followed at least 20 years of programmatic work aimed at addressing the causes and impacts of climate change. The City adopted a Climate Change Strategy in May 2021, which aims to, inter alia, act as a framework to transform the way the City plans and operates, to deal with known and projected impacts, and to contribute to efforts to reduce climate change. Alongside the strategy, the City's Climate Change Action Plan was launched in October 2021. This plan recognises the need for urgent climate action to protect, promote and enhance human and ecosystem health and well-being and the urgent need for sustainable economic recovery. The plan provides a

30 A high heat day is defined as hotter than 35 °C

31 A heat wave, within the context of Cape Town, is defined as three or more days in a row of 32 °C or hotter

set of high-level actions for implementation. The strategy and action plan identify five key adaptation strategic focus areas (SFAs): One combined adaptation and mitigation SFA and four mitigation SFAs, in addition to five cross-cutting work areas (CCWAs) that will give effect to the City's vision of achieving climate resilience and carbon neutrality (figure 44). The SFAs of the strategy and action plan are:

- Urban cooling and heat responsiveness
- Water security and drought readiness
- Water sensitivity, flood readiness and storm management
- Coastal management and resilience
- Managing fire risk and responsiveness
- Spatial and resource inclusivity
- Carbon-neutral energy for work creation and economic development
- Zero-emission buildings and precincts
- Mobility for quality of life and livelihoods
- The circular waste economy

The five CCWAs include the actions needed to enable change in local government and the city as a whole and cover the areas of governance and research, the economy, finance, communication, and human and ecosystem health.

In addition to serving as the implementation plan for the Climate Change Strategy, the Climate Change Action Plan was also a deliverable of the City's commitment to the C40 Deadline 2020 programme, which aims to put cities on track to meet the goals of the Paris Agreement and achieve carbon neutrality and climate resilience by 2050. The carbon neutrality component of the Deadline 2020 commitment includes a parallel commitment to attain net zero carbon emissions from the City's own buildings (both existing and new) by 2030, for all new buildings in Cape Town by 2030 and for all existing buildings in Cape Town by 2050. These commitments, including the target to reach carbon neutrality by 2050,[34] are embedded in the City's Climate Change Strategy and Climate Change Action Plan.

A monitoring and evaluation plan for the Climate Change Strategy and Climate Change Action Plan is currently being developed and will define indicators and targets to monitor implementation progress.

STATE OF THE ENVIRONMENT

Climate change hazards, vulnerability and risks

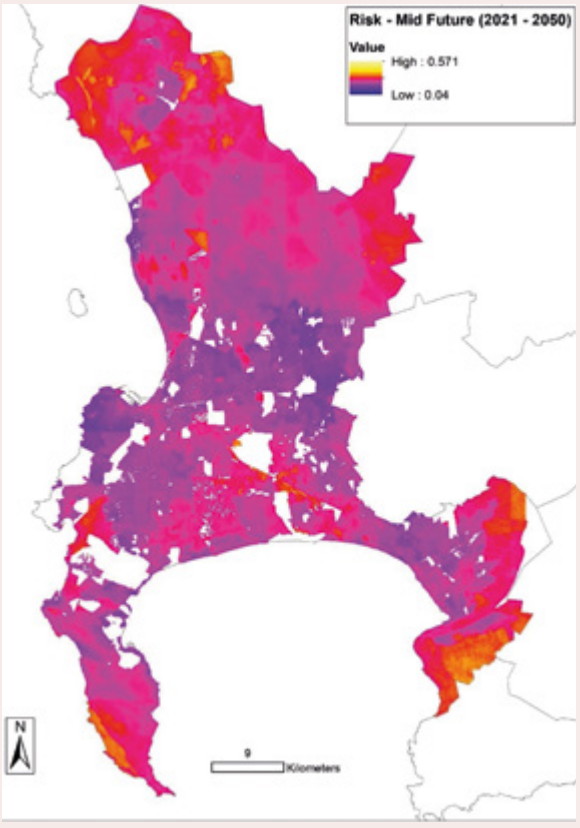
In 2018/19, the Climate Change Hazard, Vulnerability, and Risk Study was conducted for the City of Cape Town, based on a low climate change mitigation scenario, in line with current global trends. This assessment included the following components:

- Mapping of climate hazards
- Identification of areas of vulnerability (both spatially and across sectors)
- An economic risk analysis
- Identification of key risk areas (both spatially and across sectors) based on the combination of hazards and vulnerability
- A set of recommended adaptation options

The study identified six key categories of hazard that the city must adapt to,[35] namely:

1. A significant decrease in mean annual rainfall
2. Changed seasonality of rainfall
3. A significant increase in mean annual temperature and increased maximum temperatures
4. More high heat days,[30] and more frequent and intense heat waves[31]

MAP 12: CLIMATE CHANGE RISK – MID-FUTURE, 2021–2050



5. An increase in wind strength
6. A rise in mean sea level and increased coastal erosion

In general, the study found that the areas most at risk are those that experience socio-economic vulnerability and have low resilience and capacity to adapt to climate change. The hazard and vulnerability assessments were overlaid to identify key risk areas. Notably, many of the climate impacts that Cape Town currently experiences, and will experience into the future, are due to high levels of vulnerability and low levels of resilience, rather than because of particularly extreme climate hazards or events. Vulnerability is due to several factors, including physical vulnerability (i.e. geographic factors such as proximity to high-risk areas such as the coast or flood-prone areas), social vulnerability (i.e. low levels of resilience and adaptive capacity due to factors including poverty and education levels), the legacy of poor planning decisions (i.e. infrastructure or lack of services located in high-risk areas) and the adaptive capacity of local (and other spheres of) government (i.e. the ability of government to take action to address risks). Map 12 shows those areas that are most at risk as a result of a combination of exposure to climate hazards and high levels of vulnerability/low levels of resilience.

Energy consumption and carbon emissions

The City has a well-established sector-based GHG inventory to track Cape Town's carbon emissions and guide strategic planning and appropriate mitigation responses.[36] In addition to tracking emissions, the data offer valuable insights into energy supply and consumption, waste and transportation in the city. The data undergo a detailed update every five years, published in the Cape Town State of Energy Report series (the most recent being the Cape Town State of Energy and Carbon 2021 Report). Annual high-level updates (including electricity and transport liquid fuel sales and waste) are done in-between and are reported to the South African Greenhouse Gas Emissions Reporting System (SAGERS) and the global cities climate change reporting platform, the Carbon Disclosure Project (CDP).

The most recent GHG inventory is based on 2018 data and estimates Cape Town's per capita footprint to be 4,6 tonnes[32] of carbon dioxide equivalent (tCO_2e). Cape Town's carbon emissions by source and by sector are indicated in figure 41 and figure 42 respectively.[37] Figure 41 shows that the highest proportion of carbon emissions by source in Cape Town (57%) is accounted for by electricity, followed by petrol and diesel, together accounting for around 32% of emissions. Figure 42 shows that the residential and commercial sectors account for 18% and 24% of the city's carbon emissions. The road transport sector is Cape Town's largest energy consumer, accounting for 62% and 31% of the entire city's consumption and emissions respectively.[38]

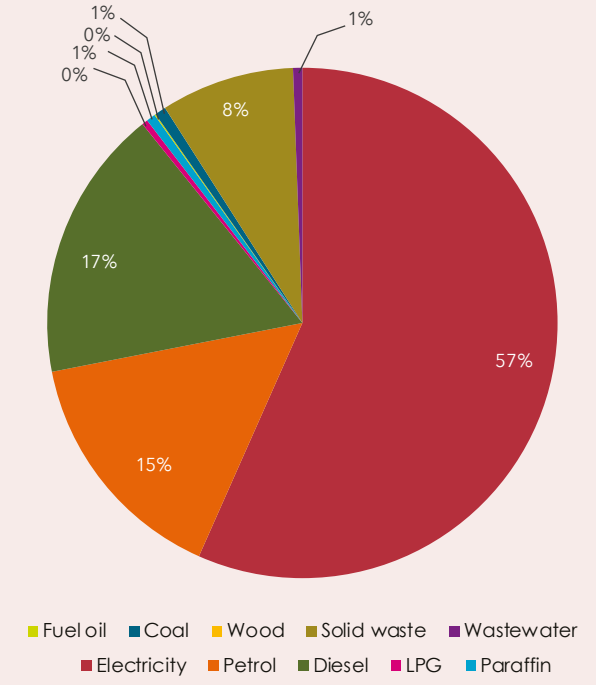
Although transport uses more energy in total, over half of the city's emissions arise from electricity use across sectors; this is due to the high carbon intensity of South Africa's coal-based grid electricity compared to the relatively lower carbon intensity of transport fuels such as petrol and diesel. For a more detailed discussion of the City's carbon footprint and the methodology used, refer to the City's Climate Change Action Plan. Additional data can be found in the *Cape Town State of Energy and Carbon Report 2021*.

The increased use of renewable electricity technologies such as wind and solar can reduce Cape Town's high electricity carbon footprint in addition to improving energy security generally, especially when supported by storage. The resumption of the national Renewable Energy Independent Power Producers Procurement Programme (REIPPPP), with the completion of its fifth bid window, promises a national shift. Recent regulatory amendments have opened up the option for the City to augment this by constructing its own assets or purchasing from independent power producers (IPPs). The City opened its IPP process in February 2022 with the first tender for bids for as much as 200 MW renewable energy.

A historical view of Cape Town's GHG inventory is presented in figure 43. The best available data indicate that total emissions are more or less stable, accounting for uncertainty in data sources. This stabilisation is attributable to a number of factors, including energy efficiency (especially evident in residential electricity demand), a changing structure of the local economy and subdued activity due to a period of low economic growth and dropping per capita incomes.

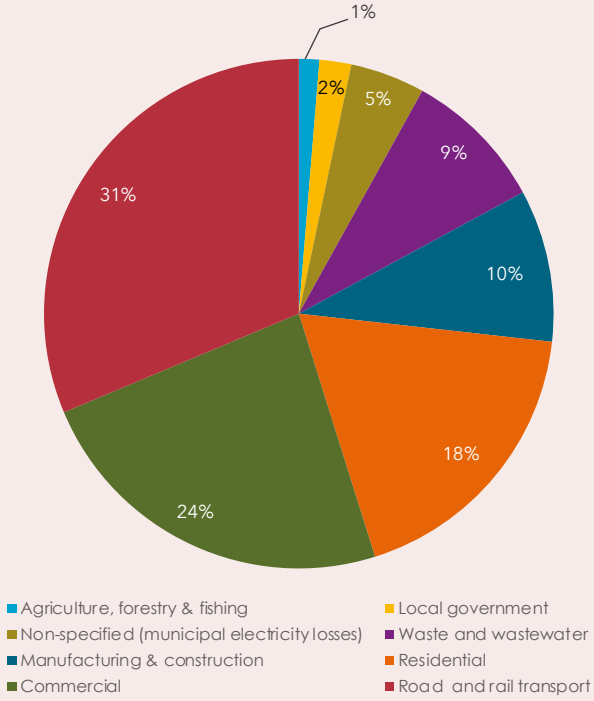
[32] BASIC emissions (scope 1 and 2) based on the City's most recent GHG inventory (2018 data year)

FIGURE 41: CARBON EMISSIONS BY SOURCE, 2018 (EXCL. MARINE AND AVIATION)



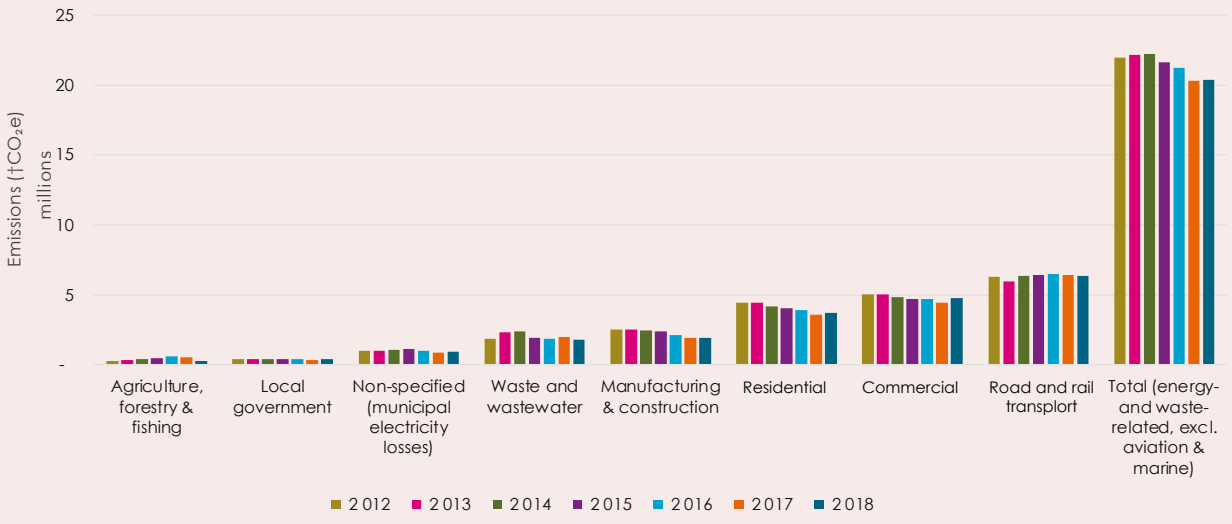
** Electricity includes electricity losses*

FIGURE 42: CARBON EMISSIONS BY SECTOR, 2018 (EXCL. MARINE AND AVIATION)



** Electricity includes electricity losses*

FIGURE 43: CITY OF CAPE TOWN EMISSIONS CONSUMPTION BY SECTOR, 2012-2018 (EXCL. MARINE AND AVIATION)



KEY MANAGEMENT RESPONSES

Climate Change Strategy and Climate Change Action Plan

The City's Climate Change Strategy (2021) aims to, inter alia, act as a framework to transform the way the City plans and operates, to deal with known and projected impacts and to contribute to efforts to reduce climate change. The strategy identifies goals within strategic focus and cross-cutting work areas that will give effect to the City's vision of achieving climate resilience and carbon neutrality. The Climate Change Action Plan further elaborates on the goals and sets out the programmes of action to address both climate change adaptation and mitigation; this will be accompanied by a monitoring, evaluation, learning and report framework,[39] which is currently under development.

Sustainable energy

The City's carbon neutral commitment requires at least 80% elimination of current emission levels by 2050 and therefore future growth needs to become carbon neutral as quickly as possible.

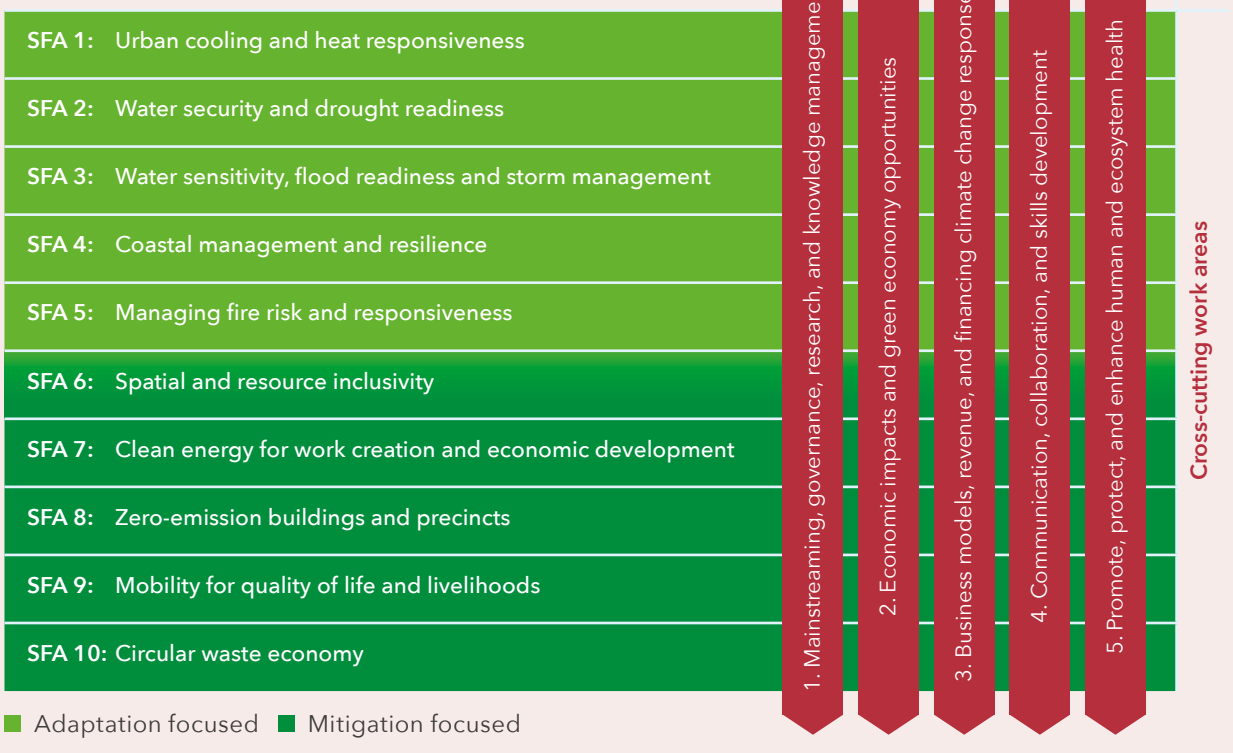
The new emission reduction scenarios present a significant ramp-up in ambition from the previous Energy 2040 Goal,[40] acknowledging the need to align with the goals of the Paris Agreement.[41] Although the City is best placed to lead, drive and enable a local carbon neutral transition, achieving city-wide carbon neutrality is not wholly within the locus of control of the City administration.

The transition therefore requires action from other stakeholders, most notably national government, national utilities like Eskom and the Passenger Rail Agency of South Africa (PRASA), the private sector and residents.

A commitment to carbon neutrality, however, would enable the City to join with other leading cities to signal a determination to take up the opportunities and long-term benefits of a sustainable, equitable and green economy. Existing programmes and projects in support of the City's sustainable energy programmes and ramping up its climate action commitments include:

- Energy strategy: A fundamental shift in the municipal energy utility is required to ensure energy security as a key input for long-term and sustained economic growth and competitiveness, along with a sustainable power utility. In response, the City of Cape Town is developing a new, long-term energy strategy with a wide-reaching scope to ensure a cost-effective and cohesive approach to overcoming the challenges and taking hold of the opportunities of the energy transition currently under way. This includes a focus on energy security, power utility reform, investment in the distribution grid of the future, using energy efficiently and alleviating energy poverty. Importantly, all these focus areas work together to create a strong foundation for economic growth to create jobs and alleviate poverty in the city. Developing an energy strategy is one

FIGURE 44: OVERVIEW OF CLIMATE CHANGE STRATEGY SFAs AND CCWA



of the four focus areas for the Energy Security for Economic Growth Programme, which has been listed as a mayoral priority programme. The aim is to have the energy strategy approved by end 2022/23 and develop an accompanying implementation plan.

- Improvements in energy efficiency and the introduction of renewables in municipal operations.
- Promoting and administering the uptake of renewable small-scale embedded generation (SSEG).[33] The City has taken steps to enable renewable energy use by residents and businesses. In recent years, Cape Town has seen an increase in the number of rooftop photovoltaic (PV) installations. In the absence of national legislation regarding SSEG at the time, the City developed a set of standards and regulations for the connection of small renewable energy systems, particularly rooftop solar PV, to the municipal grid. These have been incorporated into the drafting of national legislation and strongly promote transparent processes. By the end of June 2021, 1 320 residential and 343 commercial and industrial grid-tied PV systems had been commissioned. This represents an embedded generation capacity of approximately 60,4 MVA. Notably, there has been a rapid increase in the number of approved off-grid residential systems.

  A major challenge in this environment is that many customers are illegally connecting to the network without prior approval from the City. A City by-law requires SSEG systems to be registered, and grid-tied installations to comply with the criteria for registration. Non-compliant systems create safety risks and legal challenges for network operators, infrastructure, home owners and the City itself. An awareness campaign was therefore launched in July 2018 to educate customers about the need to register their systems, and the implications of unauthorised systems on the network. The registration process was communicated to citizens through social media, rates bill inserts and an online video. This communication campaign will continue as needed through digital and print media as well as informational events with installers. To learn more about PV basic concepts, how to link up to the electricity grid, cost and insurance, and how to install PV in your home, visit *savingelectricity.org.za*, a City of Cape Town website that addresses energy efficiency and renewable energy.
- Data management tools: SmartFacility, an integrated and automated resource data management system for City facilities, was launched in November 2018, with approximately 1 119 smart electricity meters installed in 860 municipal facilities (as at end June 2021).
- Exploring the purchase of renewable energy directly from IPPs. At the end of 2021, a new administration took office with a strong set of 'mayoral priorities' of which the foremost was 'end load-shedding over time'. This has accelerated some of the energy actions, particularly the procurement of supply from IPPs. The first tender for bids for as much as 200 MW of renewable energy was published in February 2022. This investigates new enabling technologies and fuel options for the future, including utility-scale storage and electric vehicles.
- A net zero carbon buildings programme as part of the City's participation in the C40 Cites South Africa Buildings Programme.
- Waste-to-energy processes: The City has a registered PoA (Programme of Activities) under the United Nations Framework Convention on Climate Change (UNFCCC) Clean Development Mechanism (CDM) for emission reduction of landfill gas at its active and closed disposal facilities.
- Sharing Knowledge on Energy Efficiency, Renewable Energy and Sustainable Living: In order to support resource efficiency and sustainable living, the City runs relevant communications campaigns and partnership platforms, and develops public resources. Guided by the findings of a climate change perception study, in March 2021 the City launched its new climate change communications campaign – 'Let's ACT. For a stronger Cape Town'. The campaign will act as the umbrella campaign for all the City's projects and communications in support of the carbon neutral 2050 commitment, with the aim of enabling and supporting both residents and businesses to take action for a stronger, healthier city that is resilient to a future changing climate.

  The Cape Town Energy Water Waste (EWW) Forum, a partnership running since 2009 for Cape Town's commercial sector, promotes resource efficiency in commercial buildings and operations. The commercial sector consumes a significant portion of the city's energy and, as a result, is a key target in the drive to reduce carbon emissions. The EWW Forum is a collaboration between the Sustainable Energy Markets, Solid Waste Management and Water departments and forum members, owners and managers of commercial buildings, energy efficiency-related service providers, policymakers and other stakeholders who share practical knowledge and support. Recently, the forum has been focusing on disruptive technologies in the energy sector, and the challenges and opportunities in the water sector, in addition to finding innovative solutions to waste stream challenges.

  Between May 2020 and January 2021, the City hosted the *Cape Town Future Energy Festival*. This series of fun, family-friendly virtual event experiences was

[33] The City has developed a set of standards and regulations for the connection of small renewable energy systems, particularly rooftop solar PV, to the municipal grid. By the end of June 2021, 1 320 residential and 343 commercial and industrial PV systems approved by the City had been commissioned. This represents an embedded generation capacity of 60,4 MVA.

designed to include citizens in their city's future energy story. The festival aimed to spark conversations on climate action, energy efficiency, solar and wind power, water and waste efficiency, smart transport and sustainable living. Owing to the Covid-19 pandemic and subsequent lockdown, the festival was mostly held as a series of virtual events. It also included the launch of the My Clean Green Home Pop-up, an exhibit of a net zero carbon home designed to demonstrate to the public sustainable design principles, technologies and behaviours, and to show that net zero carbon houses are feasible, accessible and can be achieved by residents of Cape Town.

The City also runs the Winter Savings Campaign. This is primarily a social media campaign targeting residential and commercial consumers and aims to reduce electricity consumption through a wide range of behavioural and technological changes. The campaign started with a focus on no-cost and low-cost advice, and thereafter moved to invest-to-save options, particularly promoting the use of rooftop solar PV, solar water heaters and heat pumps.

TREND AND TARGET

Trend:

The city's carbon footprint still remains relatively high at 4,6 tCO_2e per capita[34] (2018), mainly due to its dependence on coal-intensive grid electricity and fossil fuel-based transport. However, the city's total emissions are stable, which seems to be a combination of energy efficiency (especially evident in residential electricity demand) and subdued activity due to a period of low economic growth and dropping per capita incomes. Furthermore, energy consumption is steadily decreasing,[35] along with per capita electricity use. Notably, the electricity intensity of the city's economic output dropped steadily at an average of 2,7% per annum from 59,1 (kWh/2010 ZAR [1000] GDP) in 2003 to 38,2 (kWh/2010 ZAR [1000] GDP) in 2019, a total drop of over 35%.

Target:

The City's Climate Change Strategy and its commitment to the global C40 Deadline 2020 programme commits the City to achieving carbon neutrality and climate resilience by 2050. A parallel commitment is to attain net zero carbon emissions from the City's own buildings (both existing and new) by 2030, for all new buildings in Cape Town by 2030 and for all existing buildings in Cape Town by 2050.

Current: Cape Town's per capita carbon footprint is estimated to be 4,6 tCO_2e for 2018.[42]

Future: Continued implementation and monitoring of the Climate Change Strategy and Action Plan, refining or developing new targets where necessary, including targets focused on adaptation.

POLICY LINKAGES

- IDP 2022-2027:
  - Foundation – A Resilient City
  - Objective 14: A resilient city – Climate change programme
  - Objective 4.4. Water and sanitation: Water resilience programme
  - Objective 3.1. Diversified energy supply programme
  - Objective 3.2. Energy demand response programme
- Environmental Strategy (2017):
  - Cross-cutting Theme 4 – Climate Change
- Climate Change Strategy (2021)
- Climate Change Action Plan (2021)
- Resilience Strategy (2019)
- Water Strategy (2019)
- Inclusive Economic Growth Strategy (2021)
- Municipal Spatial Development Framework (2018)
- Municipal Disaster Risk Management Plan (2015)
- Transit-Oriented Development (TOD) Strategic Framework (2016)
- Sustainable Development Goals (SDGs):
  - Goal 11: Make cities inclusive, safe, resilient and sustainable
  - Goal 13: Climate action
- **See also:** Chapters on *Water use*, and *Biodiversity*

[34] BASIC emissions (scope 1 and 2) based on the City's most recent GHG inventory (2018 data year)

[35] Additional data has enabled an update from previous reports to include a longer time series and electricity sales in the Eskom supply area

CHAPTER 9: AIR QUALITY

UNDERSTANDING CAPE TOWN'S AIR QUALITY

Indicators:

- Percentage compliance with National Ambient Air Quality Standards (NAAQS)
- Metropolitan Air Quality Index
- Annual number of days with GOOD air quality: Circular 88 – ENV 1.1
- Percentage of atmospheric emission licences (AELs) processed within prescribed guideline timeframes: Circular 88 – ENV 1.11
- Percentage of air quality monitoring stations providing adequate data over a reporting year: Circular 88 – ENV 1.12
- Number of days where $PM_{2.5}$ levels exceeded guideline levels: Circular 88 – ENV 1.2
- Number of diesel vehicles tested daily by diesel vehicle testing officers of the City Health Department SDBIP

The right to clean air is a basic human right. The quality of air is a key factor affecting the health of a city as air pollution represents a major health risk to residents.

Air pollution is broadly defined as any change in the environment that is caused by substances emitted into the atmosphere from any activity. This change can have a negative effect on human health or well-being, or on the composition, resilience and productivity of natural or managed ecosystems.

Three main types of air pollutant[36] are measured and reported on by the City of Cape Town, namely:

- Nitrogen dioxide (NO_2)
- Sulphur dioxide (SO_2)
- Particulate matter (PM_{10})

Nitrogen dioxide, a brownish-coloured gas, is mainly produced as a result of burning fossil fuels. Some NO_2 is found naturally in the atmosphere and is produced by lightning, plants, soil and water. In Cape Town, motor vehicle emissions and the burning of industrial and domestic fossil fuels are sources of NO_2. Human health is affected by NO_2, with increased likelihood of respiratory problems due to the air pollutant inflaming the lining of the lungs and reducing immunity to lung infections. Wheezing, coughing, colds, flu and bronchitis can be a result of this. Children with asthma and older people with heart disease are most at risk.

Sulphur dioxide, a strong-smelling pollutant, is emitted predominantly by coal-fired power stations. Diesel engines are also significant sources of SO_2. Industrial activities that process materials containing sulphur are additional contributors. In Cape Town, the primary source of SO_2 is from vehicle emissions and industrial activities. Sulphur dioxide irritates the nose, throat and airways, causing coughing, wheezing, shortness of breath or a tight feeling around the chest. People with asthma or similar conditions are most at risk.

Particulate matter consists of tiny particles in the air, such as soot, dust, smoke, pollen, ash, aerosols and droplets of liquid. Particulate matter refers to particulates that are smaller than 10 microns in size. The most common sources of PM_{10} in Cape Town are emissions from diesel vehicles, the burning of wood and fuel, and dust from construction activities and unpaved roads and verges. The small size of

[36] Additional criteria pollutants are also monitored, including ozone, carbon monoxide (CO), benzene and fine particulate matter ($PM_{2.5}$)

[37] A global disclosure system where countries, regions and cities disclose the CDP on an annual basis

PM_{10} particles enables the matter to be inhaled easily by humans. The constant inhaling of PM_{10} may adversely affect human health through lung irritation and aggravate lung disorders and diseases such as asthma and tuberculosis. Cardiovascular problems are also linked to PM_{10} inhalation.

Standards and guidelines

The indicator the City uses in relation to air quality is the percentage of compliance with the NAAQS, promulgated in terms of the National Environmental Management: Air Quality Act, 2004 (NEMAQA). The NAAQS were set using epidemiological studies on the impacts of air pollution on human health. An estimate of air pollution exposure for a community can be determined by comparing the monitored ambient air quality against national standards. If the measured ambient concentrations of pollutants exceed national standards, it is indicative of possible health risks and impacts. Consequently, ensuring the enforcement and compliance of industries with the prescribed minimum emission standards for Listed Activities, in terms of NEMAQA, is a major contributor towards achieving the prescribed Ambient Air Quality Standards.

Continuous ambient air quality monitoring and analysis is undertaken[43] in Cape Town at 13 strategically located air quality monitoring stations.[44] Measured concentrations of ambient air pollutants are recorded as one-minute averages. The criteria for air pollutants[45] are compared to the National Ambient Air Quality Standards[46] for compliance purposes.

The NAAQS set out limits of acceptable levels of pollutants permitted in ambient air as are outlined in table 10. All municipalities are required to meet these national standards by developing and implementing air quality management plans (AQMPs). The aim of AQMP is to improve ambient air quality, thus decreasing environmental and human health risks.

The City's Scientific Services Air Quality Monitoring Labs report monthly on the monitored averages of the various pollutants.[37] Table 10 shows the annual average concentrations for the three main criteria pollutants with gazetted annual average Ambient Air Quality Standards, for comparison purposes. Only monitoring stations with data recovery rates above 60% are reported on and the information supplied to the National State of Air Report.[47]

TABLE 10: CITY OF CAPE TOWN AIR QUALITY INDEX AND ANNUAL AVERAGE CONCENTRATIONS

	Index level	Risk	SO_2 concentration range [µg/m³]	$PM_{2.5}$ concentration range [µg/m³]	PM_{10} concentration range [µg/m³]	NO_2 concentration range [µg/m³]
Ambient air quality standard	Good	Low	4 µg/m³	9 µg/m³	20 µg/m³	10 µg/m³
Prescribed annual average			50 µg/m³	20 µg/m³	40 µg/m³	40 µg/m³

Source: City of Cape Town Scientific Services for the 2019 calendar year

STATE OF THE ENVIRONMENT

Owing to air pollution being seasonal, localised, and significantly fluctuating at each site, general air quality trends are difficult to determine. Figure 45 and figure 46 highlight the NO_2 and SO_2 air quality trends in Cape Town between 2010 and 2020. Figure 47 highlights the PM_{10} air quality trends between 2010 and 2020 as the South African PM_{10} standards were officially adopted in 2009. Air quality in most areas has met the NAAQS apart from minor exceedances due to extenuating circumstances, such as sporadic localised bush fires and traffic congestion due to lengthy road upgrades.

NO2

Nitrogen dioxide pollution has generally decreased over the years. Significantly, all sites have monitored NO_2 levels below the South African standards over the past 11 years. The most significant decreasing trends in NO_2 averages were experienced at Goodwood. Khayelitsha also experienced a significant decrease in NO_2 levels in 2016, compared to 2014 when a significant spike occurred in 2017. Since 2019, the City of Cape Town's Oxides of Nitrogen data capture percentages were severely affected due to ageing instruments and equipment. Regrettably,

the City Hall monitoring station has been decommissioned due to facility upgrades, which displaced the monitoring station.

SO2

Sulphur dioxide levels in the city are generally low and considerably below the legislated South African Ambient Air Quality Standards. Most ambient monitoring sites have measured similar trends throughout the past 11 years, with discrepancies occurring every few years. Wallacedene has had the largest variances in SO_2 levels since 2019, significantly deviating from the overall trend in 2018. The Wallacedene spike could be attributed to vehicle emissions in close proximity to the station. The Wallacedene Air Quality Monitoring Station is located on premises where vehicles are subject to start-up in the morning and left to idle for significant periods, potentially causing data spikes. In addition, instrument malfunction could have also played a role in the recording of higher SO_2 levels.

Generally, SO_2 levels have experienced a downward trend over the past 11 years. This is a result of the introduction of mandatory lower sulphur content in diesel fuels, which decreased from 5 000 ppm to 500 ppm, with 50 ppm being readily available for consumers to use. It is important to note that even if industry is not situated directly next to the ambient monitoring site, the transboundary nature of air pollution can have an impact on a large geographical area.

PM_{10}

Particulate matter levels in Cape Town have generally been lower than that required by both the 2009–2014 interim standard and the 2015 standard. However, PM_{10} pollution has been observed to have considerably increased at most sites in recent years. Khayelitsha is the only ambient air quality monitoring site to not meet the latest 2015 South African standards in 2019 and previous years. The exceedances are attributed to the informal trading sector, which burns wood for cooking and heating purposes in close proximity to the Khayelitsha Air Quality Monitoring Station and the surrounding area. In 2015, Khayelitsha had the lowest recording of PM_{10} in the past 12 years, meeting both the 2009–2014 interim standard and the 2015 standard. This recording is significantly lower than other years at the site, but is still the highest recording site in 2015. The Khayelitsha, Wallacedene and Foreshore ambient monitoring site has recorded a considerable decrease in PM_{10} since 2009, with increases only experienced again in 2015–2020. Wallacedene and Khayelitsha experienced significant increases in PM_{10} pollution in 2016–2020. These trends could be attributed to a number of factors, which could include the proximity of the monitoring site to vehicular traffic, informal trading and a possible infrastructural development.

There are multiple factors affecting air quality around Cape Town. These are all context specific and may be attributed to many social, economic and environmental factors. The City recognises that ongoing urban infrastructure improvements, including road work, and infrastructure and property development, will have a positive impact on localised exceedances and human health, as unpaved roads and pavements contribute to high concentrations of particulate matter in windy weather. Industry and traffic also play significant roles in contributing to air pollution. Furthermore, energy costs and the presence of non-electrified households further exacerbate localised exceedances as households are forced to burn wood or paraffin for heating and cooking. The burning of tyres and other waste material, as well as veld fires, also contribute to air quality exceedances.

FIGURE 45: ANNUAL NO_2 AVERAGES, 2010–2020

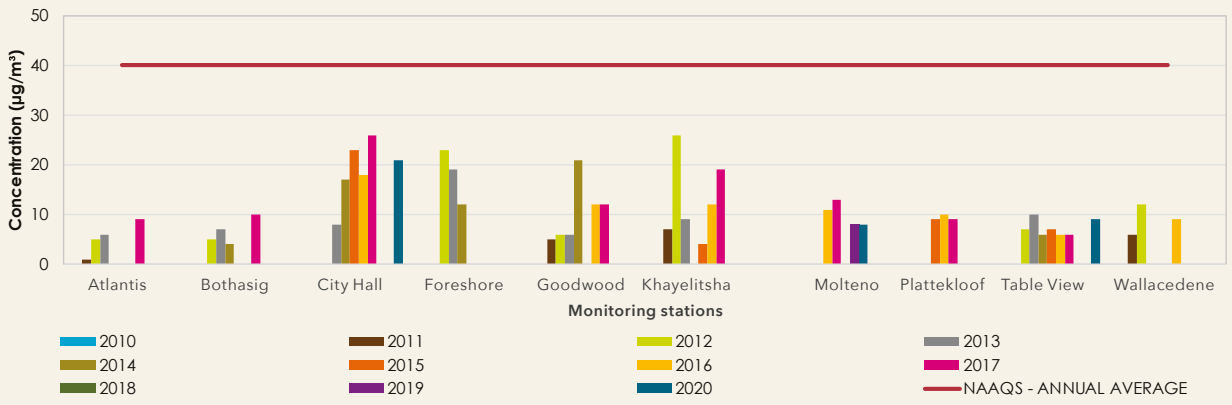


FIGURE 46: ANNUAL SO_2 AVERAGES, 2010–2020

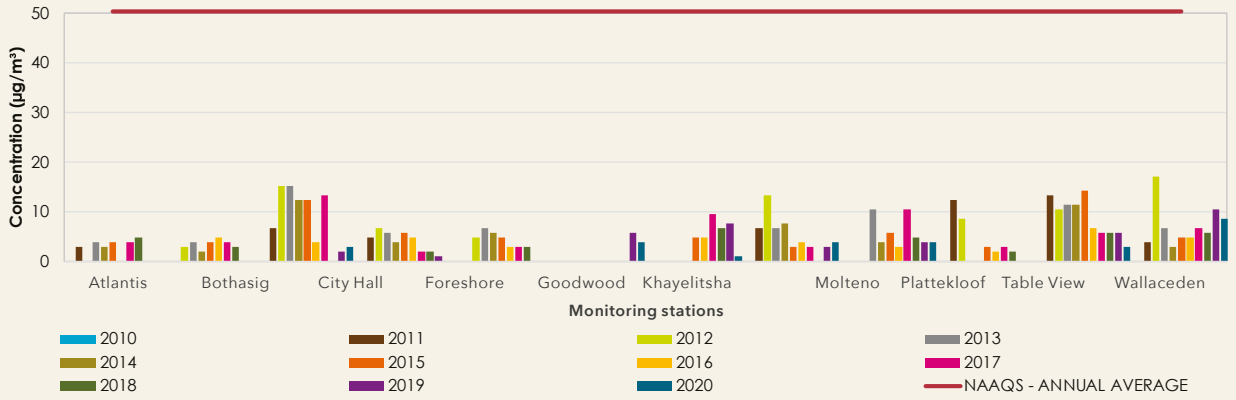
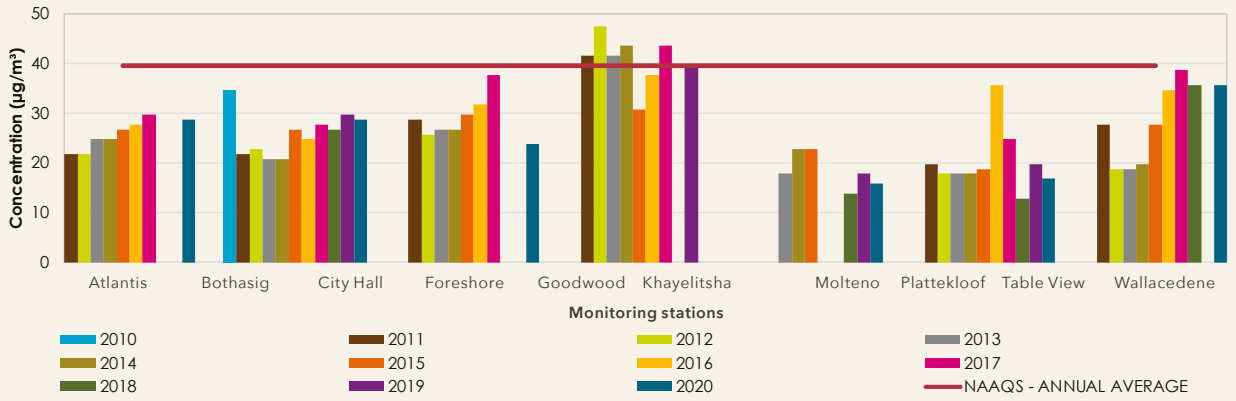


FIGURE 47: ANNUAL PM_{10} AVERAGES, 2010–2020



KEY MANAGEMENT RESPONSES

In order to improve air quality, the City developed an AQMP (2005) and promulgated the City's Air Quality Management By-law, 2010 (amended in 2016). The AQMP includes a number of goals to improve air quality in Cape Town, including formulating an air quality management system, specifying air quality standards, prioritising specific pollutants, improving air quality in informal areas and enforcing the Air Quality Management By-law, 2010.

In order to improve air quality in Cape Town and surrounds, the City, within its mandate, has legislated the control and monitoring of air quality through the use of by-laws and management plans.

The AQMP was approved and implemented in 2005. This plan aims to ensure that clean air is achieved and maintained in the city over a period of 10 to 20 years. The primary mission of the AQMP is to reduce the health effects of poor air quality on the citizens of Cape Town. In order to reduce the health effects of poor air quality, a number of goals are outlined in the AQMP, and include but are not limited to, formulating an air quality management system, specifying air quality standards, prioritising specific pollutants, improving air quality in informal areas, and enforcing current and future regulations.

A full list of objectives and actions are contained in the AQMP, which has been reviewed and will be submitted to Council for adoption in the new term of office. This action plan has resulted in a number of area-specific action plans and the formulation of the Air Quality Management By-law in 2010 (which was amended in 2016 and again in 2021).

The by-law was formulated and implemented as an outcome of the AQMP. This legislation was drafted with the aim of enforcing the strict regulations, standards and compliance monitoring systems set by national government in the context of Cape Town, in addition to enforcing the City's own local government mandate.

The Air Quality Management By-law sets out reasonable measures to prevent air pollution for any persons within the

city. It designates the powers of the air quality officer and sets local emission standards and smoke-control standards (including dwellings, non-dwellings and vehicles). The enforcement of this legislation is done through continuous compliance, enforcement and monitoring action. It encompasses other legal checks and balances, such as setting standards and specifications on fuel-burning equipment, identifying and prioritising substances emitted that present a threat to public and environmental health, open-burning approvals and notices for contraventions.

Air quality has improved across the city through cross-sectoral and departmental work and ongoing efforts to 'clean and green' areas, pave previously unpaved roads and improve infrastructure development.

TREND AND TARGET

Trend:

In general, NO_2 levels have decreased over the past 12 years. They are generally within the guidelines standard, apart from the Cape Town Central Business District (CBD). Sulphur dioxide levels have maintained low trends over the past 12 years, keeping within the guideline standards, with discrepancies occurring every few years. However, PM_{10} levels are more problematic and have considerably increased at most sites over the years.

In this regard, the impact of rapid urbanisation is playing a significant role.

Target:

Full compliance with SA Ambient Air Quality Standards.

Current: All sites meet NAAQS for NO_2 and SO_2; however, some sites have not complied with the PM_{10} NAAQS.

POLICY LINKAGES

- IDP 2022-2027:
  - Priority – Public space, environment and amenities
  - Objective 9 - Healthy and sustainable environment
- Environmental Strategy (2017):
  - Strategic Focus Area 3 – Environmental Quality Management and Monitoring
- AQMP: An integrated plan for managing air quality and reducing air pollution in the city
- Air Quality Management By-law (2016)
- Air Quality Monitoring Network
- National Environmental Management: Air Quality Act, 2004
- Sustainable Development Goals (SDGs):
  - Goal 3: Ensure healthy lives and promote well-being for all at all ages
  - Goal 12: Ensure sustainable consumption and production patterns
- **See also:** Chapter on *Climate change*

CHAPTER 10: SOLID WASTE

UNDERSTANDING SOLID WASTE IN CAPE TOWN

Indicators:

- 1 645 143 tonnes of waste managed[38]
- 1 087 670 tonnes of waste disposed
- 247 495 tonnes of waste diverted from landfill through City waste minimisation programmes
- Formal properties have 100% and informal structures have 99,79% access to basic refuse removal services or better: Circular 88 – ENV 3.1
- 99,79% of known informal settlements receiving basic refuse removal services: Circular 88 – ENV 3.11

Cities are challenged with increasing amounts of waste and the associated environmental consequences. Globally, solid waste generation rates are rapidly increasing and are projected to exceed 11 million tonnes generated globally per day by 2100. Experts believe that this growth will eventually peak and begin to decline in different global regions at different times. This depends on population growth, waste reduction efforts and changes in consumption.[48] Accordingly, responsible waste management is fundamental in ensuring the sustainability of cities worldwide. More sustainable and integrated waste management practices are vital in order to mitigate pressures on environmental and human health. Waste materials have the potential to be extremely useful resources, if used in effective and innovative ways.

Cape Town's landfills have been placed under increasing pressure in the past years and the City's landfill airspace is rapidly dwindling. The City further continues to face challenges related to littering, illegal dumping and waste in informal settlements.

Definition of waste

The National Environmental Management: Waste Act, 2008 defines waste as 'any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be reused, recycled or recovered'.

Solid waste consists of waste products generated by households, businesses and industry and includes general waste (garden waste and builders' rubble) and hazardous waste. Waste is classified into the following broad categories:

- General waste: Waste that does not pose an immediate hazard or threat to health or the environment, and includes domestic waste, building and demolition waste, and business waste
- Hazardous waste: Any waste that contains organic or inorganic elements or compounds that may, owing to its inherent physical, chemical or toxicological characteristics, have a detrimental impact on health and the environment; for example, medical waste, batteries, pesticides and chemicals

Waste management in Cape Town

Municipalities are responsible for ensuring that public areas are clean and that basic waste collection and disposal services are provided. They are also responsible for enabling the diversion of waste from landfill where possible, and managing and minimising the negative impacts of waste on human and environmental health.

[38] All indicators use City of Cape Town facilities and programmes' tonnage only. Private sector waste sites and programmes are excluded from this report

The City of Cape Town is a leading municipality in the integration of sustainable waste management. The City's goal is to improve access to basic waste management services, cleaning, collection and disposal, while significantly diverting waste from landfill.[49]

The City's Solid Waste Management Department provides all formal properties and 99,79% of known informal settlements with access to a basic refuse collection service. The City's waste management services include:

- Cleansing
- Waste collection and disposal
- Waste minimisation
- Education and awareness
- Regulatory services

To guide better delivery of waste management services to residents, the City has developed an Integrated Waste Management Plan (IWMP) to implement the Integrated Waste Management Policy (CCT-IWMP) within the overarching IDP. This ensures that integrated waste management is a priority on the agenda of local government. This policy and plan make provisions for key actions to be taken to ensure waste minimisation. The CCT-IWMP prioritises a variety of methods to achieve waste minimisation and sets ambitious waste minimisation targets for the city, such as:

- The provision of new infrastructure
- Educational programmes
- Public and private sector participation
- The facilitation of a working recycling market, job creation and implementation of waste minimisation legislation

The City enforces the sustainable waste management principles outlined in the IWMP and the CCT-IWMP through the Integrated Waste Management by-law that was promulgated in 2009. The by-law sets out a process that regulates and controls waste to ensure that environmental resources are not adversely affected by waste. It was amended in 2010 and 2016 to include further control of waste management by specifying that littering, dumping, spilling and leaking hazardous waste is an offence and provides for impounding vehicles involved in illegal waste management activities and defining the ownership of waste.

The City's waste management facilities include:

- 27 drop-off sites including two household hazardous waste drop-off sites (Athlone and Bellville)
- Two landfill sites (with drop-offs) (Vissershok and Coastal Park)
- Nine closed and rehabilitated landfill sites
- Seven landfill sites currently under rehabilitation
- One closed landfill site to be rehabilitated; contract procurement under way (Bellville)
- Two integrated waste management facilities including transfer stations (Bellville and Kraaifontein) and two stand-alone transfer stations
- Two refuse transfer stations (Athlone and Swartklip)
- One compost plant (Bellville)

The waste types accepted at drop-off sites include garage waste (used batteries, oil paint and brushes), clean garden waste, clean builders' rubble, recyclable material and bulky waste.

Key solid waste statistics for Cape Town are highlighted in table 11.

TABLE 11: CAPE TOWN SOLID WASTE STATISTICS 2019/20, UPDATED WITH 2020/21 DATA WHERE AVAILABLE

Number of wheelie bins	± 850 000
Number of wheelie bins collected per day, including multiple removal frequencies	± 190 000
Waste managed per year	± 1,65 million tonnes (2019)
	± 1,45 million tonnes (2020)
	± 1,64 million tonnes (2021)
Waste diverted per year	± 216 000 tonnes
Waste disposed per year	± 1,22 million tonnes (2019)
	± 1,08 million tonnes (2020)
	± 1,09 million tonnes (2021)
Builders' rubble stockpiled for future use	± 370 000 tonnes
Builders' rubble diverted from landfill per year	± 123 545 tonnes
Organic waste diverted from landfill per year	± 53 000 tonnes
Kerbside recycling programme offered to households	± 170 000
Free composting containers distributed	± 22 000

Domestic waste collected by the City is either diverted from landfill through one of the City's waste minimisation programmes or disposed of at one of the two City landfills. In some instances, this waste is initially taken to one of four transfer stations at Athlone RTS, Swartklip RTS, Bellville IWMF and Kraaifontein Integrated Waste Management Facility (IWMF). The Kraaifontein IWMF has an RTS and a materials recovery facility (MRF) where recyclable waste is separated and diverted to the recycling industry. Currently, the remainder of the waste is compacted at the transfer stations and transported to landfills via road. The City has operating licences for two open landfill sites, Coastal Park and Vissershok. The City also operates a compost plant where a percentage of the household waste is composted and sold to the public.

Coastal Park and Vissershok landfill sites are used for general waste disposal. Hazardous waste is landfilled at either a low-risk (Hh) facility or a high-risk (HH) facility, depending on the nature of the waste. Vissershok is a low-risk hazardous waste facility operated by the City. Another privately managed facility is located almost adjacent to Vissershok and deals with high-risk hazardous waste.

STATE OF THE ENVIRONMENT

Figure 48 and figure 49 show the estimated total waste managed (based on the total waste minimised through City initiatives) and disposed of at City landfill sites between 2008 and 2021. This excludes waste minimised through private sector initiatives or disposed of at private facilities. Whereas 2016 saw the highest annual waste managed between 2008 and 2021, of 2,67 million tonnes, 2020 had the lowest annual waste managed (1,44 million tonnes) during this period. Furthermore, annual waste managed in 2021 was significantly lower than waste managed in 2008 (199 million tonnes).

The total amount of waste disposed of in 2016 at City landfill sites is equal to just over 400 kg of waste disposed per person annually in Cape Town, increasing from just over 300 kg per person annually in 2015.

It is important to note that waste managed does not equal total waste disposed. Not all waste generated goes to landfills; some is reused and recycled. Increasing waste diversion from landfills is a waste management priority.

Inasmuch as the City is striving to provide 100% of households with access to waste collection services, there are still challenges experienced with the provision of waste collection services to informal and backyard dwellers. This ultimately contributes to challenges such as limited landfill site airspace and increased illegal dumping.

The situation with illegal dumping has resulted in the strengthening of the Integrated Waste Management By-law and penalties associated with the dumping of waste in the City. One of the key instruments to monitor the compliance within the City of Cape Town is the accreditation of waste service providers and generators. To date, 46 accredited waste generators and 212 waste service providers have been accredited. However, the City is still sitting with a massive number of private waste management companies who are operating and not adhering to the Integrated Waste Management By-law. The management of waste tyres, building waste and sanitary waste remains problematic waste within the City.

FIGURE 48: TOTAL WASTE MANAGED (CITY DISPOSAL FACILITIES AND WASTE MINIMISATION PROGRAMMES ONLY)

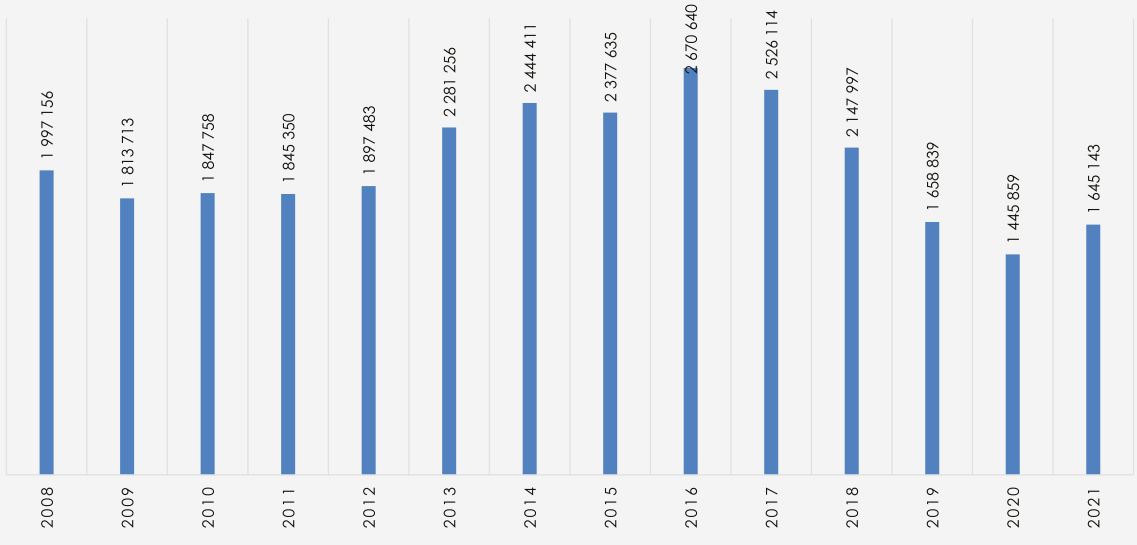
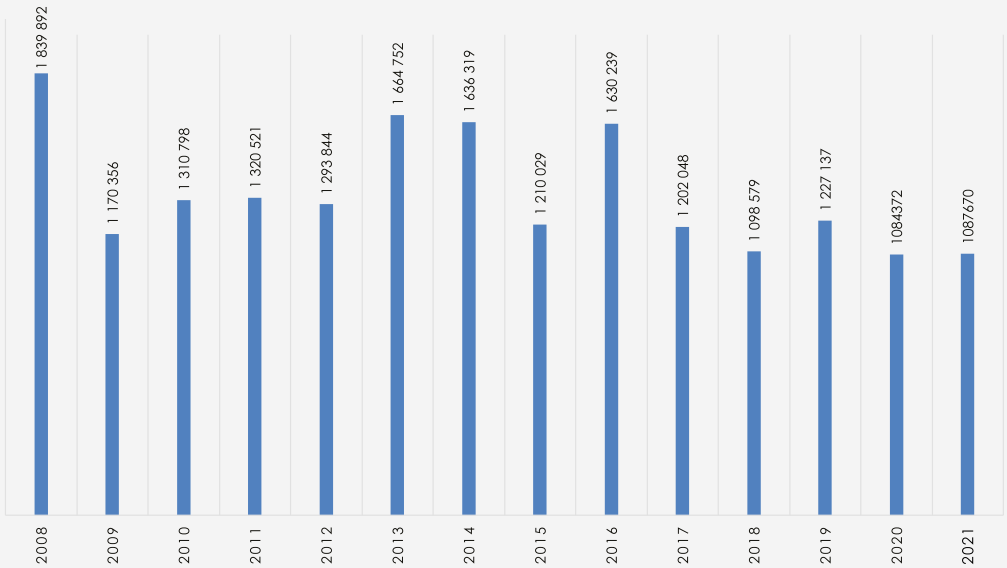


FIGURE 49: TOTAL WASTE DISPOSED (CITY LANDFILL SITES ONLY)



KEY MANAGEMENT RESPONSES

Strategic planning documents such as the IDP highlight the importance of increased recycling, along with improvements in solid waste disposal, to decrease the demand for landfill. Voluntary recycling may account for a portion of the decline in waste sent to landfill.

However, only a small percentage of Cape Town residents currently recycle their waste, and there is enormous scope for improving recycling practices. The City has a number of projects and programmes aiming to fast-track waste minimisation in Cape Town to manage waste as sustainably as possible.

In a quest to reduce the amount of waste disposed at our landfill sites, various waste minimisation projects, aligned with education and awareness, were implemented across the City. The City is also implementing waste-to-energy projects as part of the City's integrated waste management approach. These waste management projects include:

Flaring and waste-to-energy implementation

Methane is a significant contributor to global warming, which constitutes the majority of landfill gas. Landfill gas extraction and utilisation result in the reduction of methane to the atmosphere and therefore reduce its global warming impact while contributing to local and national climate change mitigation commitments. This is achieved by flaring the captured gas to destroy the GHG. Furthermore, the biogas captured can be used as fuel for industrial heating, generating electricity or as a biofuel for use in vehicles. The City has established landfill gas extraction and utilisation systems at the Coastal Park, Bellville South and Vissershok landfill sites. Currently the landfill gas is being flared and generating carbon credits as a registered CDM project under the Kyoto Protocol. Phase 2 of the project will shift to using the landfill gas to generate electricity. The gas generators have been procured and are currently being installed at the Coastal Park landfill site. Vissershok generation is currently in the design stage.

The City's current projects are designed to generate approximately 2 MW of energy, increasing to 9 MW. This energy will be used for on-site consumption and excess energy will be transferred to the City's grid.

Waste minimisation and recycling services and programmes

The City is currently planning and designing two materials recovery facilities to increase its capacity to implement waste separation at source. The construction of the Coastal Park facility is planned to start in 2021/22, while the licensing process for the Athlone facility is in progress.

The reporting period also saw the upgrading of the Retreat drop-off facility to expand its recycling area, and a similar upgrade at the Woodstock drop-off is 75% complete. Plans for a similar expansion are in place at the Killarney drop-off site and for the redevelopment of the De Grendel drop-

off site, to include a substantial recycling collection and sorting area. In addition, upgrades to the garden waste-chipping areas to include enclosed chipping sheds were completed at the Hout Bay and Kommetjie drop-offs.

A contract for the construction of a new major drop-off facility on Prince George Drive is in place and the preliminary design phase for a community-based recycling facility at Fisantekraal has been completed.

Unfortunately, the City's drop-off sites were closed to the public during the national lockdown, but a number of the large drop-offs were reopened when the lockdown eased to Level 3.

Partnering for recycling success

The City's Think Twice kerbside recycling programme is now offered to over 190 000 households across Cape Town. The programme diverted approximately 27 292 tonnes in 2020/21 and 24 234 tonnes in 2019/20 of recyclables from landfill. The City plans to expand this programme in the years ahead and has rolled out the second phase of expansion for the tender that supplies the Kraaifontein MRF. The diversion of recyclables from landfills also takes place at 27 drop-off sites across Cape Town.

To complement the above separation-at-source recycling initiatives, the City continues to partner with various initiatives, informed by extensive surveys in lower-income communities. One such partnership is with the not-for-profit industry body, Polyco, in implementing a mobile buy-back centre concept named PACKA-CHING in lower-income areas. Operating from a trailer temporarily parked on City or private land, the initiative pays residents advertised prices per recyclable material type via an e-wallet linked to users' cellphones. PACKA-CHING has been successfully running in Langa since August 2017, and is expanding to other areas with private sector partners and sponsors.

In the reporting year, the City also completed a trial of its own custom-built swop shop, a trailer where residents can swop their recyclables for tokens, which may be redeemed for groceries, clothing and similar items, all in the same trailer. The trial was completed from October to December 2020, following the previous pause in March 2020 due to the national lockdown. During the last three months of the swop shop trial, an average of 30 tonnes of recyclables per month were exchanged at the swop shop, raising the average for the entire trial to 20 tonnes per month. The main types of recyclable brought in for trade (by mass) were plastics (54%), paper and cardboard (18%), glass (15%), and metal, including cans and scrap metal (13%), with 98,7 tonnes of recyclables being diverted through this trial. The main types of recyclable brought in for trade were PET beverage bottles and rigid plastic items. Owing to the trial's success, the swop shop programme is aimed to be continued, initially by means of annual contracts with entrepreneurs to provide the services to the trial areas, but the longer-term aim is to extend and expand the service.

Recent national policy and legislation have, in late 2020, also introduced requirements for municipalities to initiate new methods of working with both the formal and informal parts of the private recycling sector to achieve increased diversion of recyclables from landfill. As a result, the City has initiated discussions with the Producer Responsibility Organisations (representing the producers of packaging waste), and representatives of the informal waste pickers, also known as reclaimers, in a bid to collaboratively work towards new ways of delivering recycling services to ensure diversion of recyclables from landfill.

Diverting waste from landfill

The diversion of organic waste from landfill has become a key national and provincial priority. In response, 13 drop-off or landfill facilities in Cape Town currently deliver a garden waste-chipping service. The chipped waste is then used for the production of compost, or as mulch for agriculture. Through this programme, over 53 077 tonnes of organic waste was diverted from landfill in 2020/21.

Unfortunately, because of the Covid-19 lockdown levels restricting City venues from being used for distribution, it was not possible to safely distribute free composting containers to residents during the reporting period so that they could compost their organic food waste at home. However, in excess of 5 000 newly designed, locally-made home composters have been procured for distribution in the next financial year.

In addition, an organic waste drop-off trial was initiated in February 2021, with the aim of trialling the willingness of residents to drop off their food waste either at one of four City drop-off facilities or at one of four 'pop-up' drop-off sites, situated at various CBD areas across the City. The main objective is to investigate the feasibility of residents bringing organic waste (fruit and vegetables, and cooked food waste) to the identified drop-offs. The residents were supplied with 5-litre plastic storage buckets and information pamphlets detailing what type of food waste is acceptable and how to handle it while temporarily storing it at home. Through this trial, over 4,25 tonnes of organic waste was diverted from landfill.

In terms of builders' rubble, the City is preparing to renew its contract for the crushing of construction and demolition waste at selected landfill sites, on an 'as and when required' basis, as the majority of the crushed material will be required for use at the landfill sites in the following years, for capital projects such as closure, capping and new landfill cell development. At the Bellville landfill, 12 535 tonnes of builders' rubble and processed material were crushed for levelling and shaping of the landfill site for the period July 2019 to March 2020. In addition, 60 000 m^3 of the builders' rubble stockpiled at the Coastal Park landfill site was used in the earthworks contract in preparation for the construction of the MRF at Coastal Park.

TABLE 12: WASTE INFRASTRUCTURE DEVELOPMENT PROJECTS

Project	Progress
Rehabilitation of: • Atlantis • Vissershok • Waterkloof • Witsand • Radnor landfill sites	Atlantis: Defects liability period has expired. The site is currently being monitored in terms of the authorisation. Vissershok: Remediation work will be ongoing for the life of the site. Waterkloof: Construction work has been completed and the defects liability period has expired. Monitoring and auditing are being executed in line with the authorisation. Witsand: Efforts to maintain the sand layer over the Witsand landfill site to continue. These include wind netting installation and repositioning. An investigation into the feasibility of re-vegetating the dune system is planned, and the results will inform the long-term approach. Radnor: Rehabilitation is currently under way. The construction design tender was awarded, but there has been an appeal.
Landfill gas infrastructure for flaring at Coastal Park landfill	The City has launched its landfill gas flaring project at Coastal Park. The system is currently in the operations and maintenance phase. The electrification tender for Coastal Park has been awarded.
Landfill gas infrastructure for flaring at Bellville landfill	Gas extraction and flaring system at Bellville South landfill is operating at reduced capacity due to vandalism and theft, although the situation has stabilised somewhat.
Landfill gas infrastructure for flaring at Vissershok landfill	Infrastructure construction phase is due to commence.
Design and development of MRF: Helderberg	During the building plan approval stage, an area on the site was identified as possible wetlands. A further EIA (basic assessment) was required and the tender process was put on hold. The EIA has now been completed and the activity authorised, but an appeal has been lodged and this needs to be resolved before a contractor can be appointed.
Drop-off infrastructure	Prince George Drive/Parkwood: The contract for the Prince George Drive/Parkwood drop-off has been awarded, and construction started early in 2021. Beaconvale: The proposed drop-off at Beaconvale had to be abandoned due to the site falling within the 100-year flood zone; De Grendel was identified as a replacement. The initial planning and site development plan for De Grendel has been completed.
Roll out and replacement of waste management fleet	The fleet capital budget for 2019/20 was R60 394 894, of which R58 919 587 was spent. Expenditure for 2019/20 was therefore 97,5%. The fleet budget for 2020/21 is R208 010 856, which includes May 2020 adjustment budgets and insurance credits.

In your household, community and business

At a household and business level, and in line with the City's recently launched Climate Change Action Plan and 'Let's ACT' campaign, the City actively encourages the minimisation of waste generation and disposal. Multiple guides and tips are available in the *Smart Living Handbook* and on the City's website on avoiding waste where possible and, where this is not an option, reusing, reducing and/or recycling waste. The City encourages the use of composting, recycling, disposing of hazardous waste appropriately and reducing waste.

As part of its prioritisation of waste minimisation and understanding its limited capacity and the recognition of small business opportunities, the City promotes the use of private recycling collectors, especially where a City of Cape Town recycling service or facility is not yet offered. Private recycling collectors are able to register with the City and be uploaded onto the *waste recyclers map* for customers to easily find the nearest private recycling centre or service provider to their household or business. The City recognises the value of waste and promotes the use of buy-back centres and waste exchange programmes.

Businesses are encouraged to connect with GreenCape, a sector-development organisation focused on stimulating the green economy, and to become involved in the *Western Cape Industrial Symbiosis Programme*, an actively facilitated waste-exchange network.

The City also provides or supports a number of community and school programmes. These include a housing consumer waste education programme, waste-to-art markets, home composting programmes, supporting event organisers with recycling bins on loan, waste education talks at schools, educational exhibitions, waste education tours, and a Waste Education and Recycling Programme. For more information, see the *City's website*.

Large-scale projects

The City is in the process of improving transfer stations and transforming them into key integrated waste management nodes. These sites are identified to be key spaces to separate waste streams, diverting waste from landfill into various recycling initiatives. Currently, the City has transformed the Kraaifontein transfer station into an integrated waste management facility. The station has a drop-off facility, an MRF, a refuse transfer station and a green-waste chipping area, thereby diverting waste from landfills and alleviating the pressure on already overstretched landfill sites. Similar facilities are planned for other existing and future transfer stations in the forthcoming years.

To create more out of waste, the City is also concentrating on waste-to-energy projects and opportunities. Existing landfills have energy-generating potential through the capture of the biogas already being generated, which can be used as a fuel to generate electricity. Certain waste streams have energy or gas-generating potential if treated by various technologies.

The City is working to further develop and roll out drop-off facilities to divert waste from being landfilled, thereby achieving landfill airspace savings.

Circular economy

The City has committed to supporting the circular economy in various high-level strategies and policies, including the City's Environmental Strategy. In addition, Strategic Focus Area 10 of the City's Climate Change Strategy, 2021 aims to facilitate a 'circular waste economy', and includes various goals related to waste minimisation and circularity.

The City's Waste Sector Plan identifies a number of strategic intents aimed at transforming Cape Town into a resilient and resource-efficient city, specifically in relation to resource and waste management. In this regard, a key strategic intention is to extend the life of the City's existing landfill space to 2040 and to accelerate waste avoidance. Consequently, the City continues to partner with GreenCape in terms of a project to 'prepare for acceleration of waste avoidance through waste-related circular economy research'. This project should deliver, among other outcomes, a waste-related materials flow analysis to inform a shortlist of waste-related circular economy focus areas for the City to consider.

The City's Green Procurement Action Plan also includes the 'circular economy' as a key principle to guide City procurement and has various outcomes and actions aimed at institutionalising closed-loop procurement systems. In this respect, the City has initiated the development of various case studies that demonstrate the successful use of circular procurement in City tenders or projects, such as the Fifty/50 Wheelie Bin Contract and the Coastal Park Materials Recovery Facility Earthworks Project. These are available for benchmarking and information sharing, specifically for officials involved in procurement.

The City website offers tips and guides on:

Composting

Recycling

Hazardous waste

Reducing waste

POLICY LINKAGES

- IDP 2022-2027:
  - Priority – Basic Services
  - Objective 4.5: Solid waste: Excellence in basic service delivery programme
  - Objective 4.6. Solid waste: Waste minimisation and recycling programme
- Integrated Waste Management By-law (2009, as amended)
- Integrated Waste Management Policy (2020)
- Municipal Spatial Development Framework (MSDF)
- Resilience Strategy (2019)
- Inclusive Economic Growth Strategy (2021)
- Environmental Strategy (2017)
- Climate Change Strategy (2021)
- Sustainable Development Goals (SDGs):
  - Goal 11: Sustainable cities and communities
  - Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management
  - Goal 12: Ensure sustainable consumption and production patterns
  - Goal 13: Climate action – climate change mitigation by reducing the emission of greenhouse gases (methane and carbon dioxide) by reducing waste to landfill
- **See also:** Chapters on *Climate change*, *Freshwater quality*, and *Coastal water quality*

CHAPTER 11: CULTURAL HERITAGE

Indicators:

- Thirty-seven previous urban conservation areas converted to Heritage Protection Overlay (2013)
- One area (Bo-Kaap) added to the Heritage Protection Overlay (2019)
- Number of areas proposed for investigation for inclusion in the Heritage Protection Overlay
- Six proposed areas nominated for inclusion in the Heritage Protection Overlay (2021)
- One area (Parow Station Precinct) exempted in terms of section 34(3) of the NHRA

HERITAGE AS AN ENVIRONMENTAL MATTER

Cape Town as an urban centre was first established in the mid-17th century. Farms and historical urban nodes grew out from the city as the settlement expanded. The 20th century under formal apartheid town planning saw established neighbourhoods and communities fragmented according to racial classification. This has resulted in a city with unequal access to high-quality natural environment; unequal access to services; and unequal access to cultural resources, heritage protection and recognition.

The heritage of all of Cape Town's citizens must be identified, protected and enhanced through appropriate heritage management practices. The City recognises the importance of heritage in building bridges between communities, fostering public pride and making everyone feel valued in Cape Town.

UNDERSTANDING CAPE TOWN'S HERITAGE

Cape Town's natural and cultural heritage is a fundamental component of its identity, its tourism appeal, and its attraction to business and investors. A heritage resource is identified as any place or object that is of cultural or natural significance. This could include cultural sites, landscapes of historical significance, areas of scenic beauty, places of spiritual importance, and places associated with oral traditions and indigenous knowledge systems. Once a heritage resource has been lost or has been irreversibly damaged or altered, it can never be regained. The City is committed to ensuring that the diverse cultural heritage of Cape Town is protected and enhanced for all its citizens and visitors (map 15 highlights 'Heritage sites of the City of Cape Town').

Heritage management in Cape Town

The Cape Town metropolitan area contains some of the oldest urban nodes in the country and has a large diversity of cultural heritage, historical places and outstanding scenic areas. It is this diversity that contributes to the special identity of Cape Town for both its citizens and tourists. It is vital that the City protects these important heritage resources for current and future generations. Heritage resource management covers the entire municipal area, including Robben Island.

The process of heritage resource management consists of legal requirements and regulations to ensure that our cultural heritage resources are managed and protected

for the benefit of future generations, as enshrined in the Constitution of the Republic of South Africa, 1996. To perform its heritage resource management duties, the City of Cape Town relies on various laws that give effect to the Constitution.

Legal and regulatory framework

The National Heritage Resources Act, 1999 (NHRA) is the overarching national law that provides the legal framework and tools for local authorities to carry out their heritage resource management responsibility to protect and manage our country's diverse and multicultural heritage resources.

The NHRA has established a three-tier system for heritage resource management. The grading system distinguishes between at least the following three categories of heritage resources:

1. Grade I: Heritage resources that are considered to be of national significance. They are identified and managed by the South African Heritage Resources Agency (SAHRA).
2. Grade II: Heritage resources that have special qualities and are significant in a province or region. They are identified and managed by provincial heritage resource authorities (PHRAs). In the Western Cape, the PHRA is Heritage Western Cape (HWC).
3. Grade III: Heritage resources categorised as 'all other heritage resources worthy of conservation'. The local authority (in this case, the City of Cape Town) is responsible for identifying and managing them. The City has further grouped Grade III heritage resources into A, B and C to assist with their respective management. More information can be found in the *City of Cape Town Heritage Advice Guideline Series – Heritage Resources Management (2020).*

Formal protections under the NHRA include declarations under section 27 (National and Provincial Heritage Sites). The formal protection for Grade III or local heritage resources is the Heritage Register (section 30). Heritage Areas (section 31) are the formal protection for geographical areas of cultural and/or environmental interest.

The NHRA makes provision for the exemption of sections 34 and 38 on condition that conservation-worthy heritage resources within such areas are adequately provided for in terms of its formal protections. The lack of regulations for the Heritage Register and delays in formulating these regulations hinder the effective implementation of the exemptions.

To protect conservation-worthy heritage resources, the City uses the Heritage Protection Overlay Zoning (HPOZ) of the Municipal Planning By-law, 2015 (MPBL) as a tool. The criteria for deciding whether a building, place or space is significant in terms of its cultural heritage are defined by the NHRA.

The HPOZ in the Development Management Scheme (DMS) of the MPBL remains the tool for managing heritage places (which includes both individual sites and geographical areas). The 37 urban conservation areas of the previous zoning scheme regulations were converted to protection under the HPOZ in 2013. The Bo-Kaap is the first HPOZ to be included in the DMS since the declaration of the MPBL. It was declared in 2019/20 financial year.

> An overview of the areas protected by the HPOZ is accessible to the public at *https://citymaps.capetown.gov.za/EGISViewer.*

STATE OF THE ENVIRONMENT

The greatest challenge to good heritage management is finding the middle ground between conserving and protecting our heritage for future generations, and stimulating sustainable development and economic opportunities within the City's metropolitan area.

The City has been identifying and mapping heritage resources since the 1980s. As part of this process, heritage resources are constantly identified, reassessed, mapped and graded, and protected. This inventory of heritage resources is available to the public online, and the quality and quantity of information in this inventory continue to improve through ongoing updates and audits. The heritage audit is in its third cycle of three years and is being applied to the strategic identification of those areas now older than 60 years where the heritage value is low. This strategic audit aims to reduce the administrative burden and to facilitate development where this is desirable in terms of its socio-economic benefit to the receiving community.

A number of City-owned heritage places have been declared under section 27 of the NHRA, as National and Provincial Heritage Sites, since 2018. These sites reflect the diversity of the heritage of Cape Town and are representative of living heritage, struggle history and the archaeological heritage of the Cape. These include:

- The quarries of the Bo-Kaap and other City-owned Bo-Kaap heritage resources

- The Old Granary in the Cape Town CBD
- Freedom Square in Bonteheuwel
- The Gugulethu 7 Memorial in Gugulethu
- The Langa Pass Office in Langa
- Princess Vlei in Retreat
- Blaauwberg Nature Reserve

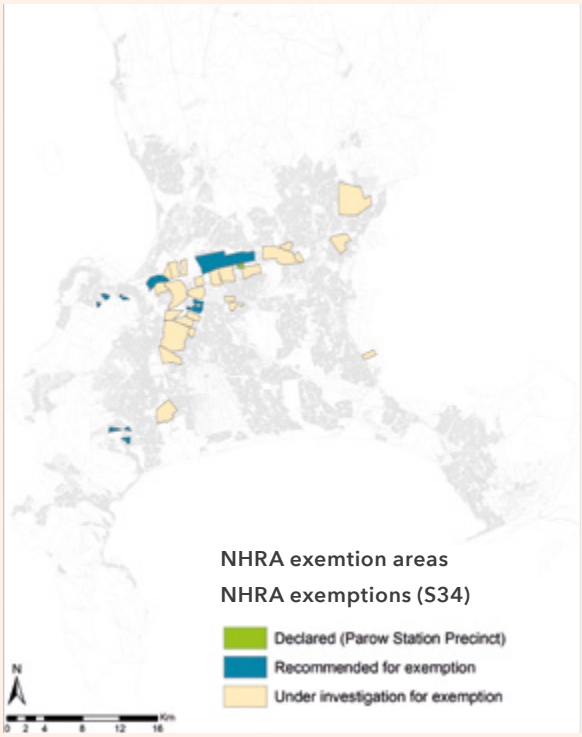
The Green Point Common and Athlone Power Station have been nominated by community interest groups, but the declaration process has not yet been concluded.

Currently, the Camps Bay, Clifton and Bakoven Bungalow Areas and the Blaauwberg Nature Reserve are the only two Heritage Areas in terms of the NHRA in the Cape Town metropolitan area.

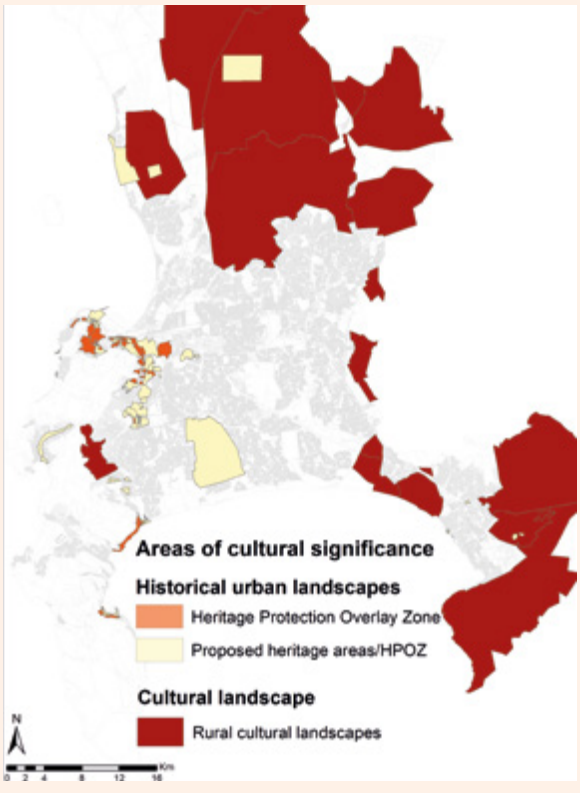
There are currently 37 areas protected by the HPOZ. In terms of formal protection of heritage conservation areas under the HPOZ (MBPL) and as Heritage Areas under the NHRA, since 2015, only one proposed HPOZ has been declared: the Bo-Kaap HPOZ area, approved in 2019/20. An additional 49 areas were identified for investigation for protection in the draft District SDFs, many identified prior to 2009. There is significant community desire for the inclusion of additional areas in the City's HPOZ, mostly due to the perceived lack of effective management of heritage within the general applications system. Notably, work is being undertaken to prioritise five more heritage conservation areas through the MPBL. Given staff capacity alongside the lengthy consultation and legal processes required, it is anticipated that between two and five new areas can be added to the HPOZ per annum. Map 14 shows areas of cultural significance, including the rural cultural landscape (which should also enjoy protection in terms of SPLUMA principles) identified in the MSDF, the existing HPOZ and areas proposed for heritage protection.

Although areas with a density of heritage resources have been put forward for consideration for HPOZ protection, other areas are being identified for lifting the requirements for heritage permission for buildings older than 60 years (i.e. section 34 of the NHRA). These are areas where there are no heritage resources worthy of conservation and where the City would like to promote redevelopment. There is considerable pressure in the City to apply for exemptions in terms of section 34 of the NHRA. Thirty-three geographical areas were identified for strategic auditing with the aim of applying to HWC for exemptions. These are areas generally developed from the mid-20th century onwards and the built environment is expected to have a low heritage value. The lifting of the requirements of Section 34 of the NHRA in areas of little or no significance has the potential to incentivise new development in areas where this is both desirable and appropriate. The intention would be to facilitate development in these areas by providing a 'one-stop shop' for applications. Exemption of the requirements of the NHRA would assist in fast-tracking

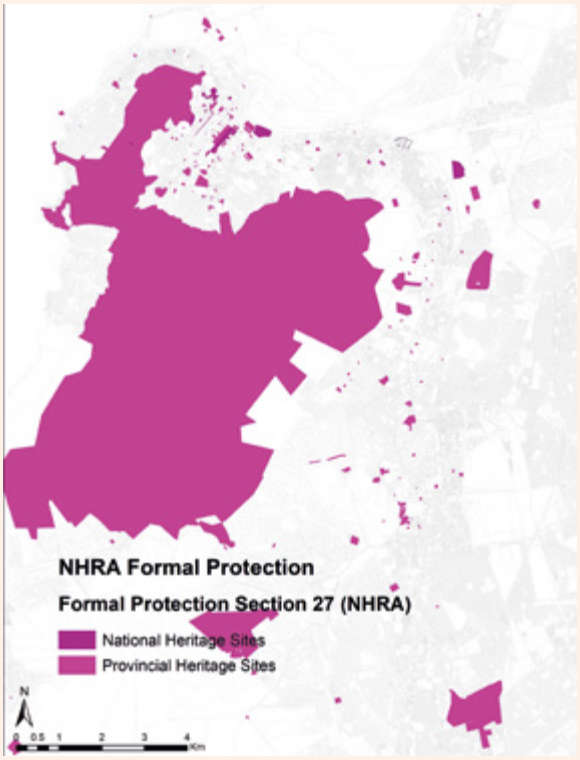
MAP 13: EXEMPTIONS IN TERMS OF THE REQUIREMENTS OF SECTION 34 AND SECTION 38 OF THE NATIONAL HERITAGE RESOURCES ACT



MAP 14: AREAS OF CULTURAL SIGNIFICANCE



MAP 15: HERITAGE SITES OF THE CITY OF CAPE TOWN



the implementation of projects in the City's Catalytic Development Precincts and urban renewal areas (e.g. Bellville Opportunity Area and Philippi Opportunity Area). The areas for possible exemption are indicated in map 13.

The Parow Station precinct was submitted as a case study to HWC to test the feasibility of applications for exemptions in terms of sections 34 and 38. The case study was submitted in 2016. In 2020, the HWC Council approved the exemption within the defined geographical area for section 34. The area was specifically selected to exclude any pockets of conservation-worthy heritage resources as these would require placement on the Heritage Register.

KEY MANAGEMENT RESPONSES

An important part of the management of our heritage resources is the identification and mapping of buildings, places and landscapes that are considered to be worthy of conservation – to be protected and nurtured for the benefit of current and future generations.

Heritage inventory

The City has been identifying and mapping heritage resources since the 1980s. The current heritage audit commenced in 2013 and is still ongoing. The City's heritage inventory is growing rapidly. As areas not previously audited are being surveyed, the number of buildings that are older than 60 years but not conservation-worthy is growing. This provides a more realistic picture of the proportion of conservation-worthy heritage resources within the City. These should have the 60 years protection under the NHRA exempted.

The heritage inventory is made public through the *EGIS Viewer*.[50] Information about heritage grading and the significance of sites is easily available to property owners and applicants. This viewer is crucial in providing information to property owners, developers, heritage practitioners and conservation bodies regarding the location and significance of heritage resources and conservation areas. Recently, the City published a number of historical maps that have been digitised and georeferenced, and are now visible on the EGIS Viewer.

The Environmental and Heritage Resources Information Centre (EHRIC) provides access to historical reports and information relating to heritage resources and management in the City. The City has a series of heritage advice pamphlets that aim to guide property owners as to the types of intervention that are appropriate and desirable within a heritage context.

Conservation planning for City-owned Provincial Heritage Sites and other significant heritage resources under City ownership

The City ensures that City-owned heritage sites are effectively managed and maintained through the implementation of conservation management plans (also referred to as heritage management plans) and ensuring public accessibility to these sites as far as possible. Significant heritage sites owned by the City include the Company's Garden, City Hall, Grand Parade and Arderne Gardens, to mention but a few.

A condition assessment was undertaken to assess and prioritise City-owned Provincial Heritage Sites for the restoration and development of conservation management plans. This will guide the development of a portfolio of restoration projects for heritage sites owned by the City. The City is commencing with either opex-funded project scoping or conservation management plans for five priority

CCT current grading (as of November 2021)	Number	Percentage of database
Recommended Grade I heritage resources	37	0,08
Recommended Grade II heritage resources	194	0,44
Grade III – A heritage resources	1 708	3,86
Grade III – B heritage resources	6 102	13,81
Grade III – C heritage resources	13 250	29,98
Potential Grade III	3 293	7,45
Requires further investigation	582	1,32
NOT CONSERVATION WORTHY	19 000	42,99
Intangible heritage (without physical manifestation)	6	0,01
Noteworthy contemporary buildings	21	0,05
	44 193	**99,99**

sites identified as part of the condition assessment.

Implementation of heritage refurbishment projects in partnership with asset-owning departments

The City has undertaken a number of restoration projects of Provincial Heritage Sites since 2018, including the restoration of the Old Granary, City Hall and Milnerton Wooden Bridge. Similarly, a number of large heritage capital and repairs projects were completed during the 2020/21 financial year: the Lightfoot Memorial, Milnerton Wooden Bridge, Longmarket Street walkway and De Waal Park ablutions.

The restoration and rehabilitation of the City Hall has transformed it into a top historical venue belonging to the City. The City Hall has become a major asset to the City and will soon be ready to welcome the public. Similarly, heritage refurbishment projects such as the Molteno reservoir's restoration and landscaping, the refurbishment of the Trafalgar Park ablution facility and the upgrade to fencing and bank stabilisation at Homestead Park are being undertaken in partnership with asset-owning departments.

Urban catalytic project planning

The City is pioneering the use of heritage, arts and culture as critical informants in the City's urban catalytic project planning to promote a sense of identity and cultural ownership, and maximising the opportunities offered by the historical and cultural resources. These projects are taking place in Philippi, Bellville and the City Gateway Precinct, and involve both tangible and intangible heritage.

Comprehensive heritage investigations were also undertaken for the Bellville CBD and the Philippi Opportunity Catalytic Areas. This was done with the aim of understanding existing heritage resources and community assets that are to form the basis for place making proposals and further public realm investment going forward, in pursuit of a quality living environment.

Cooperative governance

In relation to long-term planning for the management of local heritage resources and the delegation of functions assigned to a competent local authority under the NHRA, the City is dependent on HWC. The City is currently assessed by HWC as a competent local authority in terms of the NHRA. This assessment takes place every two years. The dependency on HWC and uncertainty related to the competence assessment criteria is a constraint to the City's medium- to long-term heritage management strategy as a competent local authority. Notably, it contributes to the challenges in the realisation of a 'one-stop shop' for heritage applications within the City.

The NHRA envisions an integrated system for managing heritage where Grade III heritage resources are managed at a local level by competent local authorities. The City continues to submit its heritage inventory to SAHRA (national inventory) and to HWC (listing on the Heritage Register).

City heritage professionals comment on applications to HWC as part of the promotion of integrated heritage management and good governance. The City reviews development applications involving heritage resources on a daily basis and advises architects, developers, local communities, heritage authorities and researchers on heritage-related issues.

The City has committed to continue working with HWC to streamline development application processes. This is in order to focus heritage management in areas of significance, to reduce red tape and to provide certainty to communities, investors and developers alike.

To incentivise development in line with spatial policy, the City Spatial Planning and Environment directorate is pursuing the establishment of mechanisms where spatially targeted areas can obtain legislative exclusion from the application of environmental impact trigger activities and sections 34 and 38 heritage trigger activities, as per the National Environmental Management Act, 1998 and the National Heritage Resources Act, 1999, respectively.

In addition, the City plans to explore options along with provincial and national government to provide incentives for the appropriate protection, maintenance and use of privately owned heritage sites.privately owned heritage sites.

eHeritage information management system

eHeritage, a heritage information management system aligned with the Development Application Management System (DAMS) and the SAP records management module, is in the development phase. It is anticipated that it will come online in June/July 2022. eHeritage proposes a SAP/GIS solution intended to improve access to relevant heritage information and therefore improve evidence-based decision making, efficiency in heritage management and quality of customer service.

Cultural mapping and planning

Culture has been widely regarded as the 'fourth pillar of sustainability' alongside the economic, social and environmental dimensions. Established in 2014, the City's Arts and Culture Branch has engaged in cultural mapping and planning processes within neighbourhoods, working directly with communities.

Cultural mapping and planning[39] is an inclusive community consultation that aims to identify and reveal known and previously unexpressed cultural resources, assets and symbols. The emergent cultural maps help to surface cultural and creative innovation useful for supporting livelihood opportunities and building a more (locally) inclusive creative economy. The Arts and Culture Branch has developed cultural mapping and planning toolkits and mapped 51 suburbs over six years from 2014 to 2020.

TREND AND TARGET

Trend:

- Increasing pressure for inappropriate development in heritage-sensitive and declared HPOZ areas
- Loss of Grade III heritage resources through demolition
- Overburdening the heritage management system with applications involving non-conservation-worthy 60-year-old structures

Target:

- Ensure the effective management of heritage through the effecting of the appropriate heritage protections, i.e. implementation of HPOZ in historically significant urban landscapes.
- Implement development guidelines in the HPOZ through the Specific Provisions and ensure development is appropriate and has a sympathetic or positive impact on the character and sense of place of the area.
- Facilitate the implementation of exemptions in areas with low heritage value to reduce the administrative burden.

Current:

- Potential blockages in moving towards a 'one-stop shop' due to the need for HWC regulations and technical amendment to the NHRA.
- Need for publication of HPOZ Specific Provisions, currently under consideration in the MPBL review.
- Exploration of a reduction in City heritage resources spent on applications involving non-conservation-worthy 60-year-old buildings.
- Development of eHeritage to assist in the provision of information in decision making.

POLICY LINKAGES

- IDP 2022-2027:
  - Priority – Public space, environment and amenities
  - Priority-Inclusive economic growth
- Environmental Strategy (2017): Strategic Focus Area 4 – Heritage
- National Heritage Resources Act, 1999 (NHRA)
- Cultural Heritage Strategy (2005)
- Municipal Planning By-law (2015)
- Sustainable Development Goals (SDGs):
  - Goal 11: Make cities inclusive, safe, resilient and sustainable
  - Target 11.4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage

[39] A cultural plan provides a framework for addressing the needs and objectives of a city's cultural sector, including arts, culture, heritage groups and practitioners that shape a city's cultural ecosystem. Cultural plans may include goals and strategies that address topics including social cohesion; community engagement; arts and culture programming; services for the creative community; cultural economic development; cultural facilities development; and funding for arts, culture and heritage programmes, including public art and programming

CONCLUSION

This report has provided information in relation to 11 different themes. The results highlight the fact that Cape Town confronts considerable challenges. In particular, during this reporting period, trends related to inland water quality and wastewater are of concern. Nevertheless, positive trends are apparent in relation to biodiversity, climate change and solid waste. Trends in relation to coastal water quality, water use and air quality are largely unchanged. Below is a brief summary of trends in relation to each of the themes explored in this report.

Biodiversity

The total area of land formally conserved within the BioNet has increased significantly over the past decade. The City's target to protect 65% of the BioNet by 2022 has been exceeded. As of June 2021, 65,41% (55 595 ha) of the BioNet is protected. A new target, to conserve and manage 66,5% (56 525 ha) of the 2009 BioNet by 2027, has been set. Despite an increase in land under formal conservation management, the city's biodiversity remains under threat. Inappropriate development (urban sprawl) is the greatest threat to the remaining biodiversity in Cape Town. The Covid-19 pandemic, and resultant 'hard lockdown' and job losses, led to increased poaching and other illegal activities, as well as a significant increase in the pressure of illegal land invasions at many sites.

Invasive alien species

Invasive alien plant and animal species are a significant threat to Cape Town's biodiversity, and reduce the quality of natural green spaces. It is estimated that nearly 4 000 ha of protected areas are woody alien-free, 2 842 ha have extensive or dominant woody invasive alien vegetation cover and 3 000 ha of habitat still need to be assessed in detail. Fynbos is particularly susceptible to invasion by alien trees, mostly Australian acacia, hakea and eucalyptus, and pines from the northern hemisphere. In lowland habitats, alien acacias with huge seed banks dominate. Pines continue to spread in water catchment areas, significantly reducing run-off into the dams. The population of invasive alien house crows increased to approximately 500 in 2020/21, as a result of Covid-19 and restrictions on contractors. The polyphagous shot hole borer infestation, which is affecting mature trees in Somerset West, received significant media coverage in 2021. The City's team successfully removed many trees infested with the borer, and continues to monitor and contain its spread.

Natural public green space

Although on average the proximity of natural public green space is sufficient, the overall trend is that access to public green space remains spatially uneven and remains problematic in some areas. The worst access levels disproportionately affect residents in the south-east part of the city where the majority of unemployed and low-income households are concentrated. There is therefore a need for the City to plan for and create more spatially even green recreational areas and/or to facilitate easier access to the available spaces for the poor and most vulnerable, including special needs groups. A significant management response is the implementation of the GIP, which aims to protect and enhance existing environmental assets, together with the promotion and creation of new green infrastructure assets.

Freshwater quality

In general, Cape Town has experienced deteriorating trends in inland water quality due to a range of contributing factors, including rapid urbanisation, informal and unlawful land settlement, and illegal dumping. Sewer blockages/overflows and faults with some wastewater treatment facilities remain a significant concern in relation to water quality. The biggest water quality issue experienced in most of the routinely monitored systems is elevated phosphorus, which drives eutrophic and hypertrophic conditions. Phosphorus enrichment makes receiving waterbodies such as vleis vulnerable to excessive

plant growth, which requires ongoing maintenance and, at times, poses human health risks due to the presence or risk of microcystin toxins. Notably, all three of the City's recreational vleis (Zandvlei, Zeekoevlei and Rietvlei) were closed to the public for a number of months during 2021 due to water quality concerns. Milnerton Lagoon has been subject to periodic and, at times, prolonged contamination, and the highest risk of unacceptable levels of *E. coli*.

That said, however, it is noted that not all of Cape Town's watercourses are highly contaminated. The monitoring data do point to a few rivers where water quality is affected to a much lesser degree. These include the Silvermine River and Lourens River systems. Other rivers, such as the Sand catchment rivers and Hout Bay River, are moderately to highly contaminated in their lower reaches only.

Coastal water quality

In terms of coastal water quality, overall, and at a citywide scale, there have been no significant changes in coastal water quality across Cape Town. Recreational beaches rated as 'poor' in 2020 are mainly the result of three or fewer results of high bacterial counts as opposed to consistently high counts in bacterial readings.

On the Atlantic coast, data analysed over the last five years (2016–2020) highlight a marginal but continual water-quality improvement at seven recreational nodes. Although there was a reduction in results of 'poor' water quality by almost 10% at the monitoring points, the variable trend also persists.

On the False Bay coast, results at recreational nodes in the 2020 reporting period, when compared to the 2019 reporting period, highlight that water quality improved in six locations, remained 'poor' in eight locations and regressed to the 'poor' category in four locations. At the coastal monitoring points, there was an increase in 20% of 'poor' water-quality ratings at monitoring sites from 2019 to 2020.

Water use

Overall, since 1996, Cape Town's daily water use per capita (per calendar year) has shown a steady decline. Water use reached a peak of 312,46 litres per capita per day in 1999. In response to the water crisis, water use per capita reached its lowest point at 112,20 litres per capita per day. Although daily water use per capita increased in 2019 (122,45 litres daily water use per capita) and 2020 (137,62 daily water use per capita), it is still well below the pre-water crisis levels of 222,15 litres per capita per day in 2015.

Wastewater

As at July 2020, the City's wastewater plants were 81,66% compliant with DWS standards. This shows an ongoing, albeit slight decline, in overall compliance since 2015. There was a decline in compliance of 0,34% from 2018 (overall compliance of 82%), a decline of 3,19% from 2016 (overall compliance level of 84,85%) and an approximate 6,34% decline from 2015 (overall compliance level of 88%).

Simon's Town has had the lowest overall compliance level in both 2018 (47%) and 2016 (56%), with low compliance for COD, ammonia, *E. coli*, nitrates/nitrites and orthophosphate.

In general, faults with some wastewater treatment facilities remain a significant concern in relation to water quality. In response, the City has prioritised the upgrading of wastewater treatment works, assisted by loan funding. Approximately R11 billion has been budgeted for wastewater treatment plant upgrades over the next 10 years.

Climate change

Since the State of the Environment Report 2018, the City has commissioned a detailed Climate Change Hazard, Vulnerability, and Risk Study. In general, the study found the areas most at risk are those that experience socio-economic vulnerability and have a low resilience and capacity to adapt to climate change.

The city's carbon footprint still remains high at 4,6 tCO_2e per capita (2018), mainly due to its dependence on coal-intensive grid electricity and fossil fuel-based transport. However, it has declined from 5,1 tCO_2e in 2015 to 4,6 tCO_2e in 2018. In general, the city's total emissions are stable, which seems to be a combination of energy efficiency (especially evident in residential electricity demand) and subdued activity due to a period of low economic growth and dropping per capita incomes. Furthermore, energy consumption is steadily decreasing, along with per capita electricity use.

In response, the City adopted a Climate Change Strategy and Climate Change Action Plan in 2021. The Climate Change Strategy is intended to provide a framework to transform the way the City plans and operates, and in dealing with known impacts and challenges presented by climate change. The Climate Change Action Plan further elaborates on the goals of the strategy and sets out the programmes of action to address both climate change adaptation and mitigation.

Air quality

In general, NO_2 levels have decreased over the past 12 years. They are generally within the guideline standards, apart from within the Cape Town CBD. Sulphur dioxide levels have maintained low trends over the past 12 years, keeping within the guideline standards, with discrepancies occurring every few years. However, PM_{10} levels are more problematic and have considerably increased at most sites over the years. In this regard, the impact of rapid urbanisation is playing a significant role.

The City's target is full compliance with the National Ambient Air Quality Standards. Although all sites meet the NAAQS for NO_2 and SO_2, some sites have not complied with PM_{10} NAAQS.

Solid waste

Estimates of total waste managed by the City between 2008 and 2021, based on the total waste minimised through City initiatives and disposed of at City landfill sites, highlight that 2016 saw the highest annual waste managed (2,67 million tonnes), whereas 2020 had the lowest annual waste managed (1,44 million tonnes). Furthermore, annual waste managed in 2021 was significantly lower than waste managed in 2008 (199 million tonnes).

In 2019/20, the City diverted ±216 000 tonnes of waste, ±123 545 tonnes of builders' rubble and ±53 000 tonnes of organic waste from landfill. Furthermore, the City distributed ±22 000 free composting containers. The City's Think Twice kerbside recycling programme is now offered to over 190 000 households and diverted approximately 27 292 tonnes in 2020/21 and 24 234 tonnes in 2019/20 of recyclables from landfill.

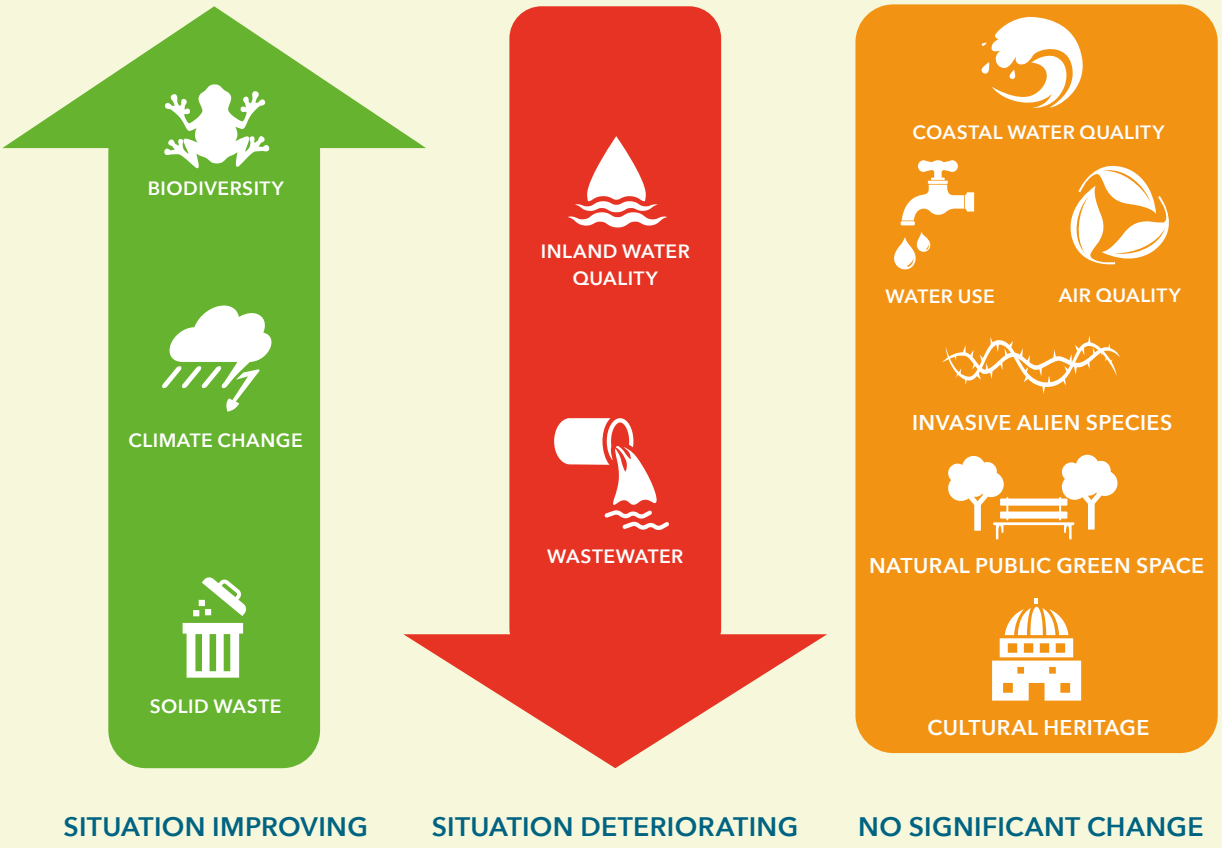
Cultural heritage

The greatest challenge to heritage management is finding a balance between conserving and protecting heritage for future generations, and stimulating sustainable development and economic opportunities in the city.

The City has been identifying and mapping heritage resources since the 1980s. As part of this process, heritage resources are constantly identified, reassessed, mapped and graded, and protected. A number of City-owned heritage places have been declared under section 27 of the NHRA, as National and Provincial Heritage Sites, since 2018. There are currently 37 areas protected by the HPOZ. In terms of formal protection of heritage conservation areas under the HPOZ (MBPL) and as Heritage Areas under the NHRA, since 2015, only one proposed HPOZ has been declared: the Bo-Kaap HPOZ area, approved in 2019/20.

Nevertheless, there is increasing pressure for inappropriate development in heritage-sensitive and declared HPOZ areas, and a loss of Grade III heritage resources through demolition. The City also faces challenges related to overburdening the heritage management system with applications involving non-conservation-worthy 60-year-old structures.

In summary, the themes showed the following trends during this reporting period:



APPENDIX 1: SUSTAINABLE DEVELOPMENT GOALS

The Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development were adopted at a United Nations' summit and came into effect in September 2015. These goals apply universally and are not legally binding. They provide a means to ensure that efforts are taken to end all forms of poverty, fight inequalities and tackle climate change in an inclusive manner.

The SDGs build on the success of the Millennium Development Goals (MDGs) and call for the end of all forms of poverty. The goals and their associated targets recognise that initiatives to end poverty need to simultaneously create economic growth and address social needs such as education, health, social protection and job opportunities. In addition, these initiatives need to tackle climate change and ensure environmental protection.

Goal 1:
No poverty

Goal 2:
Zero hunger

Goal 3:
Good health and well-being

Goal 4:
Quality education

Goal 5:
Gender equality

Goal 6:
Clean water and sanitation

Goal 7:
Affordable and clean energy

Goal 8:
Decent work and economic growth

Goal 9:
Industry, innovation and infrastructure

Goal 10:
Reduced inequalities

Goal 11:
Sustainable cities and communities

Goal 12:
Responsible consumption and production

Goal 13:
Climate action

Goal 14:
Life below water

Goal 15:
Life on land

Goal 16:
Peace, justice and strong institutions

Goal 17:
Partnerships for the goals

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