CITY OF CAPE TOWN STATE OF THE ENVIRONMENT REPORT 2018

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The City of Cape Town's Transport and Urban Development Authority

FOREWORD

Surrounded by mountains and oceans, Cape Town is home to some of the world's most significant and diverse natural vegetation and landscapes. It is a vibrant city, unique and distinctive, a place in which people are able to express their culture and art, and to celebrate their shared histories. However, Cape Town, as with many urban areas globally, faces a number of environmental challenges. These include rapid urbanisation, increasing scarcity of resources, (including water, energy, the ability to treat waste products) and pollution of the city's air, water and open spaces. Cape Town must also deal with the emerging reality of climate change, which exposes the city and its residents to increased risk from extreme weather events and long-term climatic shifts. The need to conserve natural and cultural heritage in a rapidly growing and ever-changing city, while also ensuring the effective provision of services and amenities to all citizens, is a significant challenge.

The City of Cape Town recognises that the natural environment is an irreplaceable resource, which provides a myriad of ecosystem goods and services with a host of associated economic and social benefits to the citizens of Cape Town. Functions such as climate regulation, waste assimilation, natural hazard regulation and the supply of fresh food, water, and air are essential for preserving and maintaining a well-run city. Recreational activities such as hiking, picnicking, birdwatching, and water sports; educational and scientific research opportunities; and spiritual, cultural and religious benefits offer the opportunity for diverse communities to come together in shared outdoor spaces and are essential for maintaining the social and cultural character of an inclusive city. Most importantly, Cape Town's natural environment is a collective resource that belongs to all citizens of Cape Town, which must remain accessible and deliver benefits to all citizens.

The new Environmental Strategy adopted by the City of Cape Town is committed to ensuring the long-term sustainability of the city in order to ensure that the economic and social benefits that the natural environment provides continue to be accessible to all, and to be preserved for future generations. 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 in a particular moment in time, as well as an analysis of trends over time, and ensures that city leaders and decision makers have access to accurate and transparent data and information about a range of environmental issues. This enables us to act on environmental problems as they are identified, based on clear supporting information and evidence.

It is important to remember that sustainability cannot be achieved by local government alone but requires the participation of all members of our society, including all spheres of government, the private sector, residents and visitors to Cape Town. I therefore encourage everyone reading this report to actively participate in working towards a more sustainable Cape Town.

Executive Mayor
City of Cape Town

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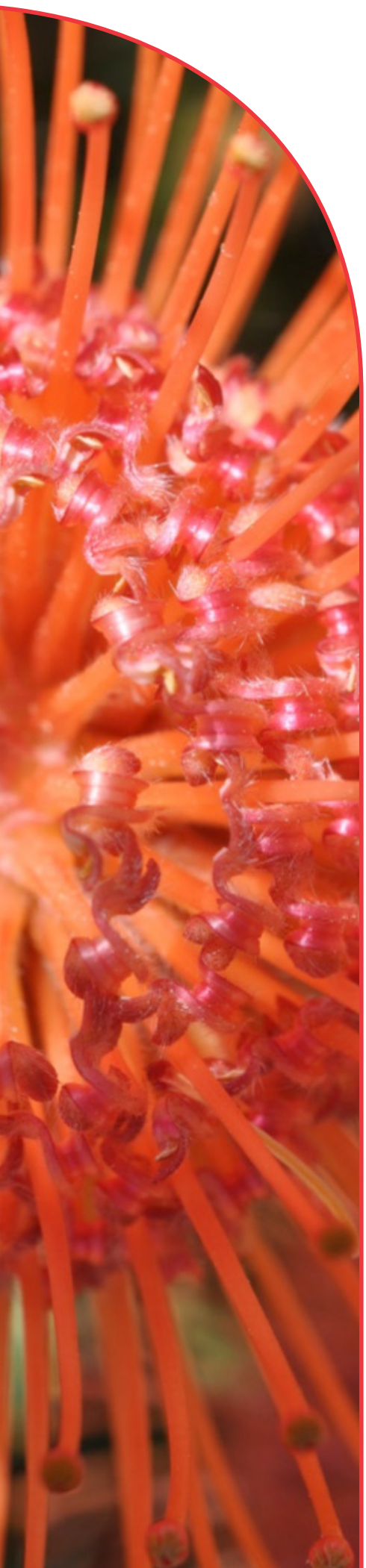

ABBREVIATIONS/ACRONYMS

BioNet	Biodiversity Network
CBAs	Critical Biodiversity Areas
CCT	City of Cape Town
CCT-IWMP	Integrated Waste Management Policy
CESAs	Critical ecological support areas
CFR	Cape Floristic Region
City	The administrative body of the City of Cape Town city The region of City of Cape Town
COD	Chemical oxygen demand
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CRO	Chief Resilience Officer
DWA	Department of Water Affairs
DCCP	Dassenberg Coastal Catchment Partnership
DWS	Department of Water and Sanitation
E. coli	*Escherichia coli*
EDRR	Early Detection and Rapid Response programme
IDP	Integrated Development Plan
IMEP	Integrated Metropolitan Environmental Policy
IUCN	International Union for Conservation of Nature
IWMP	Integrated Waste Management Plan
GEF	Global Environment Fund
GHGs	Greenhouse gases
Hh	Low-risk
HH	High-risk
METT	Management Effectiveness Tracking Tool
NEMBA	National Environmental Management: Biodiversity Act
NEMWA	National Environmental Management: Waste Act
NO_2	Nitrogen dioxide
PM_{10}	Particulate matter
PV	Photovoltaic
SDF	Spatial Development Framework
SMMEs	Small, Medium and Micro-sized Enterprises
SO_2	Sulphur dioxide
SSEG	Small-scale embedded generation
SUDS	Sustainable urban drainage systems
WCWDM	Water conservation and water demand management
WFW	Working for Water
WHO	World Health Organisation
WSUD	Water sensitive urban design
WWF	World Wildlife Fund
WWTW	Wastewater treatment work

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OVERVIEW

The natural environment in the City of Cape Town

A healthy natural environment is a requirement for all life, including humans. Natural systems are responsible for ensuring that we have clean air, clean water, and soils, which are the basis of life. These three primary services of natural systems allow us to grow food and fuel to sustain our needs. Additionally, a healthy environment provides cultural, aesthetic, and recreational benefits to all residents of and visitors to the city.

The natural environment has been negatively affected by urban development and impacted by various threats associated with urbanisation. These threats have the ability to impact water and air quality through pollution and the disruption of 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 Cape Town, to actively work towards conserving and promoting a healthy environment while ensuring that economic and social development continues 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 its essential goods and services, impacting negatively on development and, most notably, human health.

Environmental sustainability is an essential component of ensuring healthy social and economic growth in Cape Town. The City of Cape Town is committed to adopting and implementing the principles and approaches needed to reach this goal.

The Integrated Metropolitan Environmental Policy (IMEP) adopted in 2001, followed by the Environmental Agenda 2009 – 2014 and a new Environmental Strategy, brings the City's environmental policy approach into line with more contemporary thinking on the matter. The new Environmental Strategy was approved in 2017. Additionally, environmental concerns have been integrated into strategic City planning documents, such as the Integrated Development Plan and the Cape Town Spatial Development Framework.

The State of the Environment Report

The State of the Environment Report is an essential monitoring and evaluation tool that is 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

Five environmental benefits are used as themes throughout this report to highlight the overarching goods and services that the environment provides, enhancing 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 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 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.

Targets and policy linkages

The Five-Year Review of the City's first Integrated Metropolitan Environmental Policy (IMEP), adopted in 2001, identified the need for the City and its communities to actively shift from a business-as-usual approach towards a driven and targeted sustainability agenda. As such, IMEP was reviewed to include key measurable environmental commitments for the five-year period 2009 – 2014. These environmental commitments to a sustainable future were formalised as the City's Environmental Agenda 2009 – 2014.

The Environmental Agenda 2009 – 2014 was adopted to uphold the City of Cape Town's commitment to increasing levels of ecosystem and heritage protection, while reducing overall resource consumption. This commitment took place with the recognition that quality environments and resource-use patterns are significantly skewed and aligned with the wealth gap. Resource-use targets and strategies were therefore aimed at reducing current over-consumption patterns in middle and upper classes while increasing appropriate resource use in impoverished and disadvantaged communities so as to extend quality living environments and basic services.

This report uses the Environmental Agenda 2009 – 2014 targets as a baseline target for most chapters. Where there are updated targets set for specific City functions, these are used. The future State of the Environment Reports will use the Environmental Strategy adopted in 2017 as a basis for measuring progress.

Indicators

This report is based on the 2016 calendar year – January 2016 to December 2016 – unless stated otherwise. The data in the report is used in accordance with indicators. Indicators set measurement in order to be able to track environmental changes over time. The selected indicators are aligned with the Integrated Development Plan (IDP) and the Strategic Environmental Policy for the City of Cape Town. The selection of indicators was also guided by international and local experience in this field, scientific research and consultation with key stakeholders.

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 allows one to draw fair conclusions about trends, while working towards ensuring that necessary action is taken in a timely fashion.





CHAPTER 1: BIODIVERSITY

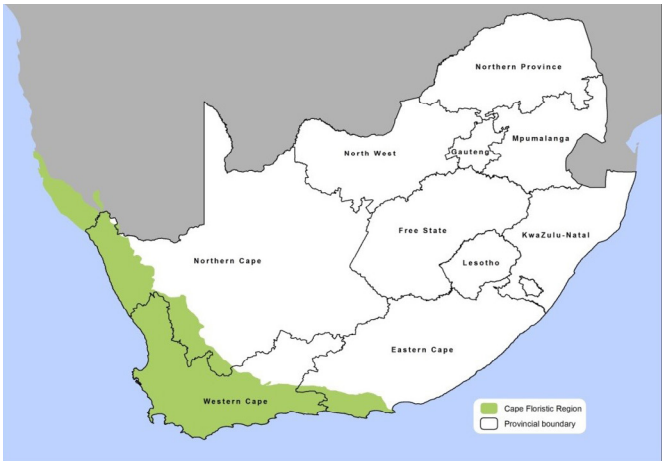
Understanding Cape Town's biodiversity

Cape Town is abundantly rich in biological diversity and recognised around the world for its natural beauty. The city is located within the Cape Floristic Region (CFR), part of the Greater Floristic Region biogeographical unit, as indicated in Map 1. The most biologically diverse of the six plant kingdoms, the Cape Floristic Region is also recognised as one of the planet's 25 most-threatened ecosystems. The region is home to 9 600 plant species, of which over 70% are found nowhere else in the world[1].

With such a unique plant kingdom both within the urban fabric and around the outskirts of Cape Town, 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.

Indicators:

- Indigenous vegetation remaining, by national vegetation type
- Extent of natural vegetation within the city
- METT-SA and Protected Area Review scores



Map 1: The Greater Cape Floristic Region[2].

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.

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, as well as its ability to thrive in poor soils and seasonally hot and dry conditions.

Mountain Fynbos

Found on the upper and lower mountain slopes, Mountain Fynbos has been negatively impacted 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 eight vegetation types: Peninsula Sandstone Fynbos, Kogelberg Sandstone Fynbos, Western Coastal Shaleband vegetation, Elgin Shale Fynbos, Peninsula Granite Fynbos, Boland Granite Fynbos, and Cape Winelands Shale Fynbos. Peninsula Sandstone Fynbos 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*), as well as 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 Fynbos, Atlantis Sand Fynbos, Hangklip Sand Fynbos, Lourensford Alluvium Fynbos, and Swartland Alluvium Fynbos. Of these five types, 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 of about 80% of the CFR[3]. Historically, Cape Flats Sand Fynbos was the most widespread vegetation type in Cape Town, but now a mere 11% of this remains, mostly in a degraded state, with only 2% conserved.

Renosterveld

Renosterveld is thought to be named after the black rhinoceros historically found in this vegetation. There are four remaining Renosterveld vegetation types found 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 of one to two metres tall comprised of ericoids with a ground layer of grasses[4]. Renosterveld is dominated by the grey Renosterbos (*Elytropappus rhinocerotis*), but historically 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[5].

Strandveld

Strandveld grows in alkaline coastal sands and dunes and has been considerably impacted by coastal development. It is confined mainly to the coastal margins and extends inland only on 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 monilifera*), annual daisies and numerous succulent vygie species. CFDS differs from fynbos and Renosterveld as it is not fire-prone and should burn infrequently, with a fire cycle of typically 20-to-100 years.

Understanding fauna in Cape Town

Cape Town has a rich fauna, mirroring the plant diversity. 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 now is a characteristic more associated with the savannas in the eastern regions of South Africa. Highly nomadic, these animals would move great distances in the search of food availability, 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.

There are 74 mammal species thought to occur within Cape Town, 16 of which are endemic to South Africa.
The nocturnal nature of these mammals in the CFR makes them difficult to observe[6]. The City's reserves are home to many smaller mammals, including the Cape Leopard, Large and Spotted Genet, Honey Badger, Caracal, Grey Mongoose, Striped Mouse, Rock Hyrax (or Dassie) and small antelope such as the Cape Grysbok, Steenbok and Duiker. Baboons are also commonly found within the city, particularly within 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 while others have evolved to rely on a single, highly specialised pollinator. Two locally endemic butterflies, the Unique Cape Flats Ranger and the Barber's Cape Flats Ranger, are on the brink of extinction and urgently need their remaining habitats secured into conservation.

Amphibians

Cape Town's watercourses and wetlands are home to an abundance of frogs and toads. There are 27 species within the city boundaries. Two of these, the Table Mountain Ghost Frog and the Lightfoot's Moss Frog, are endemic to the CFR[7] and both are found in the Table Mountain National Park. The Cape River Frog and the endangered Western Leopard Toad are also commonly found within 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 due to their confinement to sandy coastal lowlands of the Western Cape. Also, as a result of urbanisation, their wetland habitats have been impacted by drainage, in-fill, pollution and building. 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' that indicates a healthy Cape Town biodiversity. Visit the City website to see ways on joining efforts to conserve these endangered toads (click here).

Reptiles

There are an estimated 65 species of reptile within the city, 30 of which are endemic to South Africa[8]. 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 City nature reserves, while wetlands and streams are home to Marsh Terrapins.

Birds

There are 374 recorded bird species in the Cape Town area, 16 of which are endemic to South Africa and 24 of which have been assigned Red Data Status[9]. This includes numerous species adapted to suburban gardens and a diversity of water birds.

Cape Town is home to six CFR endemic bird species: the Cape Sugarbird, Orange-breasted Sunbird, Cape Siskin, Protea Canary, Cape Rock-jumper and Victorian'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 Pinia, Pied Crow and White-necked Raven. The most common birds of prey are the Rock Kestrel, Peregrine Falcon, Rufous-chested Sparrowhawk and Jackal Buzzard.

Cape Town is also home to many marine birds along its long coastline. These include the African Penguin, Cape Gannet and Bank Cormorant, all of which are vulnerable to extinction and endemic to South Africa. Various types of gulls, terns, waders, cormorants and gannets can commonly be found along the coast throughout the year, while pelagic birds such as albatrosses, shearwaters, skuas and petrels may sporadically be seen from clifftops along the coastline.

State of the environment

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

The Biodiversity Network (BioNet) is the fine-scaled conservation plan for the City of Cape Town municipal area. Aimed at securing national conservation targets, the BioNet consists of a series of interconnected critical biodiversity areas (CBAs) ranging from pristine habitats to degraded highly threatened ecosystems and critical ecological support areas (CESAs). The City aims to have 65% of the BioNet conserved by 2019. The extent of the BioNet is shown in Map 2.

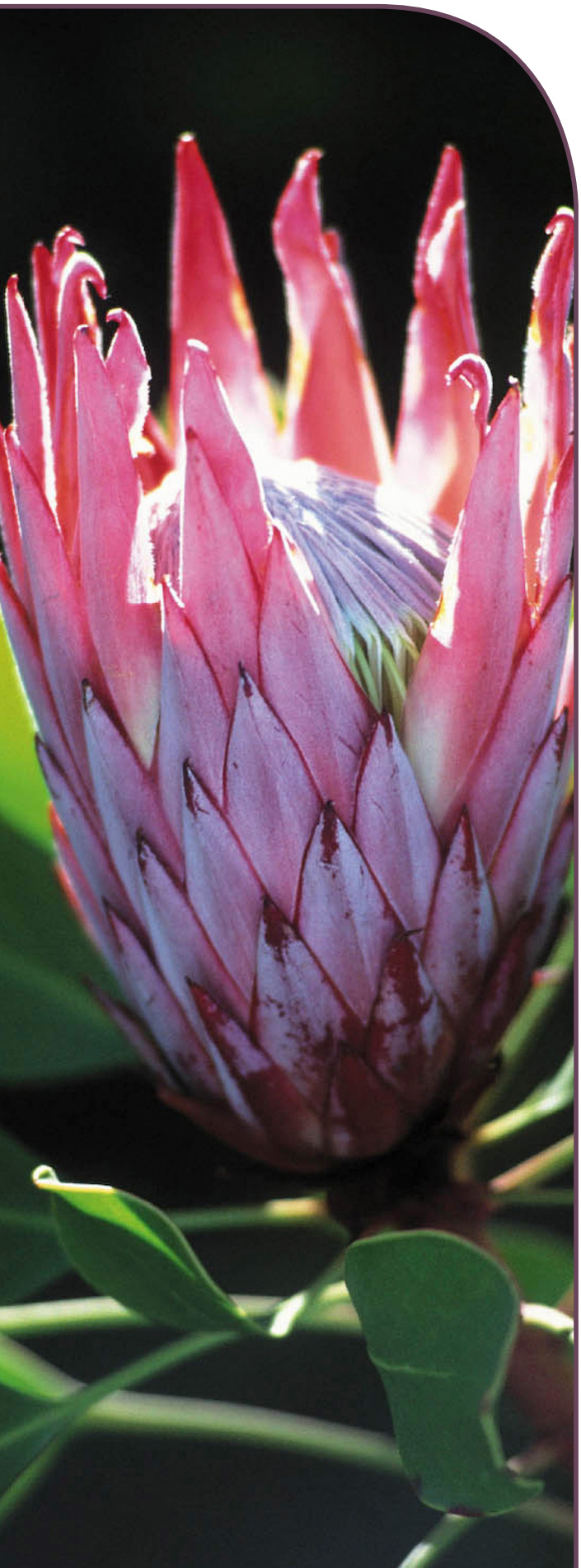
The total area of land formally conserved within the BioNet has increased significantly over the past decade. By 2014 60.81% of the BioNet had been formally conserved, rising to 64% in 2016. This steady increase has put the City on track to reaching its 2019 target of 65% of the BioNet conserved. The BioNet covers a total of 87 902 ha of land, with 85.6% of the land being outside the urban edge.

There is a total of 90 587 ha of indigenous terrestrial vegetation remaining in the city. This indigenous terrestrial vegetation comprises 37.1% of its original historical extent, with 21.9% of that original extent proclaimed or managed. In addition, all wetlands and rivers form part of the BioNet.

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

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 Peninsula Sandstone Fynbos and Peninsula Granite Fynbos. The most poorly conserved endemic vegetation types are Lourensford Alluvium Fynbos and Cape Flats Sand Fynbos.

There are currently 21 039 ha 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[10]. As such, 81.43% of this type is managed or 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.

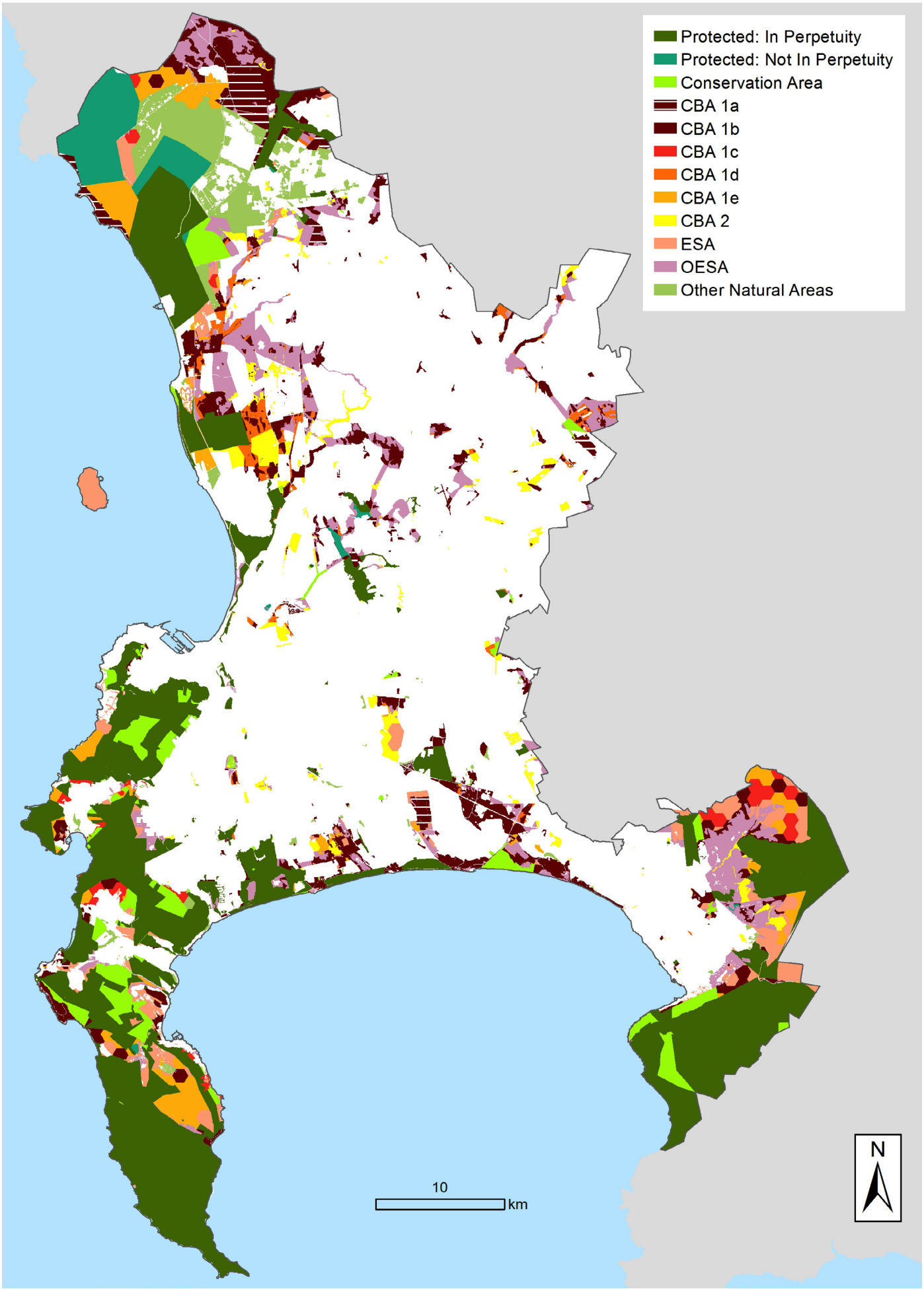


There are currently 3 949 ha of Peninsula Granite Fynbos remaining, or 42.8% of its historical extent. A significant proportion of the South Peninsula Granite Fynbos subtype is recovering from pine plantation impact and invasive alien species are a major additional threat. Peninsula Granite Fynbos occurs 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 within the Kirstenbosch National Botanical Garden and is a very popular vegetation type for recreational activities such as hiking, cycling, dog walking and horse riding[11]. A total of 30.7% of this is proclaimed, but a lack of fire is allowing invasion by forest species to the detriment of the Peninsula Granite Fynbos species.

The most poorly conserved endemic vegetation types include Cape Flats Sand Fynbos and Lourensford Alluvium Fynbos. There are currently 5 951 ha of Cape Flats Sand Fynbos remaining, which is only 11% of its historical extent and only 2.3% of this type is proclaimed or being managed. This vegetation type and its associated soils drain easily and are suitable for housing and urban development. Due to the suitability of this vegetation for urban activity, urbanisation has considerably reduced its extent and fragmented remaining habitat. Furthermore, side effects of urbanisation have also impacted the existence of the vegetation. Mowing, fire protection, dumping, polluted waterbodies and alien plant invasion are identified to be threats to this fynbos type[12].

Only 228 ha of Lourensford Alluvium Fynbos remain, which is 6.3% of its historical extent, mostly highly degraded. Only 2.1% is managed or proclaimed. This vegetation type is found in the low-lying areas between Firgrove and Gordons Bay, including areas of Strand and Somerset West 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 type being one of the most impacted 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.

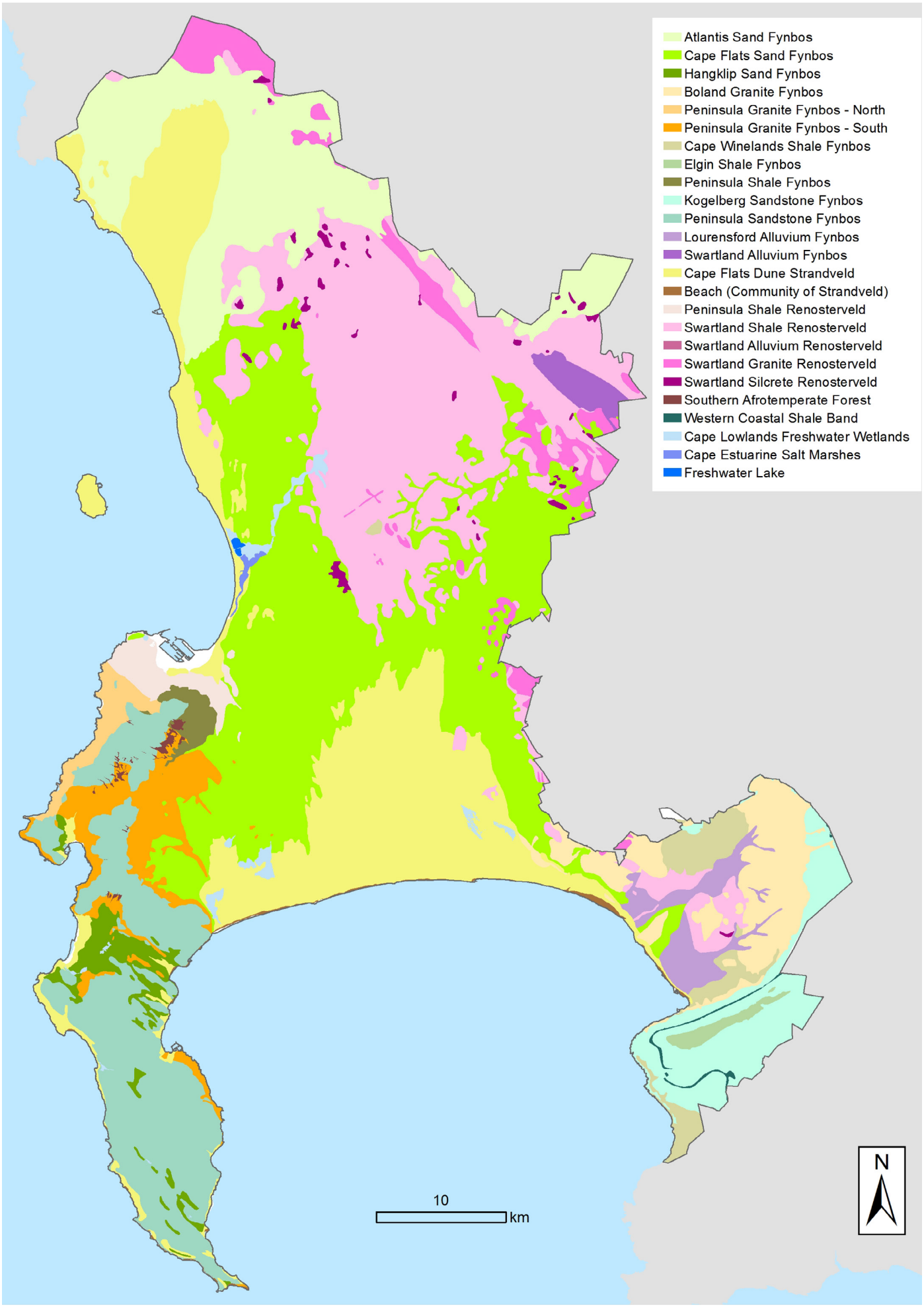


Map 2: City of Cape Town's Biodiversity Network[14 15]

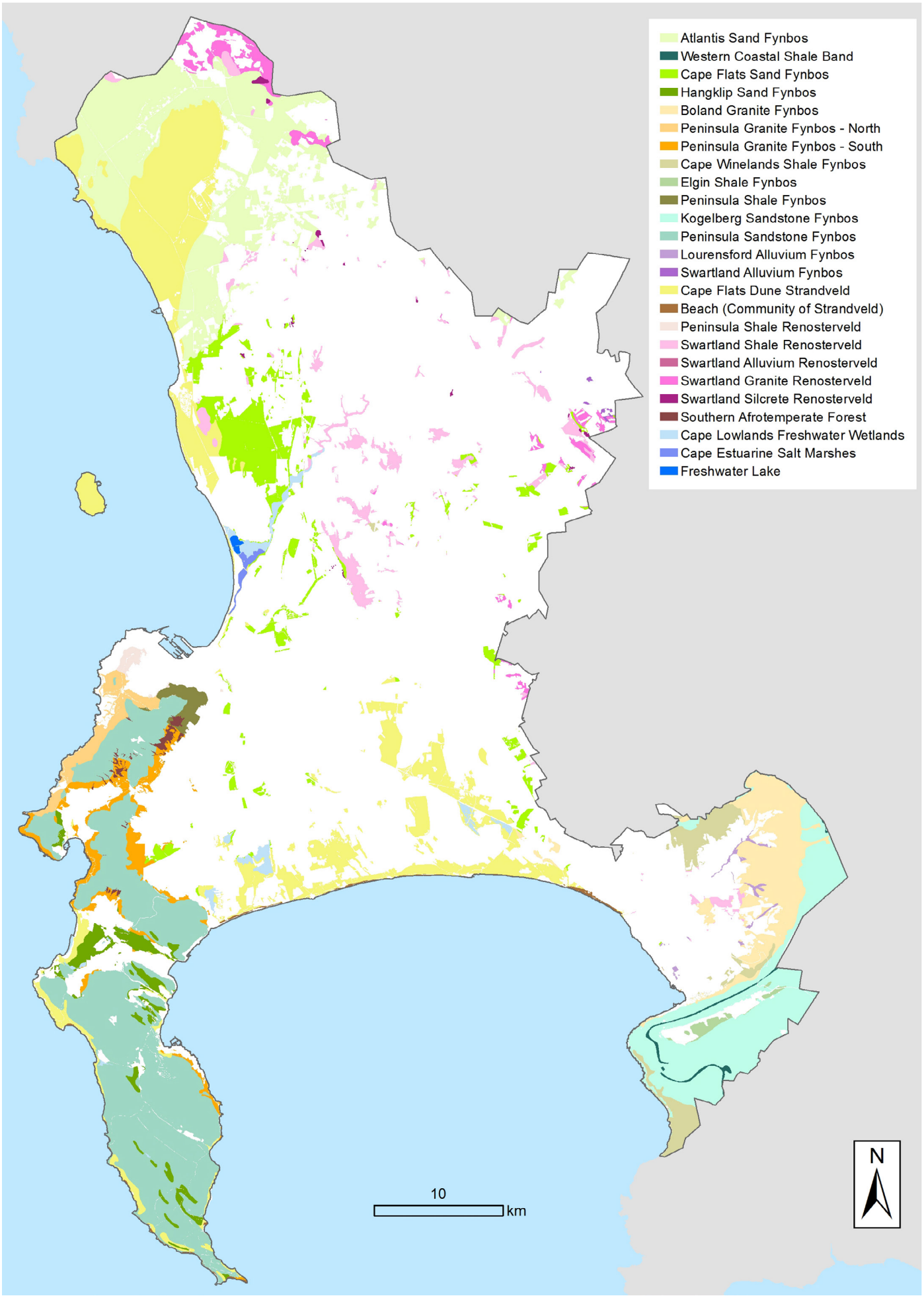
Vegetation type	Ha Vegetation Remaining	% Remaining of Historical	% Historical Proclaimed/ managed	Ecosystem Status
Atlantis Sand Fynbos	14 696	58.4	19.0	Critically endangered
Boland Granite Fynbos	5 601	59.7	21.7	Vulnerable
Cape Flats Dune Strandveld	**18 315**	**44.4**	**23.8**	**Endangered**
****Cape Flats Sand Fynbos***	**5 951**	**11.0**	**2.3**	**Critically endangered**
Cape Winelands Shale Fynbos	2 937	55.7	38.5	Vulnerable
Elgin Shale Fynbos	331	39.3	38.0	Critically endangered
Hangklip Sand Fynbos	1 850	56.1	43.4	Endangered
Kogelberg Sandstone Fynbos	9 201	97.5	88.1	Critically endangered
****Lourensford Alluvium Fynbos***	**228**	**6.3**	**2.1**	**Critically endangered**
Peninsula Granite Fynbos	**3 949**	**42.8**	**30.7**	**Endangered**
Peninsula Sandstone Fynbos	**21 039**	**95.9**	**81.3**	**Endangered**
****Peninsula Shale Renosterveld***	**275**	**11.6**	**10.3**	**Critically endangered**
Southern Afrotemperate Forest	345	99.2	90.9	Least threatened
*Swartland Alluvium Fynbos	56	3.2	0.0	Critically endangered
*Swartland Granite Renosterveld	1 834	25.1	2.9	Critically endangered
*Swartland Shale Renosterveld	3 516	7.4	2.2	Critically endangered
*Swartland Silcrete Renosterveld	149	13.7	0.4	Critically endangered
Western Coastal Shaleband	316	99.8	95.6	Least threatened
TOTAL	**90 587**	**37.1**	**21.9**	

Table 1: Percentage of historical vegatation remaining[16]

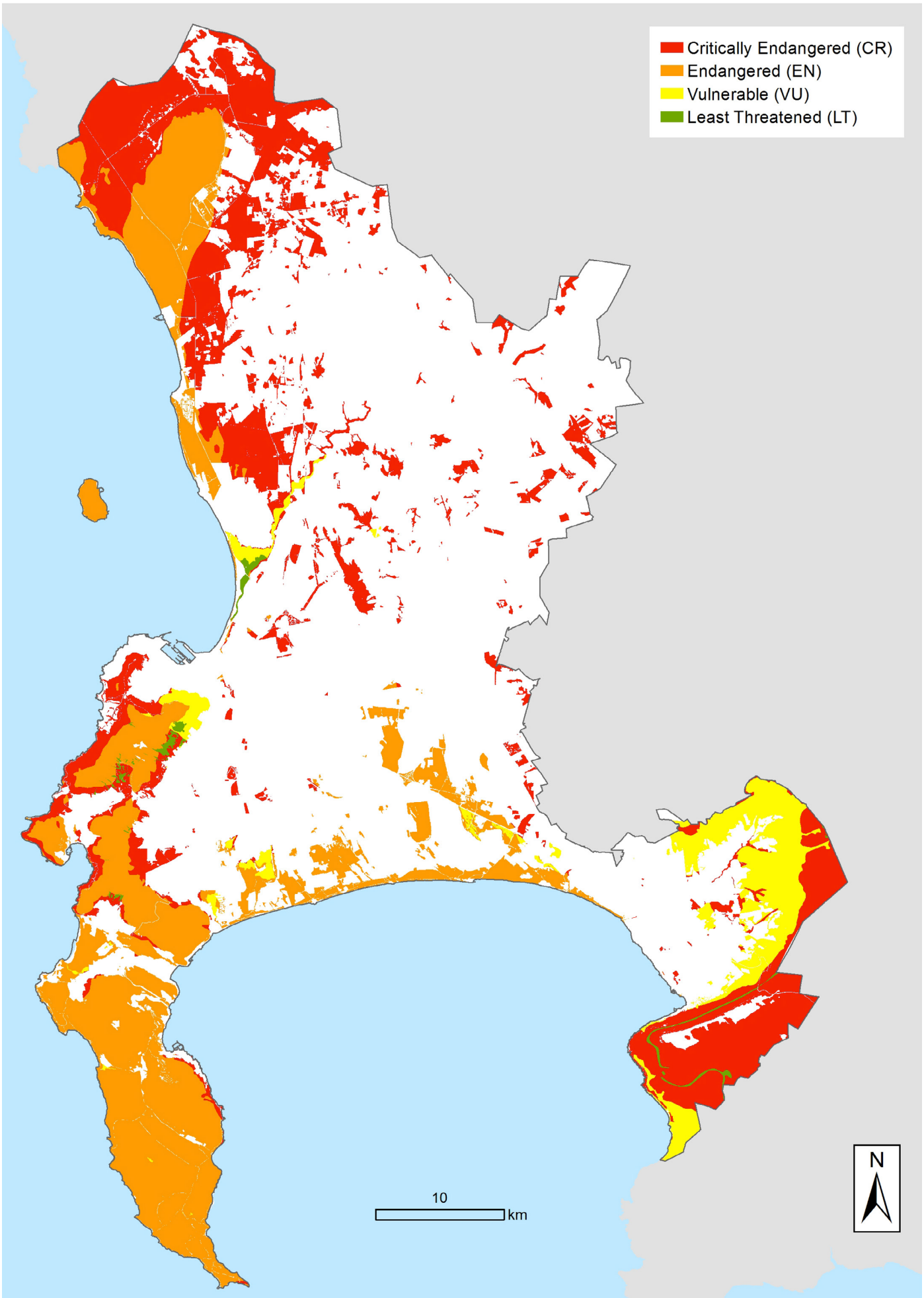
* Indicates vegetation types that have insufficient habitat remaining to meet minimum national targets. *Italicized* and **bolded** vegetation types are endemic to Cape Town and can only be conserved within the city area.



Map 3: Historical distribution of indigenous vegetation in Cape Town[17]



Map 4: Current extent of indigenous vegetation in Cape Town[18]



Map 5: Ecosystem status of indigenous vegetation in Cape Town[19]

Key management responses

The City runs a number of programmes to promote the sustainable conservation of fauna and flora, with a key focus on job creation 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 a multi-stakeholder landscape initiative. The area is a conservation priority for CapeNature (highlighted on 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[20]. It is included in the BioNet and is also acknowledged as a conservation area on the City's Spatial Development Framework. The DCCP is prioritised on the basis of having extremely high biodiversity value, with some of the most extensive critically endangered lowland habitat within Cape Town. It comprises the last relatively intact and ecologically functional area of critically endangered and poorly protected Atlantis Sand Fynbos, and includes critically endangered Swartland Shale Renosterveld, Swartland Granite Renosterveld, Swartland Silcrete Renosterveld and endangered Cape Flats Dune Strandveld habitat.

The area is 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, but clearing alien vegetation will also enhance the productivity of the aquifer. Recreation and tourism activities, such as Mamre Heritage and the 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 (No. 57 of 2003).

The Atlantis revitalisation scheme

In May 2013 Council approved the Atlantis Industrial Incentive Scheme, which includes biodiversity off-sets in the targeted area. Over 906 hectares of vacant land in Atlantis contains critically endangered Atlantis Sand Fynbos and/or endangered Cape Flats Dune Strandveld vegetation and numerous plant species of conservation significance. The mitigation for the loss of this biodiversity requires the identification of an off-set area or financial contribution to biodiversity conservation and is therefore an additional cost and deterrent to investment in Atlantis. By proactively purchasing and conserving key biodiversity properties outside the urban edge within the DCCP, these conservation gains can be used to proactively mitigate the loss of biodiversity remnants within the urban edge and industrial area of Atlantis, thereby facilitating new investment opportunities in Atlantis.

This scheme is supported by the provincial Department of Environmental Affairs and Development Planning, which is the competent authority to process 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.

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 effective management of areas designated for biodiversity conservation in protected areas such as nature reserves. The Management Effectiveness Tracking Tool (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, World Wildlife Fund (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 interventions required to ensure management effectiveness 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 first METT-SA audit of the City's Nature Reserves was conducted in 2007. This 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 identification of steps towards reaching METT standards, an assessment tool, the Protected Area Review (or PA Review,) was designed to be conducted at each nature reserve annually to break these steps up into achievable targets.

The City conducted METT-SA audits in 2007 and 2012, and has conducted the PA Review every year since 2007, showing gradual improvement in scores with an increase from 49% in 2007 to 76% in 2016. Comparison between 2007 and 2012 METT-SA overall scores for the City's Nature Reserves shows an increase from 40% in 2007 to 51% in 2012. The next METT-SA audit was scheduled for August 2017.

Trend and target

Trend: More land is being proclaimed, but biodiversity remains under threat

Target: 65% of the BioNet conserved by 2019

Current: 64% of the Biodiversity Network is formally conserved

Policy linkages

IDP: Strategic Focus Area 1 – The Opportunity City

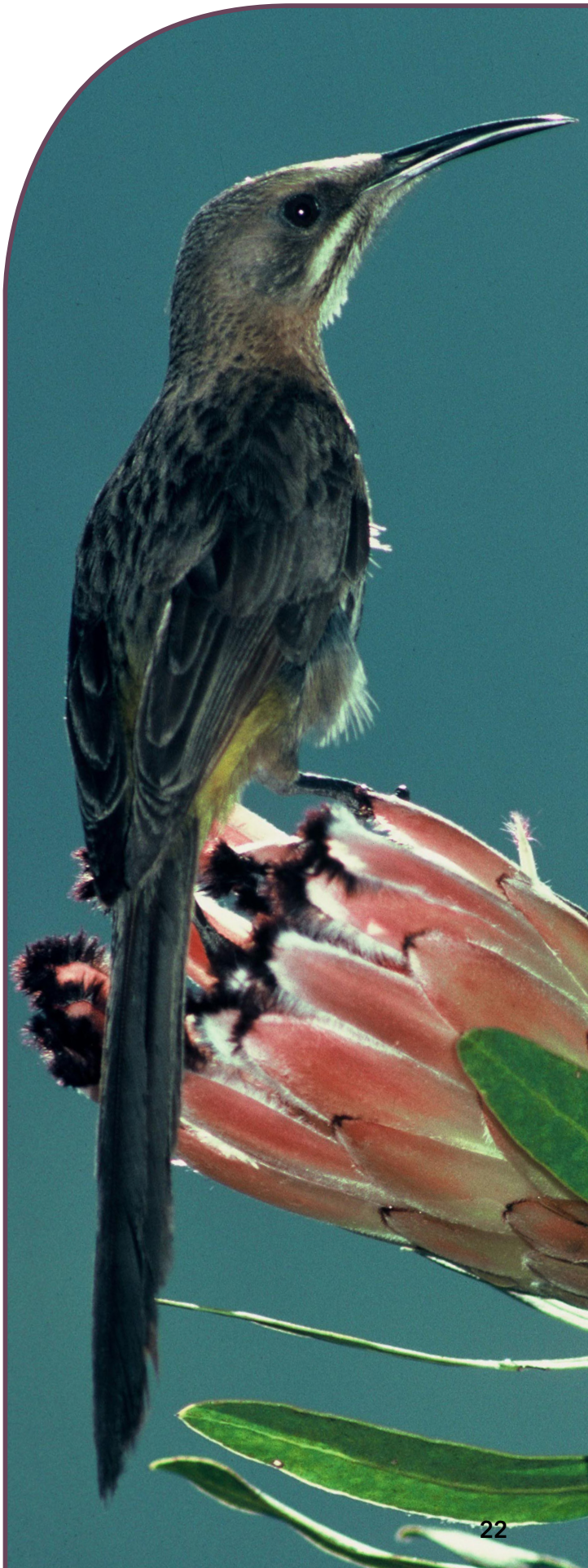
Environmental Agenda 2009 – 2014: Target 1 – Biodiversity

City of Cape Town Bioregional Plan: 65% Target for 2019

Local Biodiversity and Action (LAB) programme: Local Biodiversity Action Plan (LBSAP) 2009 – 2019.

Sustainable Development Goal (SDG) 15: Life on Land

See also: *Chapters on Invasive Alien Species and Natural Public Green Spaces.*



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"[21]. 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 numbers, 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[22].

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 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 indigenous plants.
- Alteration in nutrient content of soils by invasive species with negative effects on the indigenous ecosystem.

Invasive alien species

Many different types of species, both plant and animal, are deemed to be invasive in Cape Town. National guidelines set by the National Environmental Management: Biodiversity Act (NEMBA) categorises the status of invasive species. The City of Cape Town adheres to these categories and addresses them as part of their environmental management responsibilities. The categories set out by NEMBA and their management actions are outlined in Table 2.

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 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 2: NEMBA Categories

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

Name	Description	NEMBA Category
Invasive alien plants and trees		
Black Wattle ***(Acacia mearnsii)***	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, increases fire severity and uses 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. Uses significantly more water than native fynbos vegetation.	Category 2 for plantations and wind-rows 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	NEMBA Category 1b in riparian areas, protected areas and fynbos. NEMBA Category 2 for plantations, woodlots, bee-forage areas, wind-rows and the lining of avenues.

Table 3: Most problematic invasive tree species in Cape Town

Methods of control

In response to threats posed by invasive species the City of Cape Town 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 the plant's natural enemies to reduce the invasive plant's competitive edge. Using 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 school children.
More information can be found on the Cape Town Green Map.

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 of seedlings or cutting down smaller plants with hand tools.
- Herbicides – 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 – 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 new habitat.

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 in specific programmes. Each species has an existing specific control programme or one that is still to be developed.

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.

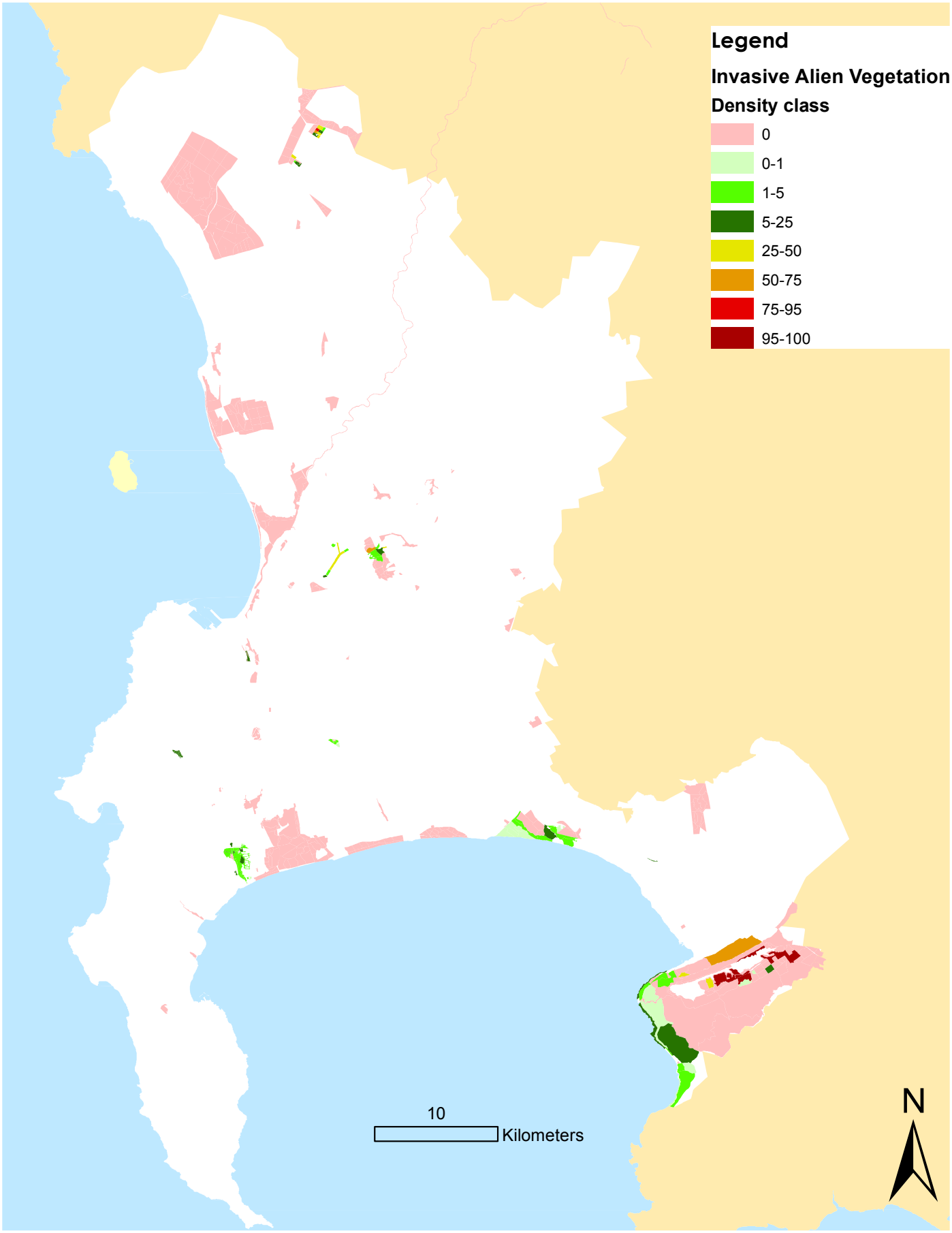
The EDRR programme currently prioritises 28 plant and animal species that can potentially be eradicated in Cape Town (click here). Cape Town residents can contribute to managing invasive species and report sightings of target plants. Members of the public are encouraged to inform the Invasive Species Unit if any of their targeted species are spotted 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 137 listed invasive alien plant species, including weedy plants and trees across the 16 protected areas managed by the City, of which 11 are Category 1a, 102 are Category 1b, 13 are Category 2 and 11 are Category 3. In addition, the City also controls approximately 93 other species that are not listed as invasive alien species but which have 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 4 000 hectares of protected areas in Cape Town are alien-free, while 2 842 hectares have extensive or dominant invasive alien vegetation cover. About 3 000 hectares of habitat still need to be assessed in detail. The extent of invasive alien vegetation in protected areas is indicated in Map 6.

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 assessed-species have reduced the abundance and impact of the alien species, while only 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, control of the *Nymphaea mexicana* (Yellow water lily) has an effectiveness rating of '2'. There has been no significant impact on this invasive species using manual and chemical control methods. The inability to control this species highlights its rapid ability to spread by quickly covering water surfaces with large flat leaves. The rapid spread of this species reduces water movement and displaces other submerged aquatic plants as well as depriving water bodies of oxygen[23].



Map 6: The extent of invasive alien vegetation in the City of Cape Town nature reserves

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
Lythrum salicaria	1a	manual	4
Melaleuca hypericifolia	1a	manual, chemical, mechanical	4
Myriophyllum aquaticum	1b	biological	4
Nymphaea mexicana	1b	manual, chemical	2
Pennisetum setaceum	1b	manual, chemical	4
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	4
Verbesina encelioides	NL	manual	4

Table 4: Alien species assessed for clearing methods in Cape Town:

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

Key management responses

The Kader Asmal Integrated River Catchment Project

In addition to day-to-day invasive species clearing operations and the EDRR programme, the City of Cape Town has established the Kader Asmal Integrated River Catchment Project. This project is integral to the clearing of invasive species through skills development, green job creation, and environmental education. The project was established by Mayor Patricia de Lille to honour the late Kader Asmal, a former Minister of Water Affairs who was passionate about creating jobs and conserving water and who established the Working for Water (WFW) programme.

As an inter-departmental, multi-stakeholder initiative, the Kader Asmal project aims to contribute to a healthy and sustainable natural environment for the benefit of all in Cape Town. This is achieved by uplifting communities through developing skills and capacity, as well as creating job and small business opportunities in the ecosystem service sector. The programme achieved its objectives through facilitating inter-departmental collaboration in implementing and managing job creation projects.

During the 2015/16 financial year, 2 305 work opportunities were created for people indirectly employed by skilled small, medium and micro-sized enterprises (SMMEs). This equates to a total of 620 full-time equivalents.

The objectives of the programme are to:

- Control invasive alien species through labour-intensive methods.
- Restore biodiversity by propagating indigenous plants and re-vegetating cleared areas.
- Mass-rear biological control insects, helping 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, skilled and unskilled labourers. The team has a variety of different skills, with chainsaw operators, herbicide applicators, re-vegetation and general labour skills.
- Work with communities to roll out a river warden system.

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.

Target: Environmental Agenda 2014 Target: 60% of protected areas and biodiversity network to be cleared and under maintenance; populations of significant animal invaders to be eliminated.

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

Policy and linkages

IDP: Strategic Focus Area – The Opportunity City

Framework for a Strategy and Action Plan for the Management of Invasive Species in the CCT (2008)

Environmental Agenda 2009 – 2014: Target 2 – Alien Invasive Species

City of Cape Town Bioregional Plan (2015): Invasive Species Management (ISM)

SDG 15: Life on Land

See also: *Chapter on Biodiversity.*

CHAPTER 3: NATURAL PUBLIC GREEN SPACE

Understanding natural public green space in Cape Town

Indicators:

- 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 contained within the United Nations Sustainable Development Goal 11[25]: Make cities inclusive, safe, resilient and sustainable.

The City of Cape Town has also recognised 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, bird watching and boating (among others), while also providing for spiritual, aesthetic and educational needs, and meeting the needs of children to have an open and well-managed environment in which to play. Environmentally, these spaces allow for both the conservation of biodiversity and the provision of various other ecological goods and services. Economically, the significance of these spaces is in sustaining Cape Town as an attractive tourism and investment destination.

The importance of public green space is reflected in various City planning documents. The City's Spatial Development Framework (SDF) prioritises the conservation of biodiversity and green space within the urban fabric and recognises it as a vital informant of the future development of the city. The SDF specifies that the City's Biodiversity Network and targets need to be taken into account in future planning and underpins the incorporation of green spaces.

The City's Urban Design Policy, approved in 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 increase accessibility to all facilities[26].

Through policies such as the SDF and the 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.

This report notes that that 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 and large district parks that are able to support a range of biodiversity, greenbelts and river corridors, and smaller parks that do not have a significant biodiversity function but which provide recreational space. Managed public green space will generally have some measure of basic facilities, such as toilets, picnic spots, parking areas, on-site staff, or 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 that are managed as nature reserves by the City, provincial and national government and 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. This report focuses on natural public green space.

Guidelines

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. The standards are to be used for all new developments and city planning as a strategic guide for space allocation at neighbourhood, district, and metropolitan scales in order to facilitate improvement of quality of life for all residents. The guidelines provide space allocations for semi-natural public green spaces according to surrounding residential population and their accessibility to these spaces. They provide standards for district, regional and community parks amongst other City public open spaces and facilities.

The guidelines, however, do not provide standards for natural public green space. This is a result of many factors but is particularly due to the uneven geographical distribution of these spaces. This report makes use of the English Nature guidelines for the provision of managed natural public green space to identify the distribution of natural public green space in Cape Town. These spaces include the coastline, greenbelts, biodiversity areas, 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:

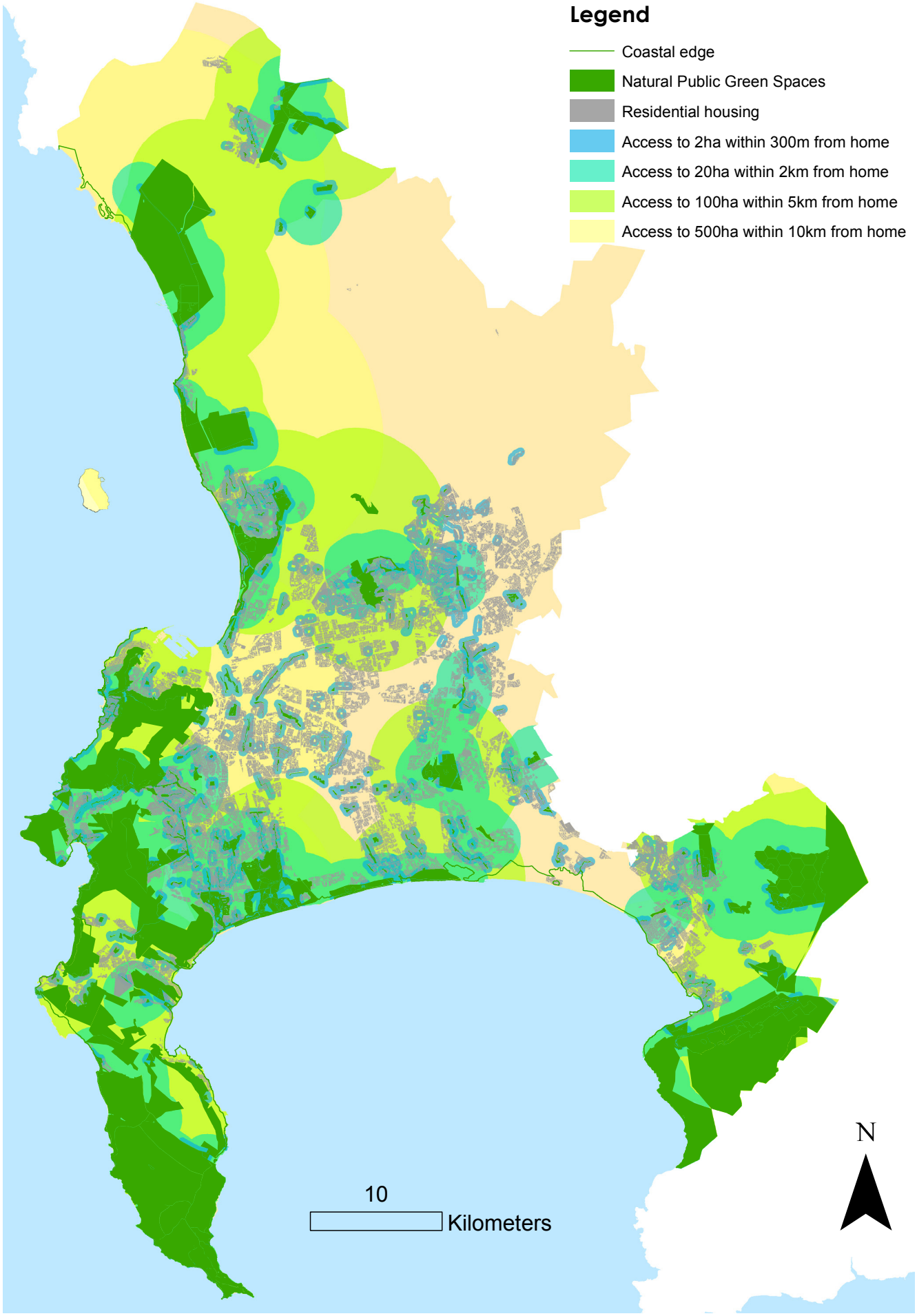
- At least one accessible 2-hectare site within 300 m of home
- At least one accessible 20-hectare site within 2 km of home
- At least one accessible 100-hectare site within 5 km of home
- At least one accessible 500-hectare site within 10 km of home

State of the environment

The City currently manages 13 district parks and 354 greenbelts across Cape Town, accounting for just over 1 349 hectares of natural public green space. There is also 307 kms of coastline and over 45 000 hectares of accessible protected areas (nature reserves).

Accessibility to natural public green spaces larger than two hectares is shown in Map 7. 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.

However, in the central and northern areas of the city 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, while some areas require the development of undeveloped public open space to create a functional space and a sense of place for residents to access. 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, elderly people, and disabled people can all contribute to under-use of natural public green spaces.



Map 7: Distance to Natural Public Green Space in Cape Town

Key management responses

The City takes numerous steps to ensure access to well-managed natural public green spaces. One such step includes the prioritisation and implementation of the Biodiversity Network and expansion of the City's network of nature reserves and protected areas. Significant focus has also been placed on the coastline as a key recreational natural public green space. Alongside the rich natural environmental resources, the City has prioritised a number of projects that create and enhance the functionality of space for residents and visitors through the development of district or regional parks that incorporate biodiversity elements.

Creating functional and natural spaces

There are numerous innovative programmes that highlight the City's public parks planning. Most pertinent is the introduction of regional parks in recent years. These parks operate similarly to district parks, offering similar functions but at a much larger scale. Currently there are two regional parks, the Valhalla Park Family Recreational Centre and the 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 recreated through managed landscape architectural features. Visit the City's website to explore all the natural public green spaces and open spaces in Cape Town.

Accessibility

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, as well as improving 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 reverse the legacy of apartheid spatial planning. The proposed routes include connecting Wynberg and Khayelitsha, Mitchells Plain and Claremont, Khayelitsha and Century City, Klipfontein Road corridor connecting Mitchells Plain and the city centre, and 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.

Trend and target

Trend: The indicator does not change significantly over time. However, with the introduction of two new regional parks, Valhalla Park Family Recreational Centre and the Green Point Urban Park, access to public green space has improved. Access still remains an issue in many places.

Target: There are no formal targets set for natural public green space. However, the 2019 target of 65% of the Biodiversity Network under formal conservation is on track to being met. The 2014 guidelines and standards for planning City social facilities and recreational spaces are widely incorporated into City planning.

Current: On average, the proximity of natural public green space is sufficient. However, access to these spaces remains problematic in some areas.

Policy linkages

IDP: Focus Area 4 – The Inclusive City

Environmental Agenda 2009 – 2014: Target 1 – Biodiversity.

SDG 11: Make cities inclusive, safe, resilient and sustainable.

Urban Design Policy (2013)

Spatial Development Framework (SDF)

City of Cape Town Bioregional Plan: 65% Target for 2019

See also: *Chapters on Biodiversity, Fresh Water Quality and Coastal Water Quality.*

CHAPTER 4: FRESHWATER QUALITY

Understanding freshwater quality in Cape Town

Indicators:

- Compliance with Department of Water and Sanitation standards
- Trophic tendency in freshwater systems

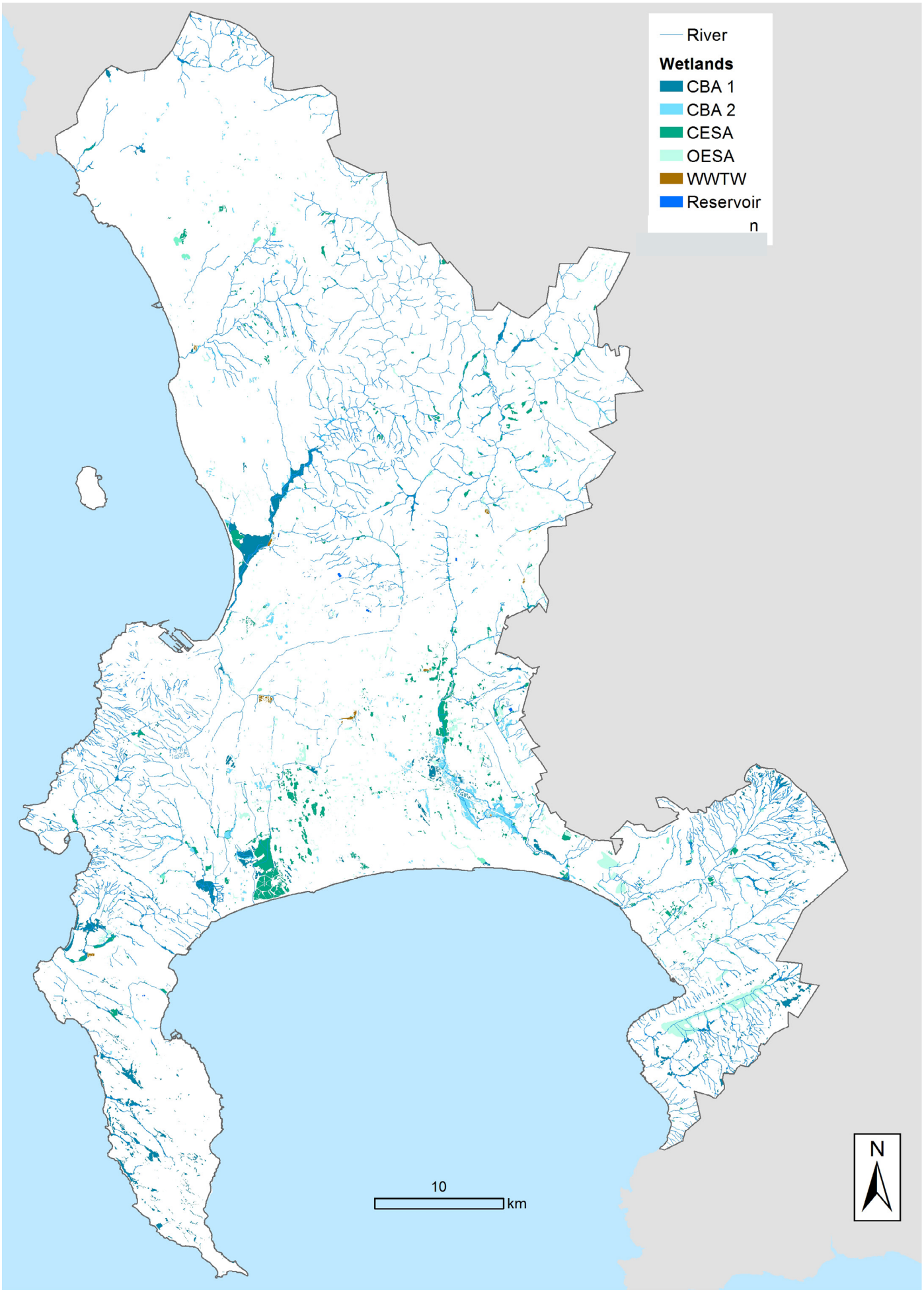
Cape Town is home to a substantial network of rivers and wetlands, as shown in Map 8, that perform a dual function. While acting as a habitat for aquatic fauna and flora, the freshwater system also acts as a natural infrastructure asset for the management, treatment and conveyance of storm water and treated wastewater effluent.

The City's constructed storm water infrastructure (road-side gutters, sidewalk inlets, pipes, canals and detention ponds) merges directly with the freshwater and coastal receiving environments. To manage these connected systems, an integrated management approach is essential for the protection of the environment.
The City promotes the concept of water sensitive urban design (WSUD) to move towards a 'water sensitive city'. This approach includes the focussed management of storm water using established urban watershed and sustainable urban drainage system (SUDS) management tools.

However, on-going organic and inorganic pollution and littering of Cape Town's storm water and freshwater systems pose a threat to both biodiversity and human health. The City has the responsibility to address the multiple complex factors that impact water and water quality in Cape Town. This requires a multifaceted plan involving multiple departments and partnerships.

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 bird watching

In 2012 the City implemented the Inland and Coastal Water Quality Improvement Strategy and Implementation Plan to address water quality issues. With this strategy the City recognises that rivers, wetlands, and vleis have diverse ecological, aesthetic, recreational and infrastructure functions. These functions are essential elements of Cape Town, providing beauty, a sense of place, tourism and recreational and health benefits to residents and visitors. However, many of these watercourses are severely impacted by the surrounding urban and peri-urban areas. With this in mind, the strategy provides a framework to address inland water quality issues to achieve developmental objectives set out by the City. The plan has set priority areas for intervention, including the Disa River (Hout Bay), central Salt River catchments surrounding Athlone, Kuils River catchments below Bellville, Soet River, Mosselbank River (Kraaifontein), and Diep River/Rietvlei Wetland (Milnerton/Table View).



Map 8: Cape Town's freshwater system

Factors influencing water quality in Cape Town

A variety of factors contribute to water pollution in urban areas, including:

- Bacterial contamination due to inadequate wastewater collection and treatment.
- Spillage or disposal of sewage or grey water directly into the storm water system or natural environment within informal areas.
- Sewage overflows, due to accidental breakage or ageing infrastructure.
- Illegal disposal of industrial pollutants into the storm water system or natural environment.
- Run-off from agricultural activities, including fertilizer run-off and animal waste, adjacent to and within the city.
- Litter and illegal dumping in waterways.
- Loss of wetlands and other natural systems that provide a filtration function[27].

It is also recognised that the current drought that Cape Town and the surrounding Western Cape is experiencing has some implications for freshwater quality. However, due to water quality testing being conducted on a monthly basis it is difficult to measure the full extent of the drought on Cape Town's watercourses.

Evaluation of freshwater quality

The water quality of Cape Town's freshwater ecosystems is evaluated from two perspectives – public health (recreational contact) and ecosystem health. Both perspectives make use of indicators derived from the recommendations and guidelines of the national Department of Water and Sanitation (DWS), previously the Department of Water Affairs and Forestry. The dual importance and interdependence of people and the freshwater environment is acknowledged by both perspectives.

Public health and recreation

Microbiological data is used to determine the suitability of inland waters for recreational use, in accordance with the DWS intermediate contact recreational guideline. This guideline states that samples should not exceed 1 000 indicator organisms per 100 millilitres of water. Monthly samples are taken at monitoring points throughout the freshwater ecosystems. The percentage of samples with results less than or equal to the above guideline for a 12-month period is used to indicate whether each monitoring site meets the guidelines or not.

'Intermediate contact' includes recreational activities involving a high degree of contact, such as water skiing and windsurfing, as well as those that involve less, such as canoeing and angling. During these activities full immersion in the water is likely to occur only occasionally, compared with full-contact activities, such as swimming. The City of Cape Town does not support full immersion swimming or diving in any urban waterway due to potential risks posed by physical obstructions in the water, water quality impairment and the absence of formal lifeguard facilities.

Ecosystem health

To determine ecosystem health, the trophic state (extent of nutrient enrichment) or the ecological condition of the water body is analysed. The concentration of phosphorous in these water bodies is used as a proxy measure to identify this trophic state. Phosphorus is commonly identified as a key nutrient pollutant in urban and peri-urban areas. Too much phosphorus in a freshwater system leads to eutrophication. As plant material grows denser, or algal blooms develop, light penetration through the water column may be reduced. Large-scale die-off and subsequent decomposition of plants or algae can increase potentially toxic ammonia concentrations and reduce the oxygen content of the water, leading to compromised health and even death of fish and other aquatic life.

Trophic Tendency	Total Phosphate (mg/l)	'State' and typical conditions
Oligotrophic Low nutrient level	<0.005	'Excellent': Usually moderate levels of species diversity; usually low productivity systems with rapid nutrient cycling; no nuisance growth of aquatic plants or blue-green algae.
Mesotrophic Moderate nutrient level	0.005-0.025	'Good': Usually high levels of species diversity; usually productive systems; nuisance growth of aquatic plants and blooms of blue-green algae; algal blooms seldom toxic.
Eutrophic High nutrient level	0.025-0.125 Fair 0.125-0.25 Poor	'Fair' to 'Poor': Usually low levels of species diversity; usually high productive systems; with nuisance growth of aquatic plants and blooms of blue-green algae; algal blooms may include species that are toxic to humans, wildlife and livestock.
Hypertrophic Excessive nutrient level	>0.25	'Bad': Usually very low levels of species diversity; usually very highly productive systems; nuisance growth of aquatic plants and blooms of blue-green algae, often including species which are toxic to humans, wildlife and livestock.

Table 5: Prevailing environmental characteristics of varying phosphate levels

State of the environment

Public health and recreation

In 2009, the City set itself an internal target as part of the Integrated Metropolitan Environmental Policy (IMEP) Environmental Agenda that half of all water bodies (rivers and wetlands) in the city would achieve 80% adherence to the intermediate contact guideline by 2014. This means that at least 80% of samples taken in a year would need to meet the DWS guideline. Those water bodies that support intermediate contact recreational activities, such as sailing, canoeing and water-skiing (Zeekoevlei, Zandvlei, Rietvlei and Milnerton lagoons) should aim to achieve 100% of the guideline level by 2014. This target has generally not been met, according to 2016 water quality data, with only two of the water bodies achieving the 100% targeted guideline.

As indicated in Figure 1, in 2016 less than half of all rivers achieved 80% adherence to the IMEP target. Only the Sir Lowry's Pass, Schusters, Lourens and Silvermine rivers achieved the target. This is an improvement from previous reporting years. In 2012, only three rivers, the Schusters, Lourens and Silvermine rivers, achieved the 80% target.

Contrasting with the slight improvement of the rivers in achieving the target, over half of the wetlands and vleis in Cape Town achieved the 80% target. As Figure 2 indicates, eight wetlands and vleis exceeded the 80% target: Zoarvlei, Wildevoelvlei, Langevlei, Die Oog, Zandvlei, Zeekoevlei, Rietvlei and the Westlake Wetland. Zeekoevlei, Zandvlei, Rietvlei and Milnerton Lagoon were targeted to achieve 100% adherence to the target by 2014, as per the 2009 IMEP Environmental Agenda. In 2016, Westlake Wetland and Rietvlei had 100% adherence, while the Milnerton Lagoon achieved neither of the targets set for 2014.

Ecosystem health

In 2016, 10 out of 14 river systems and nine out of 13 wetlands exhibited eutrophic or hypertrophic characteristics, as indicated by Figures 3 and 4. Eutrophic and hypertrophic tendencies indicate that these water bodies have a poor ecosystem health. Two river systems, Silvermine River and Lourens River, had mesotrophic tendencies indicating good ecosystem health.

The health of freshwater ecosystems has maintained similar results to previous years. The 2012 State of the Environment Report indicated that seven rivers were hypertrophic (bad), three were eutrophic (poor), one was moderately eutrophic (fair) and three were mesotrophic (good). There were five wetlands that were hypertrophic (bad), four were eutrophic (poor), three were moderately eutrophic (fair), and only one was mesotrophic (good). When comparing 2016 data to the 2012 State of the Environment Report, the data indicates that river systems have on average maintained similar trophic tendencies. The Schusters River had increased trophic tendency in 2016, from mesotrophic to moderately eutrophic (fair). The Bokramspruit River also had increased trophic tendency and went from being eutrophic (poor) to hypertrophic (bad), according to 2016 data. Between 2012 and 2016, Westlake Wetland experienced an improved trophic tendency and is now regarded to be eutrophic (poor) after previously being hypertrophic (bad). The Glencairn vlei increased in trophic tendency between the 2012 and 2016 reports going from mesotrophic (good) to moderately eutrophic (fair).

Figure 1: Percent of test results for specific rivers in Cape Town which met the DWS intermediate contact guideline during 2016

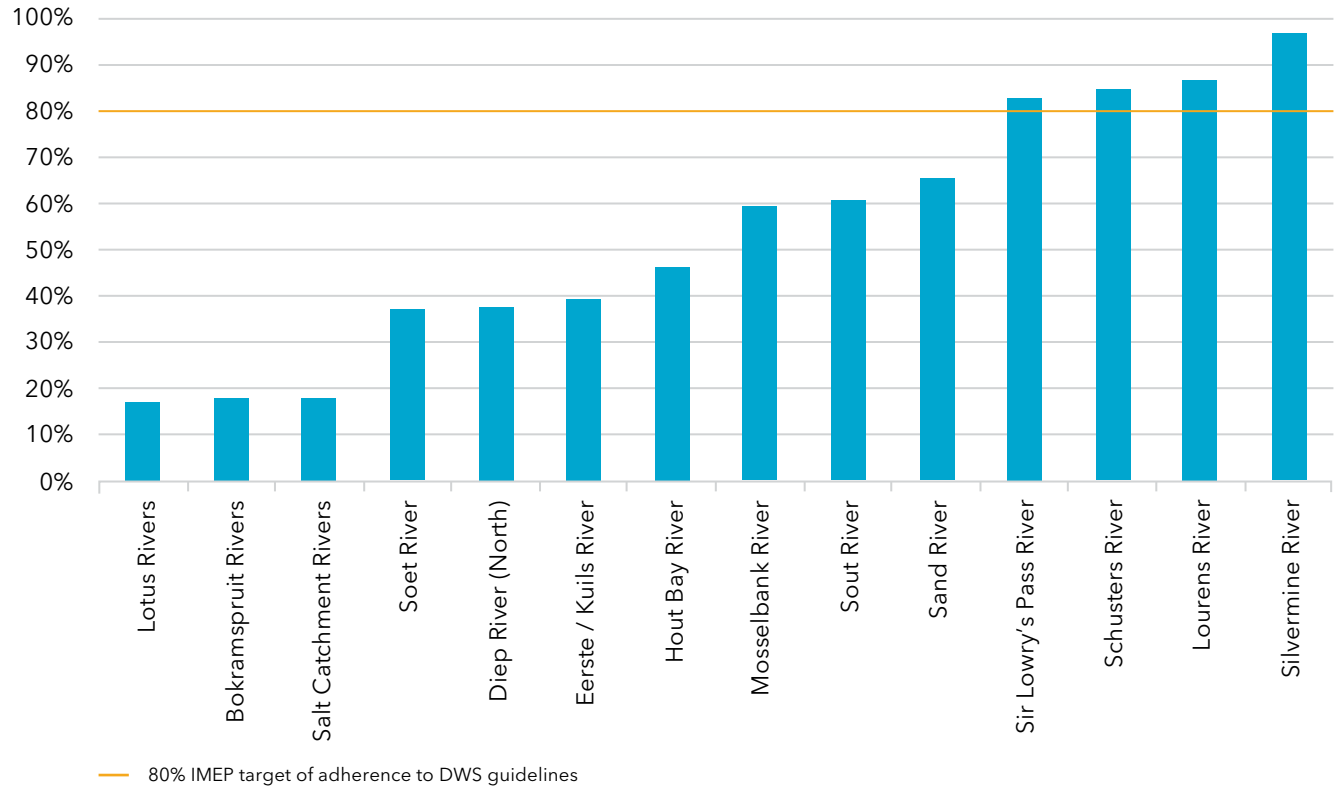


Figure 2: Percent of test results for specific wetlands and vleis in Cape Town which met the DWS intermediate contact guideline during 2016

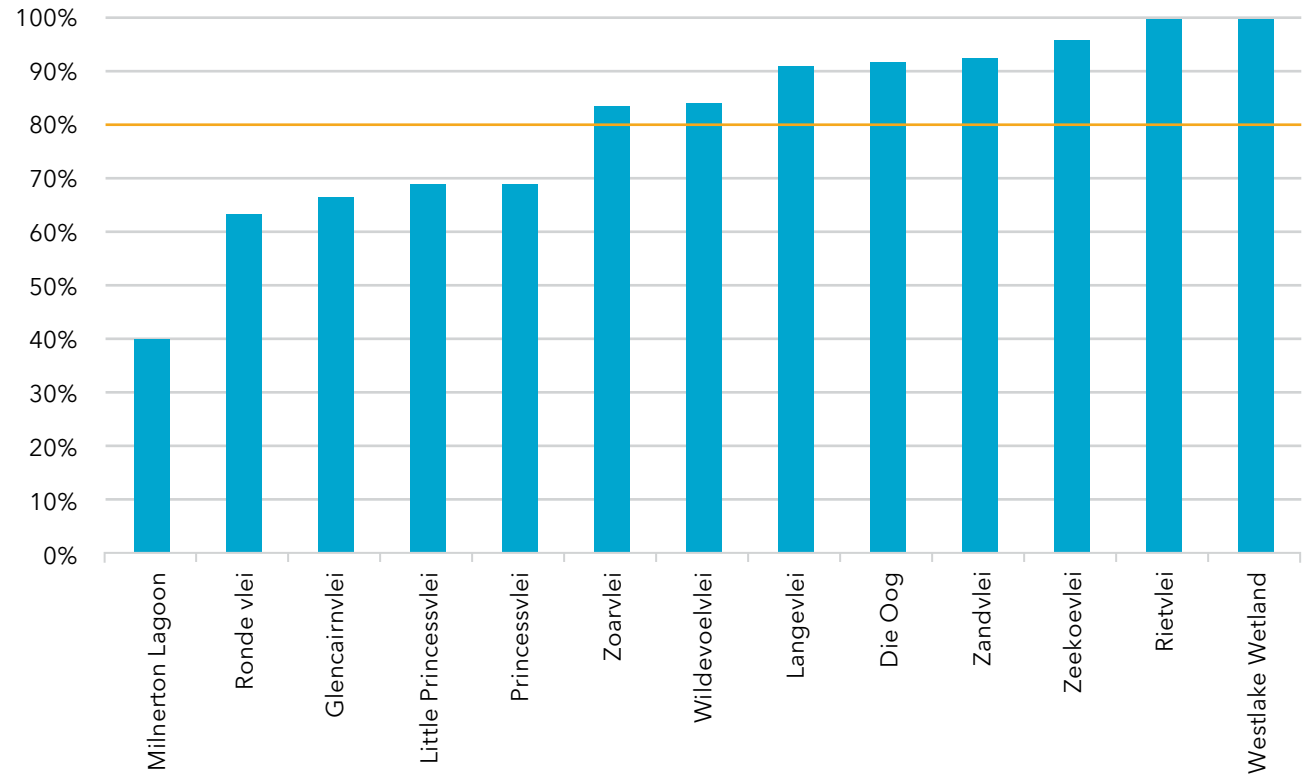


Figure 3. Trophic tendency in some Cape Town rivers during 201

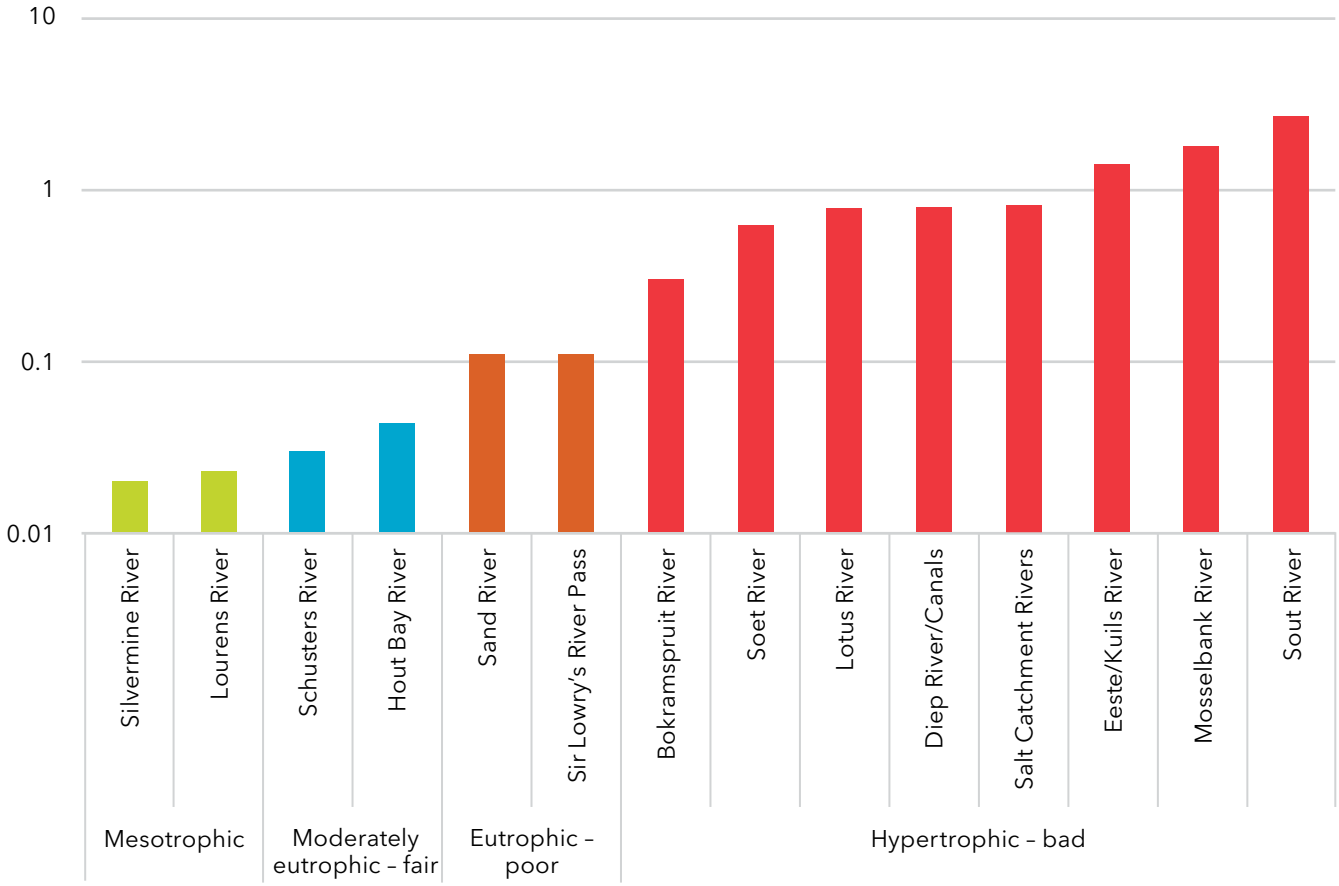
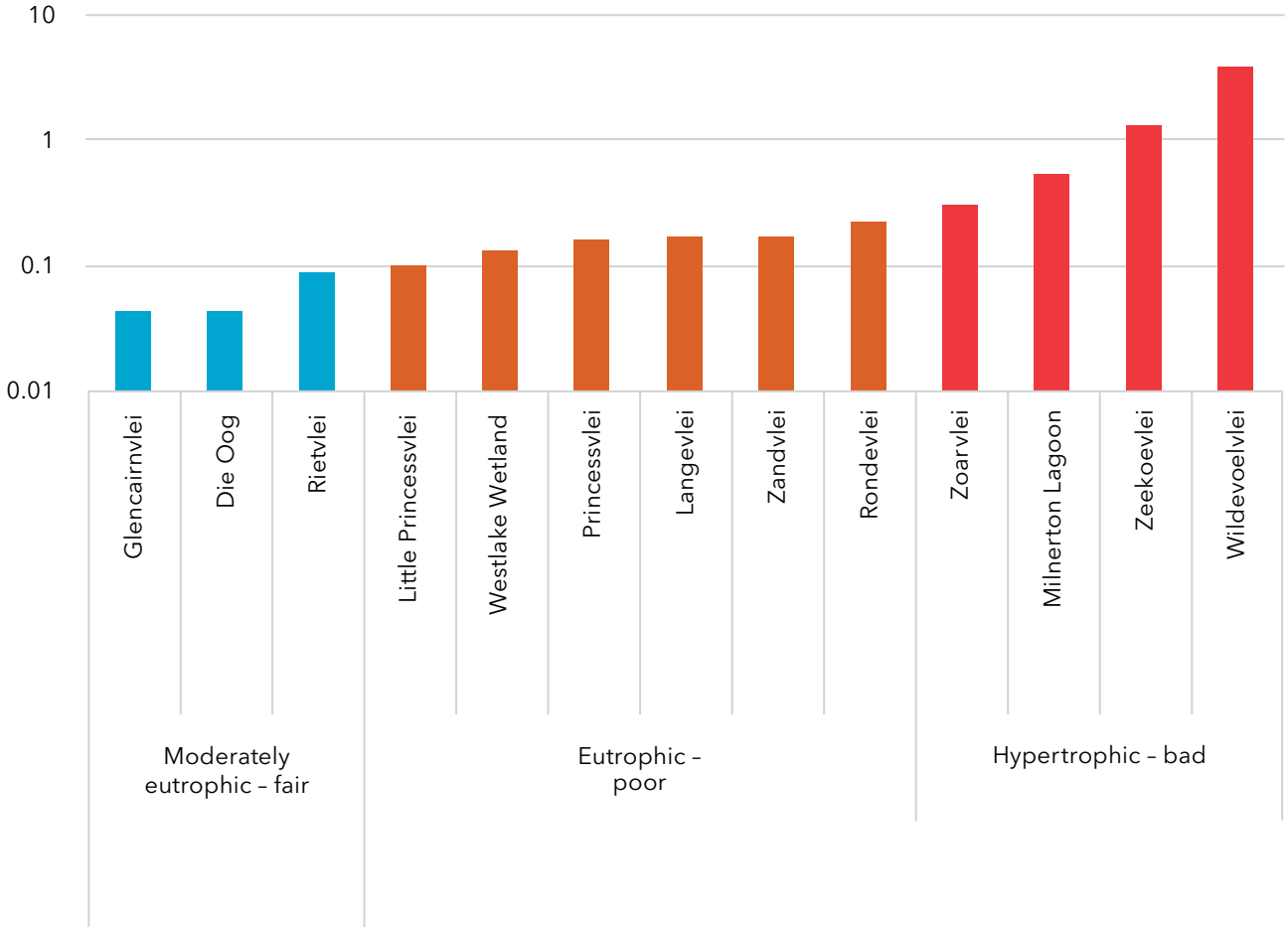


Figure 4: Trophic tendency in some Cape Town wetlands and vleis during 2016



Key management responses

The state of freshwater quality in Cape Town has seen a slight improvement from previous years. However, it still falls short of targets set in 2014. The inability for the majority of the rivers and a few of the wetlands and vleis to reach the IMEP 80% target and continuing high trophic levels is a result of a number of contributing factors. Trying to identify the exact reasons for improvements in freshwater quality is incredibly complex, as the City's attention and action to freshwater management has increased over time.

Contamination of the city's freshwater systems is primarily due to contaminated urban storm water 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 strains 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

There are no strict national standards for phosphorous concentrations in treated wastewater effluent that apply to City of Cape Town waste water treatment works (WWTW). However, the City makes use of general standards for phosphorous and has committed to new efforts in ensuring that WWTWs are able to remove phosphates effectively. This is currently being operationalised at the Wildevoelvlei WWTW.

It is important to note that bacterial pollution and nutrient enrichment do not always correlate. Some systems that have poor trophic tendencies may have good levels of compliance with bacterial guidelines, such as Wildevoelvlei. This is a result of effective disinfection of effluent discharged into the vlei from the adjacent Wildevoelvlei WWTW but a poor reduction in effluent phosphate levels. However, in the absence of man-made influence, wetlands and vleis will naturally accumulate more organic nitrogen and phosphorus, resulting in continuous nutrient enrichment, than rivers. Therefore, it is not possible to have all water bodies classified as oligotrophic and being able to meet both ecosystem and public-health guidelines. It is necessary, however, to ensure that the water systems do not change permanently into a higher trophic state.

In line with its intention to become a 'water sensitive city' and 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 storm water systems, improving aquatic weed and algae management measures, improving informal settlement servicing and managing databases to include downstream water-quality criteria, and eliminating sewer-to-storm-water cross connections, to name a few.

Furthermore, the City has partnered with a number of entities, including other spheres of government, neighbouring municipalities, business, 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 also implemented the national 'Adopt-a-River Programme' to encourage communities to adopt and clean dirty rivers. The City also 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: There have been some significant improvements in river and wetland health.

Target: IMEP Environmental Agenda 2009 – 2014 Target of half of all rivers and all vleis achieving 80% compliance with the public health recreational guideline.

Current: Less than half of rivers are meeting the 2014 target, but more than half of wetlands and vleis are meeting the target.

Policy linkages

IDP: Strategic Focus Area 3 – The Caring City

Inland and Coastal Water Quality Improvement Strategy

Storm Water Management By-law

SDG 6: Ensure access to water and sanitation for all

See also: *Chapters on Invasive Alien Species, Natural Public Green Space, Coastal Water Quality, Wastewater Quality, and Solid Waste.*

CHAPTER 5: COASTAL WATER QUALITY

Understanding coastal water quality in Cape Town

The Cape Town 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. One of Cape Town's most significant assets in terms of marine and coastal biodiversity, the coastline attracts high levels of tourism and recreational activities. 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.

Indicators:

Percentage adherence to DWS recreational coastal water guidelines

Water systems are interconnected. Efforts to improve the water quality of freshwater systems have significant impacts on the quality of coastal water systems.

Coastal water quality

Coastal water quality is impacted by numerous sources of bacterial pollution, with the three main sources being overflows from the sewage reticulation network, wastewater discharge from waste water treatment works (WWTWs), and storm water run-off. Final treated effluent from the 26 WWTWs in Cape Town is discharged into rivers flowing into the coastal environment or is released directly into the ocean after initial preliminary treatment (maceration and screening) via deep-sea marine outfall pipes. While this wastewater is treated in a manner which reduces contaminants in accordance with licenses issued by the Department of Water and Sanitation (DWS), overflows from the sewage reticulation network are serious, since the sewage flowing in this pipe network has not yet been treated at a WWTW, and thus very high levels of *E. coli* enter the environment as a result of such spills. If not addressed, these spills ultimately flow into the storm-water network and, from there, into rivers or coastal areas.

Storm water that is contaminated with pollutants may also significantly impact the water quality of coastal waters. Storm water flowing through inadequately serviced informal settlements often contains both grey water and untreated sewage as a result of residents using the storm-water network to informally dispose of household washing water and sewage. This form of domestic wastewater disposal is often caused by residents being unaware that storm water and sewage reticulation networks are not intended to be connected. Waste from domestic pets and livestock is an additional source of faecal contamination of storm water.

Coastal water quality is significantly influenced by rainfall patterns. Increased storm-water 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.

Effects of pollution

Polluted coastal water may detrimentally affect the health of humans swimming, surfing and diving in coastal waters and near-shore marine ecosystems. 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. The DWS has recommended coastal recreational guidelines aimed at safeguarding human health, which have been in place for a number of years. However, the Department of Environment Affairs (DEA) has taken over the mandate to manage coastal and marine waters and has recommended a new set of recreational guidelines which coastal municipalities are gradually switching over to.

80th percentile guideline (strict):

80% of samples must contain no more than 100 indicator organisms per 100 ml.

95th percentile guideline (relaxed):

95% of samples must contain no more than 2 000 indicator organisms per 100 ml.

Although the City has commenced monitoring coastal water quality in accordance with the new DEA guidelines, for the purpose of this report and to facilitate comparison with previous State of the Environment reports, coastal water quality results are reported in terms of the previous DWS South African Water Quality Guidelines for Coastal and Marine Waters (Volume 2: Recreational use). These guidelines set 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 target for faecal coliform (including E. coli) counts is based on 80th and 95th percentiles. These are calculated on long-term data sets typically covering a 12-month period. For public health reasons, in order for a beach to fully meet the guidelines, it must meet both targets.

State of the environment

Coastal water quality along Cape Town's coastlines has seen some improvement in recent years. Figures 5 and 6 highlight the adherence with coastal water quality guidelines on the False Bay and Atlantic coastlines between 1992 and 2016. In the past decade, the False Bay coast has met the guidelines on fewer occasions than in the previous decade. Adherence with the strict guideline was very low in 2008 and 2014, while adherence with the relaxed guideline was generally better. The Atlantic coast had significantly better adherence levels than the False Bay coast and generally experienced slight improvements in both strict and relaxed targets with the DWS guidelines. The Atlantic coast only experienced a significant decrease in adherence in 2014, similar to False Bay.

Map 9 shows the adherence to DWS guidelines for each beach in 2016. Adherence with coastal water quality guidelines can be explained by understanding the geographical and climatic factors of the coastline, as well as 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 Gordons Bay coastline, Fish Hoek and Simon's Town. Reduced mixing and circulation in these areas results in stagnation and trapping of poor-quality water close to the shoreline[28].

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 storm-water 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 storm-water systems.

The Atlantic coast's water quality has shown a slight improvement over time. The slightly higher compliance levels than along False Bay are likely the result of not having the same geographical and climatic factors and a more formalised storm-water and sewage system. However, the improvements are still lower than required in order to ensure full adherence with the guidelines. This could be a result of factors of the natural and urban environments along this coastline. 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.

Figure 5: Adherence of coastal water quality to DWS guidelines: False Bay coast

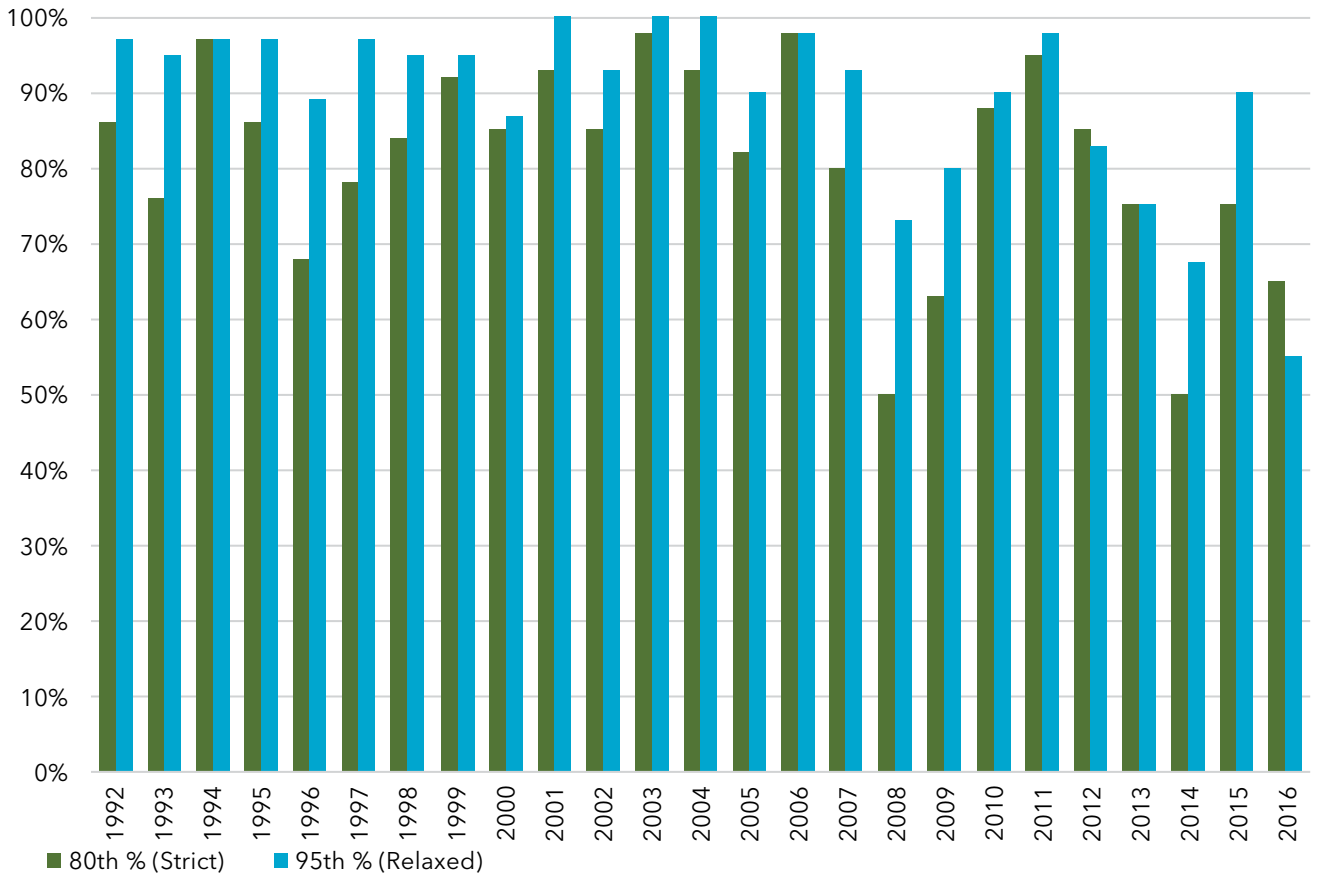
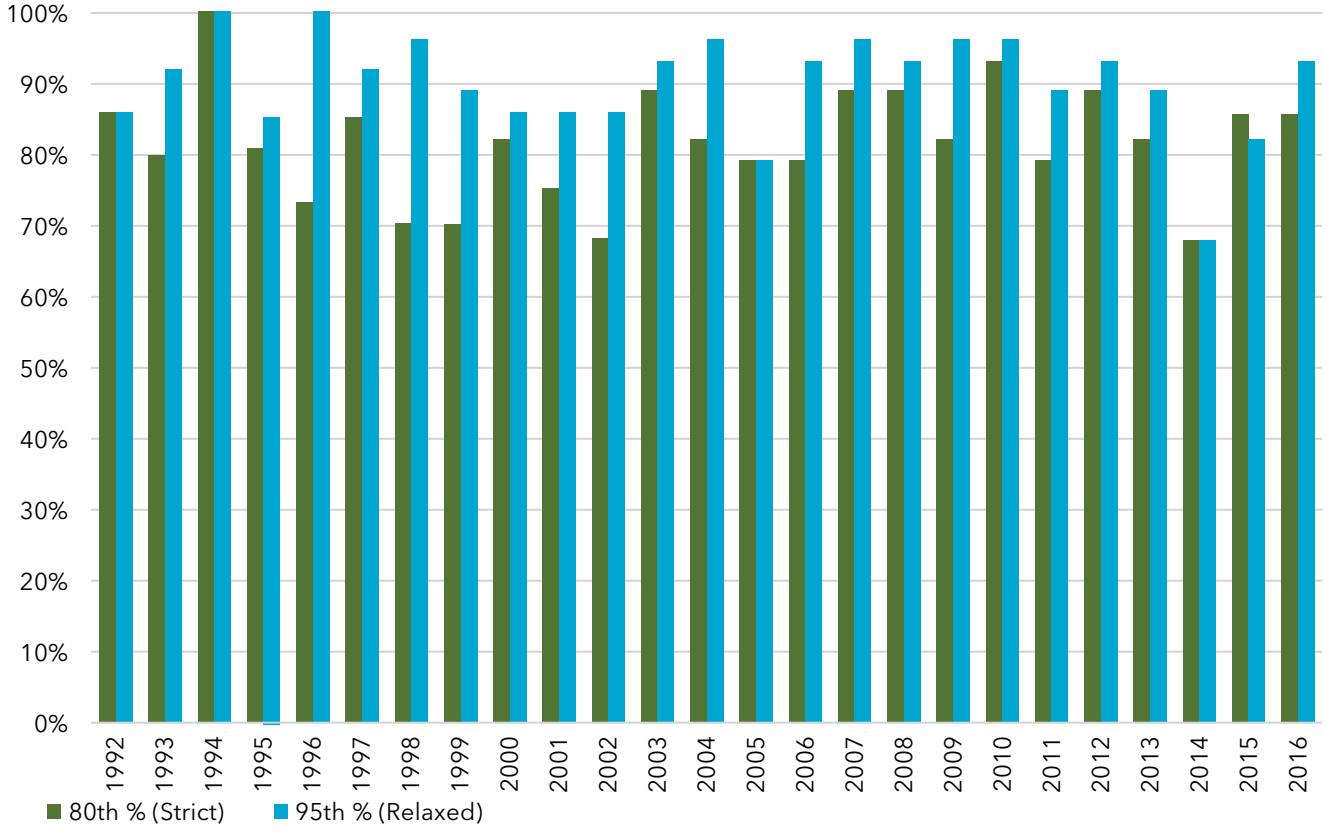
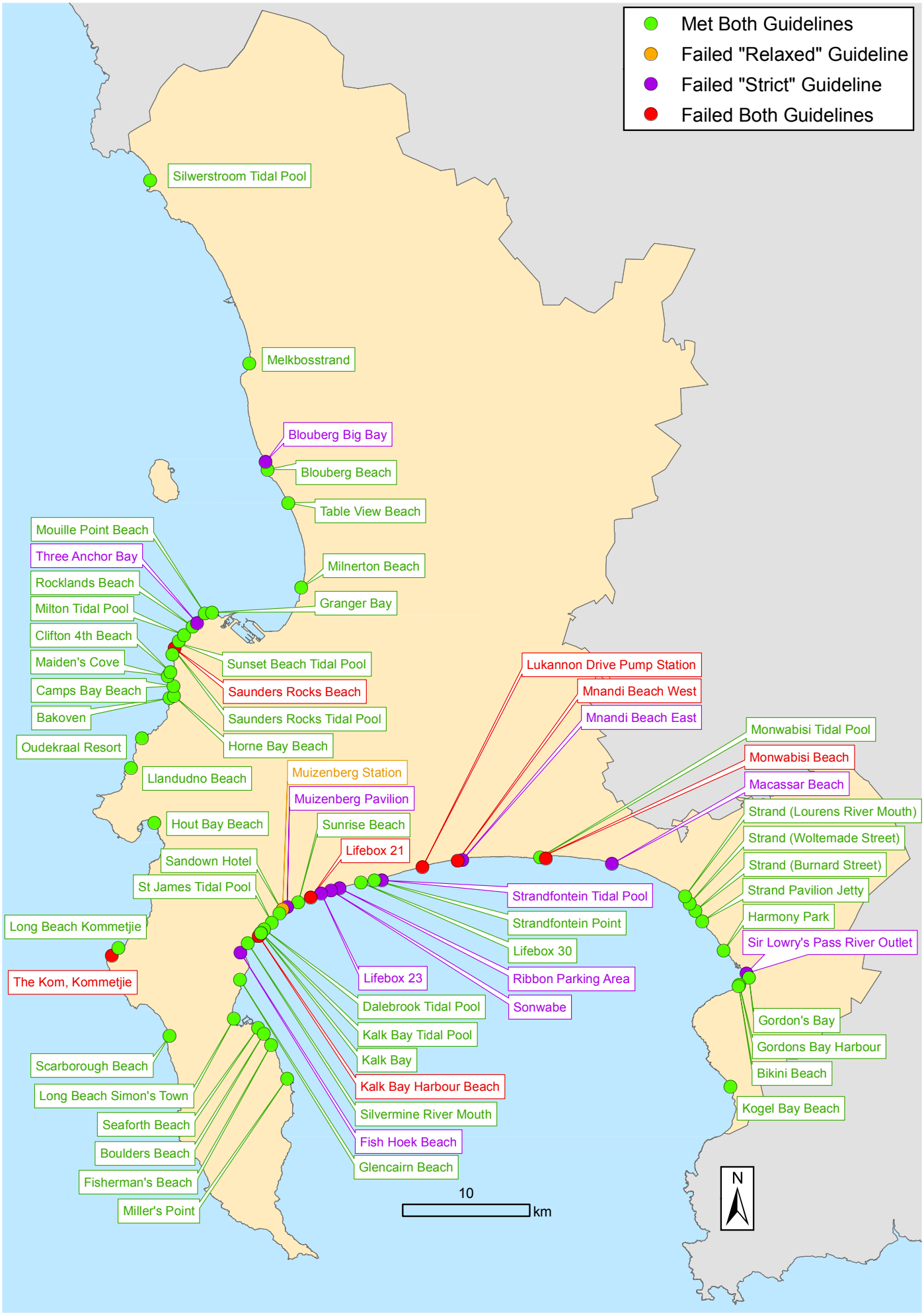


Figure 6: Adherence of coastal water quality to DWS guidelines: Atlantic coast





Map 9: Adherence to DWS guidelines for each beach in 2016

Key management responses

Ensuring a high standard of water quality is a complex task that requires the work of many City departments. Coastal water quality is impacted largely by land-based activities[29].

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-storm-water cross connections. The key management responses outlined in the Freshwater Quality chapter will also significantly benefit coastal water quality.

Revisit the freshwater quality and the wastewater chapters for more information on management responses that affect all water bodies in the city.

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 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.

Monitoring the coastal environment goes beyond monitoring water quality

Coastal dynamics

The dynamics of sandy beaches being influenced by waves, wind and currents are also 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. 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 of 2014, as well as in City-led projects focussed 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.

There are more than 70 beaches, tidal pools and estuaries along the city's coastline.

Explore these on the CCT website.

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 safety, amenity, cleanliness, environmental information and management[30]. The City strives to ultimately achieve this eco-label for all of its beaches. Table 6 outlines the Cape Town beaches that have been awarded Blue Flag status. Most, bar one, have held their status over several consecutive years. Blue Flag status is awarded on an annual basis and may be repealed and re-awarded once issues that resulted in the withdrawal of the award have been addressed.

To find out more on Blue Flag status browse through their website. Cape Town has 10 of the 40 Blue Flag beaches in South Africa.

These beaches have their water quality tested every two weeks to ensure that the quality is up to international standards. There are programmes in place at each of the beaches that ensure the safety, cleanliness, amenities and environmental standards of a world-class beach.

Beach	No. of years with Blue Flag status
Silverstroomstrand	6
Melkbosstrand	1
Clifton 4th	13
Camps Bay	9
Llandudno	6
Seaforth	2nd year of Pilot Status
Fish Hoek	1
Muizenberg	8 (Did not achieve the status in 2015/16)
Strandfontein	5
Mnandi	6
Bikini	13

Table 6: Blue Flag beaches in Cape Town

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 licencing 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 more informed sustainable decisions on which fish you eat and/or fish by following SASSI guidelines.

Trend and target

Trend: The False Bay coast has experienced variable adherence to coastal water quality guidelines in the last five years. The Atlantic coast has had a relatively stable trend over the last five years, with a large variance in 2012.

Target: 95% of coastal water quality monitoring points will adhere to coastal water quality guidelines (80th percentile guideline).

Current: 68% of sites (44 out of 64) adhered to the 80th percentile guideline.

Policy linkages

IDP: Strategic Focus Area 3 – The Caring City

IMEP Environmental Agenda 2009-2014: Target 7 – River and Coastal Health

SDG Goal 14: Life Below Water

Catchment, Storm Water and River Management Strategy: Aims to safeguard human health, protect natural aquatic environments and improve recreational water quality.

Catchment, Storm Water and River Management policies: Management of Urban Storm Water Impacts Policy.

By-law relating to Storm Water Management: Provides for regulation of storm water management and regulates activities which may have a detrimental impact on the City's storm water system, including natural receiving water systems.

Integrated Coastal Management Policy (2014): Envisions management of the coast as core city infrastructure, valued and protected as an asset for current and future generations.

See also: *Chapters on Natural Public Green Space, Freshwater, and Wastewater.*

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 resources. 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 about four million people.
In the current severe drought water supply is stretched to the limits, highlighting the city's position in a water-scarce region. Changing weather patterns due to climate change have contributed to the drought, with increasingly long, hot and dry summer months.

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

The City also 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
- 12 water treatment works
- 25 large (bulk) reservoirs
- Over 450 pump stations
- 26 wastewater treatment 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 high-quality water supply, and has won numerous awards, including:

- Multiple Blue Drop awards, indicating 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 a high-quality standard of waste water 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 litres per capita per day to meet essential requirements of health and hygiene. A larger quantity of about 20 litres 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, Act 108 of 1997, stipulates a daily minimum per capita supply of 25 litres. The WHO estimates that households with optimal access (piped water within the home) use between 100 and 300 litres per capita daily, while households with intermediate access (a single tap within the house or yard) would use approximately 50 litres per capita daily. The City's 2009-2014 IMEP Environmental Agenda envisioned a target of providing 180 litres of water daily per capita. This was based on a history of high water demand. The aim was to reduce the amount of water used in wealthy households and to ensure that poorer households are given increased access to water.

In the current drought conditions, the daily water consumption target per person has been drastically reduced. At the time of writing, in accordance with level 6b water restrictions, the City urges residential water users to use a maximum of 50 litres of water per person daily, with an overall total water demand target of less than 450 megalitres per day. These water restrictions can be found on the City's website.

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. With effect from 1 July 2017, the City provides indigent households with a monthly minimum free allocation of 6 000 litres of water, and informal settlements with free water. Previously, all households received 6 000 litres free. The tariff for residential customers for the 2017/18 financial year is outlined in Table 7.

Water Steps	Level 1	Level 2	Level 3	Level 4
Step 1 (>0≤6kl)	R 4.56 Free for indigent households	R 4.56 Free for indigent households	R 4.56 Free for indigent households	R4.56 Free for indigent households
Step 2 (>6≤10.5kl)	R 17.75	R 17.75	R 17.75	R 17.75
Step 3 >10.5≤20kl)	R 20.77	R 22.85	R 24.93	R 25.97
Step 4 (>20≤35kl)	R 30.76	R 37.22	R 41.53	R 43.69
Step 5 (>35≤50kl)	R 38.00	R 51.30	R 70.29	R 113.99
Step 6 (>50kl)	R 50.12	R 111.38	R 238.59	R 302.24

Table 7: Cape Town water tariffs as per water restrictions, including VAT, for 2017/18

State of the environment

Cape Town's water use has remained relatively stable over the last 20 years despite a rapidly increasing population.

In 2015 the city recorded its highest ever water usage with 357 865 Ml treated and used by city and external users, a drastic increase believed to be a result of prolonged warmer and drier weather. However, 2016 had the lowest water usage in the last 10 years, as indicated in Figure 7, with 311 011 Ml of water treated of which 9.9% went to external customers such as neighbouring municipalities.

In 2016 there were approximately 4 012 000 residents, with each one accounting for an estimated average of 190.86 litres of water per day. This was a decrease of 31.29 litres per resident per day from the previous year, in line with the trend of decreasing per capita use since 2009 but still higher than the 2014 Environmental Agenda target of 180 litres per capita daily. In July 2017 daily per capita water usage was 140 litres, which achieves the target. It also meets the WHO guideline and exceeds the 1997 Water Services Act guideline. However, this does not reflect inequalities in access to water and the varied amount of water used per person across Cape Town. Some residents only have access to shared water points rather than individual water points, which means not everyone has the same access to water, nor do all individuals use water in the same way.

The stability in water demand and the decline in water usage in 2016 follows the implementation of water restrictions and various City initiatives. These include award-winning water demand management and conservation initiatives and more water-wise planning.

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 shower heads. Water restrictions implemented during 2016 and 2017 have also contributed to reduced water usage.

The City has increased its efforts in reusing water, in accordance with water demand and conservation initiatives, as seen in Figure 9. Currently the City does not recycle water for drinking use but treats wastewater for reuse in industry and for watering golf courses and sports grounds. This is discussed in further detail in the wastewater chapter.

Public awareness videos can be found on the CCT website in English, Afrikaans and isiXhosa. These outline Water System Management, Water By-laws, leak prevention and more.

Figure 7: Annual water treated and provided by CCT, 1996-2016

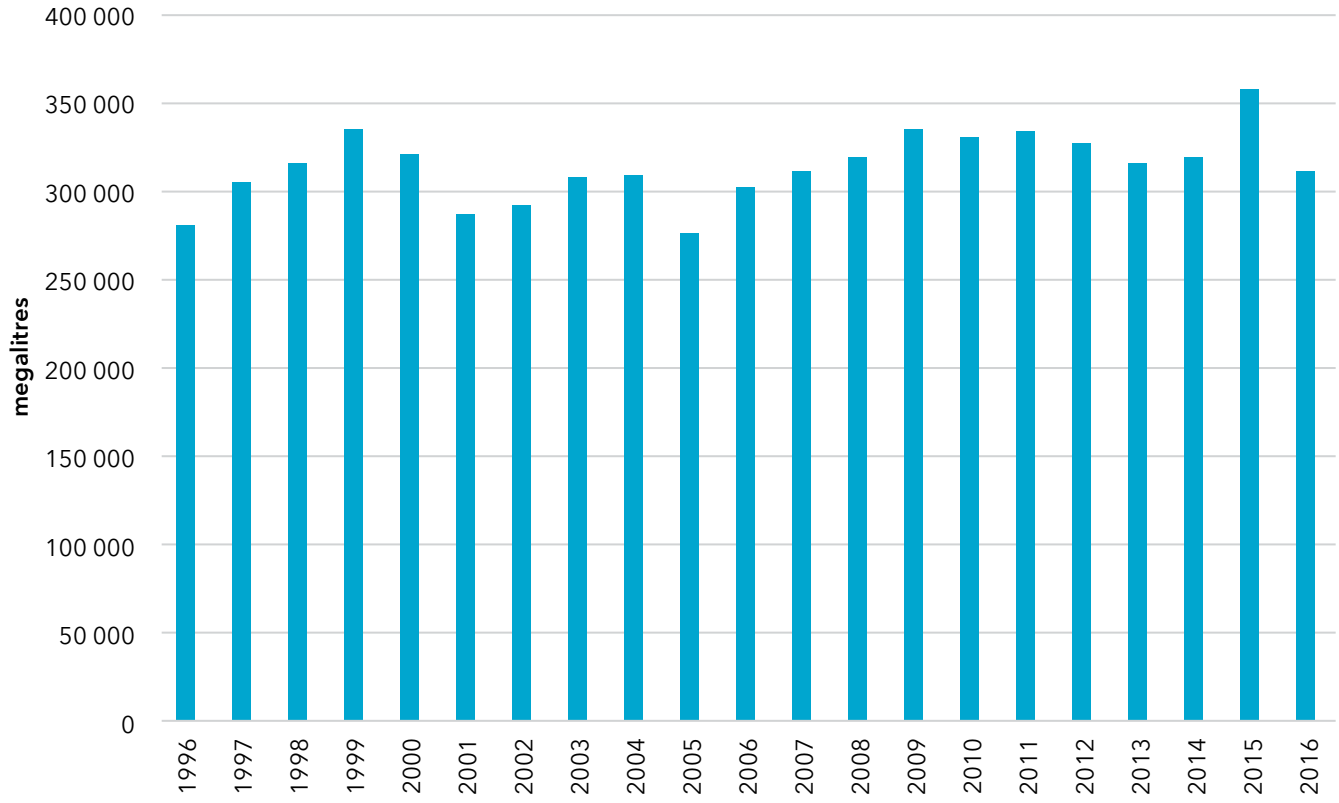


Figure 8: Daily water use per capita, 1996-2016

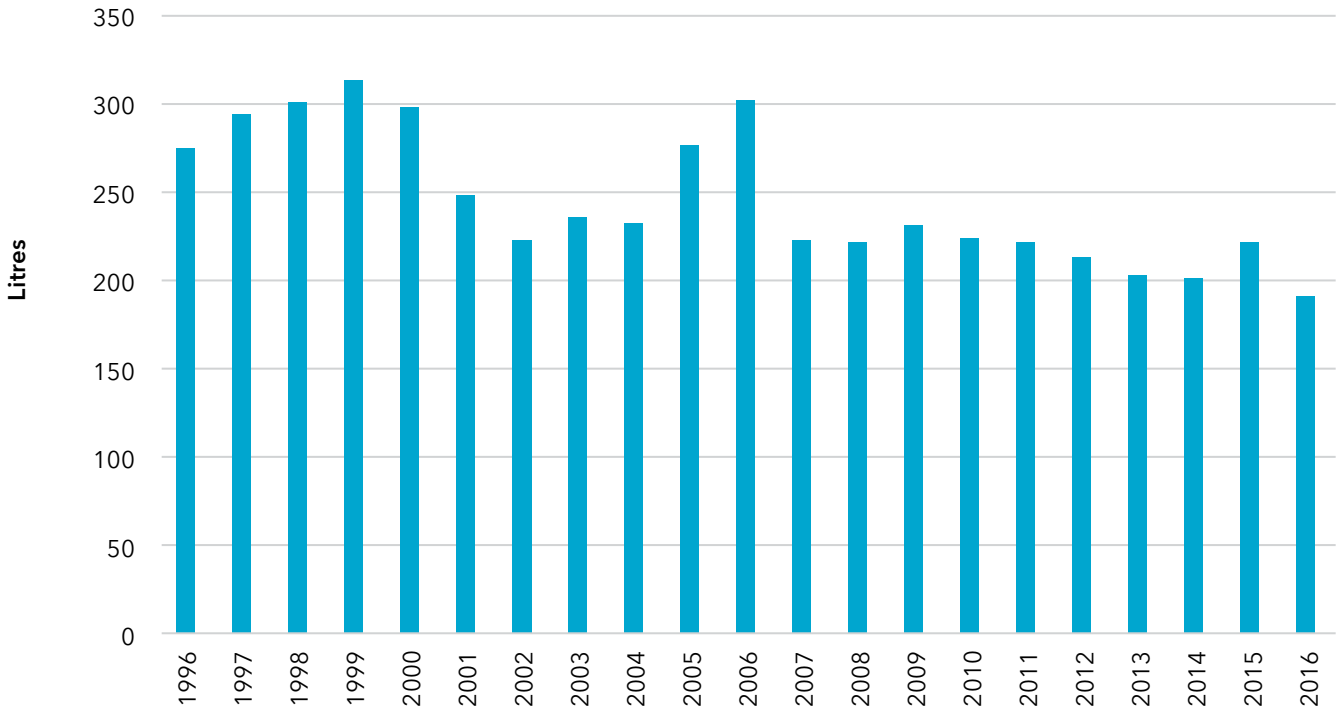
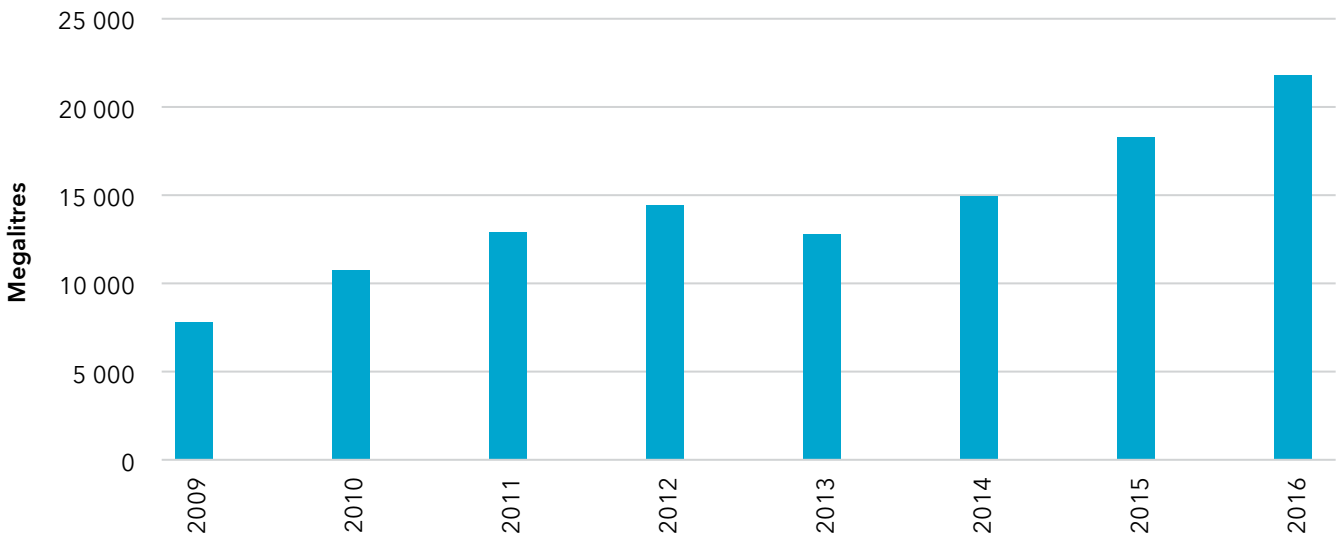


Figure 9: Megalitres of water reused, 2009-2016



Key management responses

The City has the responsibility of ensuring water security in the face of the challenges of increasing population, unpredictable weather conditions, natural water scarcity and the need to connect more people to water. 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, under the 'Family and Home' tab on its main page.

With water restrictions it is vital that municipal water is only used for essential washing, cooking and drinking purposes.

Two major programmes to reduce water usage

One of the initiatives to curtail water demand described in the City's 2012-2017 IDP is the reuse of treated effluent. 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, agriculture and in industries. This reduces the use of municipal drinking (potable) water for activities other than for essential health and hygiene purposes, such as drinking, cooking and bathing.

In 2007, the City implemented a Water Conservation and Water Demand Management (WCWDM) Strategy after the success of earlier programmes. The strategy aims to minimise water losses and promote efficient water use by focusing on 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, 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, pressure management, pipe replacement programmes, leak detection and improved meter management.

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 to reduce water use now and in the foreseeable future. Each person needs to be water conscious and forward thinking, as the future of the Cape Town is dependent on the efficient, sparing use of water.

Trend and target

Trend: Overall water usage has decreased. In 2016 water usage was lower than in previous years after a drastic increase in 2015.

Target: The Environmental Agenda 2014 target is to reduce per capita usage to 180 litres per day. During the current drought conditions, usage should be in line with applicable water restrictions.

Current: The Environmental Agenda 2014 targets have been met. There is still a need to reduce water consumption drastically under drought conditions.

Policy linkages

IDP: Strategic Focus Area 1 – The Opportunity City

IMEP Environmental Agenda 2009 – 2014: Targets of water provisions per capita

SDG Goal 6: Ensure access to water and sanitation for all

Water Services Act: Act 108 of 1997.

Environmental Agenda (IMEP) 2009 – 2014: Target 8 - Water.

Urban Environmental Accords: Action 19: Develop policies to increase adequate access to safe drinking water, aiming at access for all by 2015.

Water Conservation and Water Demand Management Strategy (2007)

Drought Crisis Water Restrictions: Levels 1-5

See also: *Chapters on Wastewater and Climate Change.*

CHAPTER 7: WASTEWATER

Understanding Cape Town's wastewater system

Indicators:

Percentage compliance with Department of Water and Sanitation (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 then passes to a wastewater treatment plant to be processed. This water includes wastewater that is produced by bathing, showering, washing clothes and dishes, flushing toilets, and industrial and commercial effluent. Processing this water is required by the National Water Act (NWA) of 1998 and is essential 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[31].

Treated effluent and treatment 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 a total of 20 000 kms of pipes and sewer reticulation network[32]. The treatment and reuse of wastewater is 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 multiple different pollutants and contaminants, such as bacteria and other pathogens, organic compounds and organic matter, synthetic chemicals, nutrients and heavy metals. Regulation of what pollutants or contaminants enter the water system is vital as some substances can adversely affect treatment processes. Furthermore, wastewater can contain high levels of nutrients such as nitrates and phosphates. High concentrations of these compounds can lead to 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

There are 26 wastewater treatment works (WWTWs) in Cape Town, which are also commonly called sewage works. The treatment of wastewater is as follows:

- Preliminary treatment: Screening to remove all materials that can be easily collected from raw sewage. Non-biodegradables are removed through processes of screening and grit removal.
- Primary treatment: A physical process that may involve maceration and sedimentation.
- Secondary treatment: A biological process, through solar and other energy, bacteria, algae and a variety of aquatic biota, to remove organic matter.
- Tertiary treatment: Remove remaining bacteria and viruses through disinfection techniques.

The outputs of this treatment process are as follows:

- The majority of treated effluent is released into rivers, canals, vleis or the ocean, 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.
- Sludge or bio-solids left over from the purification process, depending on its composition, are either used or disposed of. 'Activated' sludge is dewatered and applied to agricultural land and 'primary' sludge is sent to landfill.

Standards for treated wastewater discharge

The City of Cape Town uses wastewater purification specifications set by the national Department of Water and Sanitation (DWS), namely the NWA's General Authorisations. Previously purification specifications were authorised through regulation 991, which was a DWA (now DWS) authorisation. These prescribed standards are intended to ensure that the wastewater has minimal impact on the natural environment and on the health of anyone who may come into contact with it. The specifications for the treatment of water differ depending on the environment that treated water will be discharged into. The City currently measures up to 32 parameters in treated effluent. Eight parameters are regarded as the most important for monitoring purposes:

Physical parameters

Suspended solids

Suspended or floating particles in wastewater are referred to as suspended solids and could 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 in turn affects light penetration and thus also photosynthesis. Suspended solids could negatively affect filter-feeding organisms, whereas solids that settle out may smother aquatic plants and animals. General standard: No more than 25mg/l.

pH

This is the measure of alkalinity or acidity of water. Water can be acidic (below 7pH), neutral (7pH) or basic (above 7pH). 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 individuals, households, and industries. General standard: Between 5.5 and 9.5.

Conductivity

This refers to the measurement of water's ability to conduct electrical flow and relates to the concentration of ions in a waterbody. The more ions present, the higher the conductivity of water and the higher the salinity is. Conductivity is used to measure the salinity and total dissolved solids of water, both of which affect water quality and aquatic life. Organisms in waterbodies are only able to tolerate certain ranges of salinity. Sudden increases and decreases in conductivity of a waterbody may be indicative of pollution, such as sewage leaks, oil spills and agricultural runoff. General standard: Not exceeding 150mS/m determined at 25°C.

Chemical parameters

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. General standard: Not exceeding 6mg/l, with a long-term goal of no more than 2mg/l.

Chemical oxygen demand (COD)

COD is the measure of the amount of oxygen in water that is consumed for the oxidation of organic compounds. COD provides a good indication of the amount of organic pollutants in water. Oxidation of large quantities of organic matter in water results in significant reduction in dissolved oxygen levels, which could in turn result in respiratory distress in aquatic organisms. General standard: Not exceeding 75mg/l.

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. General standard: 10mg/l.

Nitrates and Nitrites

The presence of high levels of nitrites in waterbodies can be detrimental to aquatic organisms. Thus, it is 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. General standard: 15mg/l (nitrates).

Microbiological parameters

Escherichia coli (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 with 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 therefore is important in determining guidelines for recreational water quality. General standard: 1000 counts/100ml, with a long-term goal of 0 counts/100ml.

State of the environment

This State of the Environment Report only reports on 17 land-based WWTWs out of the total of 26 in Cape Town. This is due to a number of factors. One, Parow, is no longer in operation, and two others, Philadelphia and Groot Springfontein, are not reported on as they do not discharge treated water and are authorised by the General Authorisation in terms of section 30 of the NWA. Another six are marine outfalls: Hout Bay, Green Point, Camps Bay, Llandudno, Millers Point, and Oudekraal. The marine outlets are also authorised by the DWS currently, but Coastal Water Discharge Permit applications have been sent to Department of Environmental Affairs (DEA) to gain authorisation in line with new protocols.

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 practices 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

The compliance of WWTWs with DWS standards annually and overall in 2016 is shown in Figures 10 and 11. In 2016, the City achieved an overall compliance level of 84.85%, a decrease of about 3% from 2015, which had an overall compliance level of 88%. Achieving this level of overall compliance is based on some WWTWs receiving very high compliance results and others having low compliance with standards.

In 2016 nine of the 17 treatment works achieved an overall compliance over 90%, three sites achieved between 80% and 89%, one site between 70% and 79%, while four sites had overall compliance levels between 50% and 69%. The lowest overall compliance level in 2016 was Simon's Town with 52.59% (also lowest in 2015 with 59.86%). Simon's Town has struggled to comply with standards for suspended solids, COD, ammonia, *E. coli* and nitrate/nitrites, and also scored poorly with regards to orthophosphate. Simon's Town has generally had lower compliance in the past, usually scoring between 60% and 70%.

The highest-scoring treatment works in 2016 was Kraaifontein with 99% overall compliance. Kraaifontein has achieved compliance levels of over 90% since 2011, a significant improvement over its previous compliance levels of 70-80% between 2008 and 2010.

Figure 10: Average compliance of all WWTWs to DWS standards, 2007 – 2016

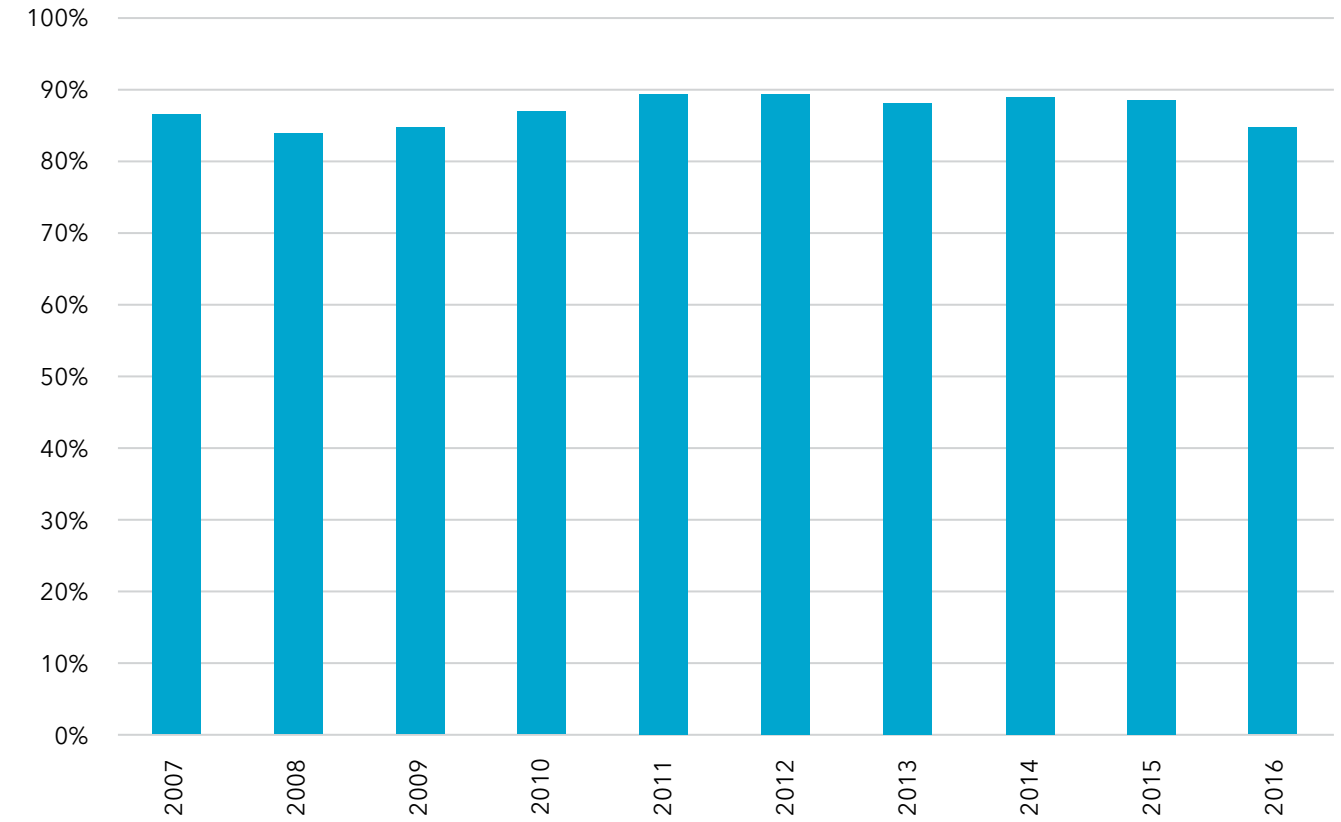
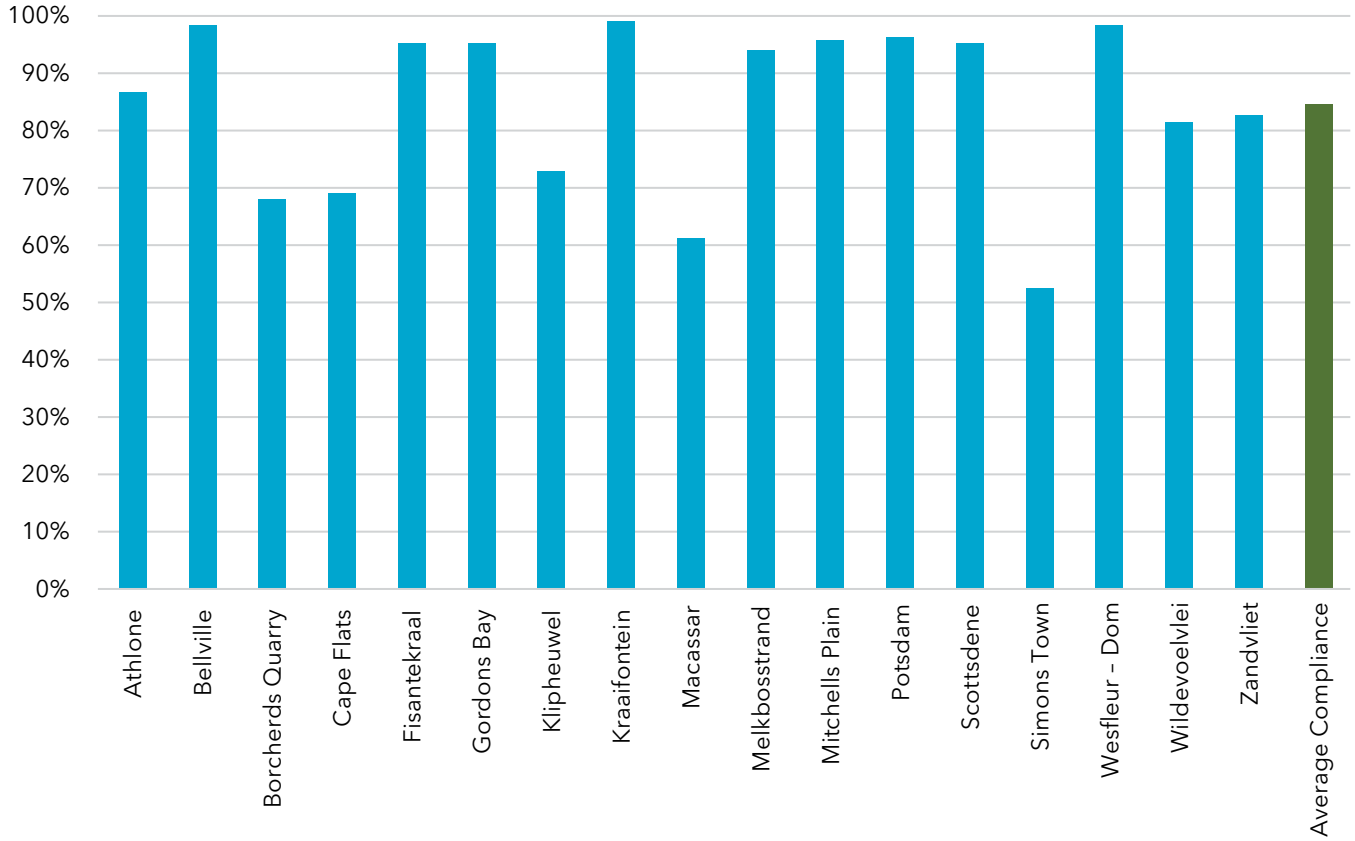


Figure 11: Compliance with DWS standards, 2016



Suspended Solids

Compliance with suspended solids standards are shown in Figures 12 and 13. Average compliance across the city was 86% in 2016, which was lower than the 92% achieved in 2015. Notably, 2016 had larger variances of compliance across all WWTWs compared to 2014 and 2015. There were five WWTWs that had full compliance of 100% in 2016: Athlone, Gordon's Bay, Kraaifontein, 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 2016 was Macassar with 44% compliance, which is a significant decrease in compliance compared to previous years.

Figure 12: Average compliance of all WWTWs with DWS standards for suspended solids, 2007-2016

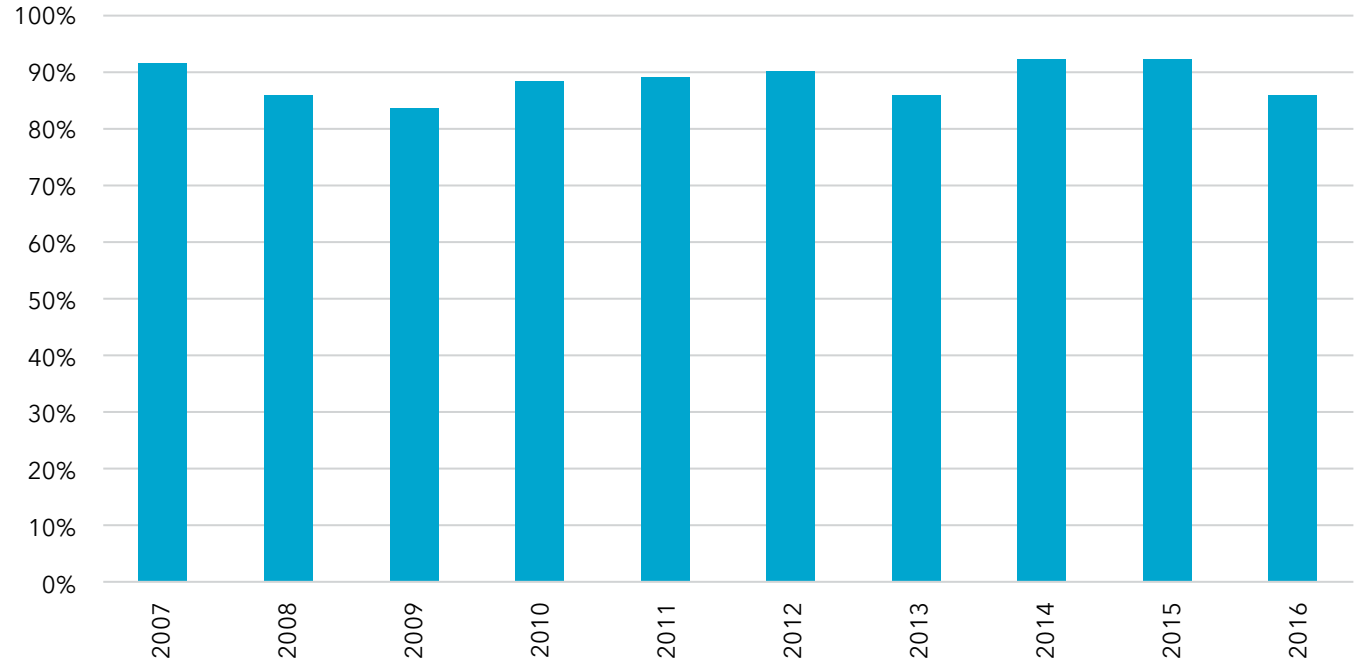
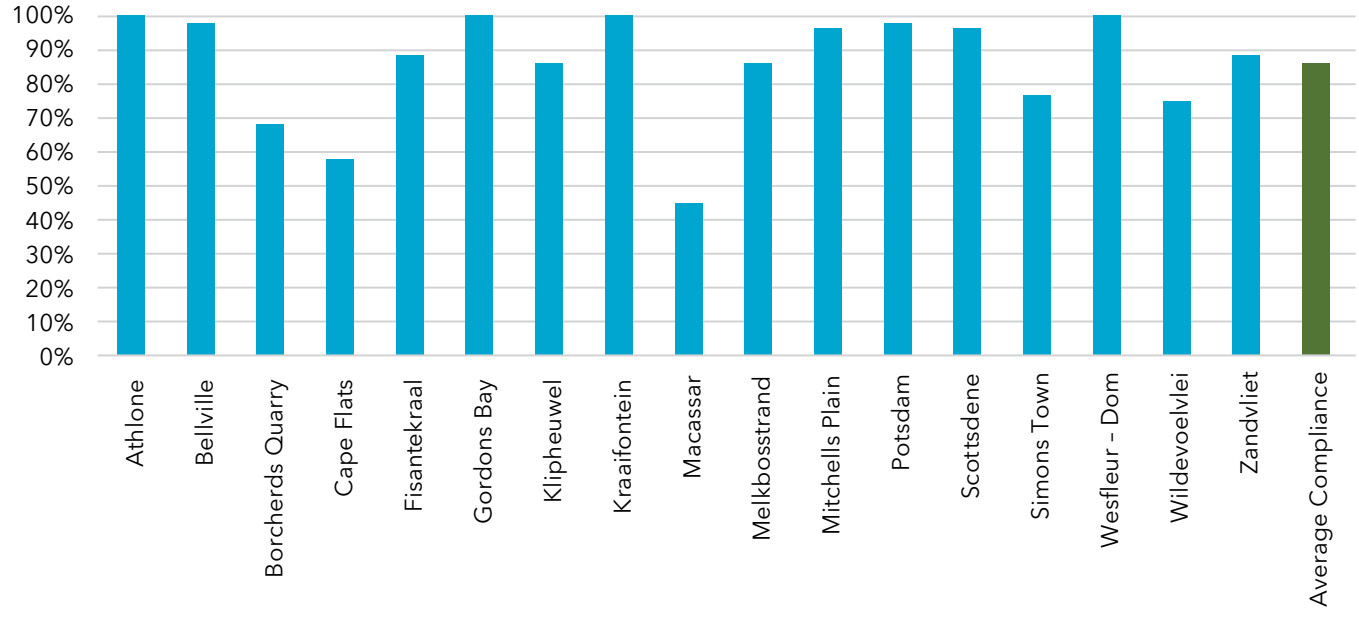


Figure 13: Compliance with DWS standards for suspended solids, 2016



pH

Compliance with pH standards is shown in Figures 14 and 15. Levels of pH have been acceptable over the past 10 years, with every year scoring an average of 96% and above. In 2016, 14 out of the 17 WWTWs had 100% compliance, the only year in the past decade to have all WWTWs achieving above 90% compliance.

Figure 14: Average compliance of all WWTWs with DWS standards for pH, 2007-2016

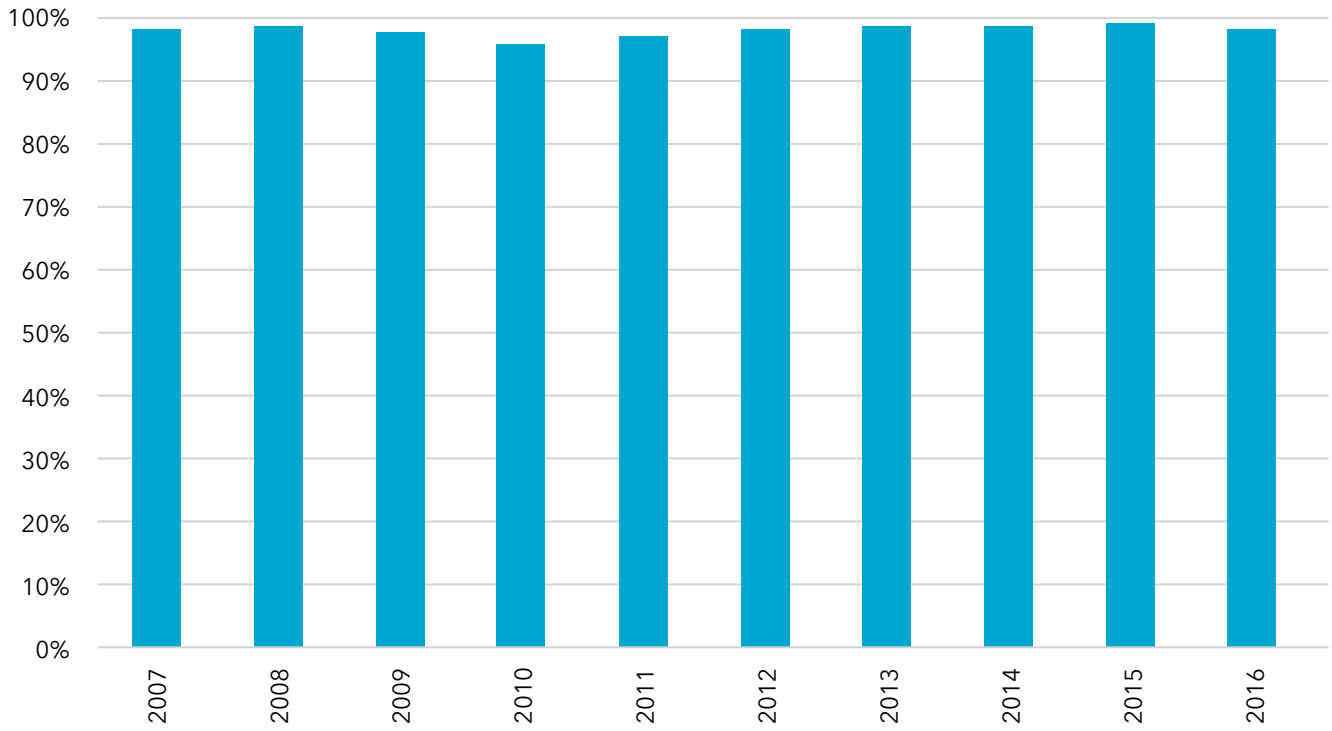
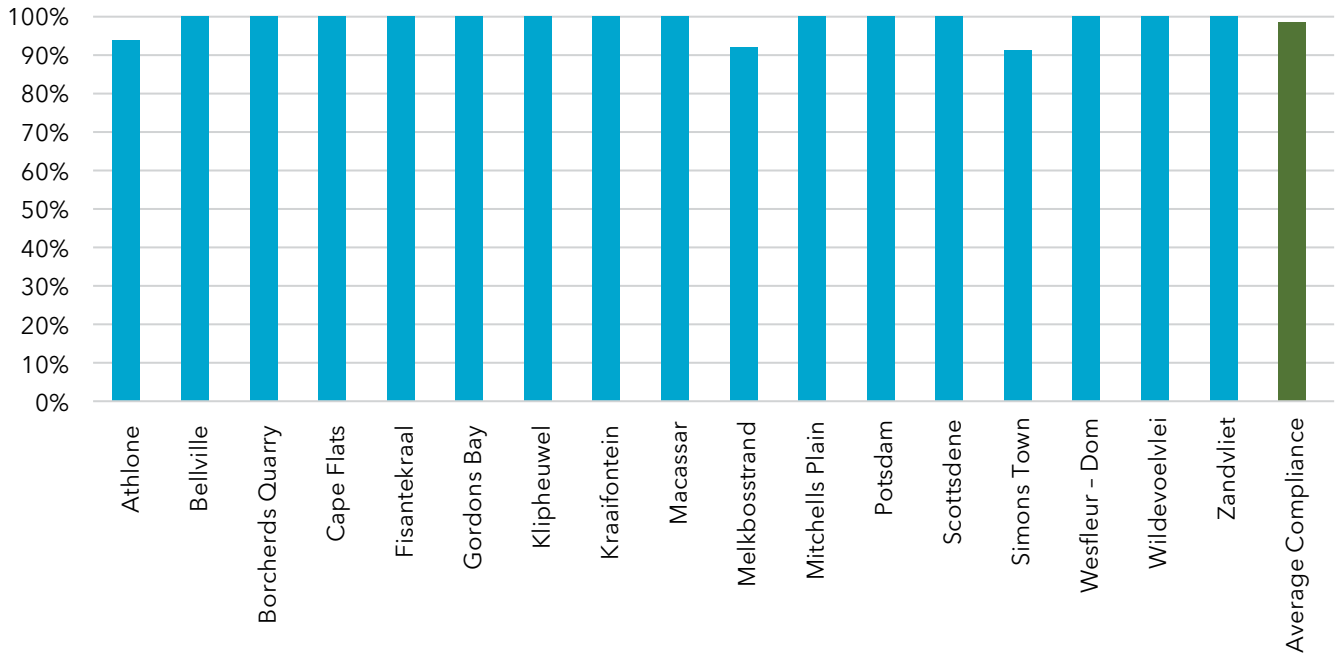


Figure 15: Compliance with DWS standards for pH, 2016



Conductivity

Compliance with conductivity standards is shown in Figures 16 and 17. Over the past decade average annual compliance with conductivity standards has been above 90%. In 2016, only two treatment works did not achieve 100% compliance, Mitchells Plain (96%) and Simon's Town (92%).

Figure 16: Average compliance of all WWTWs with DWS standards for conductivity, 2007-2016

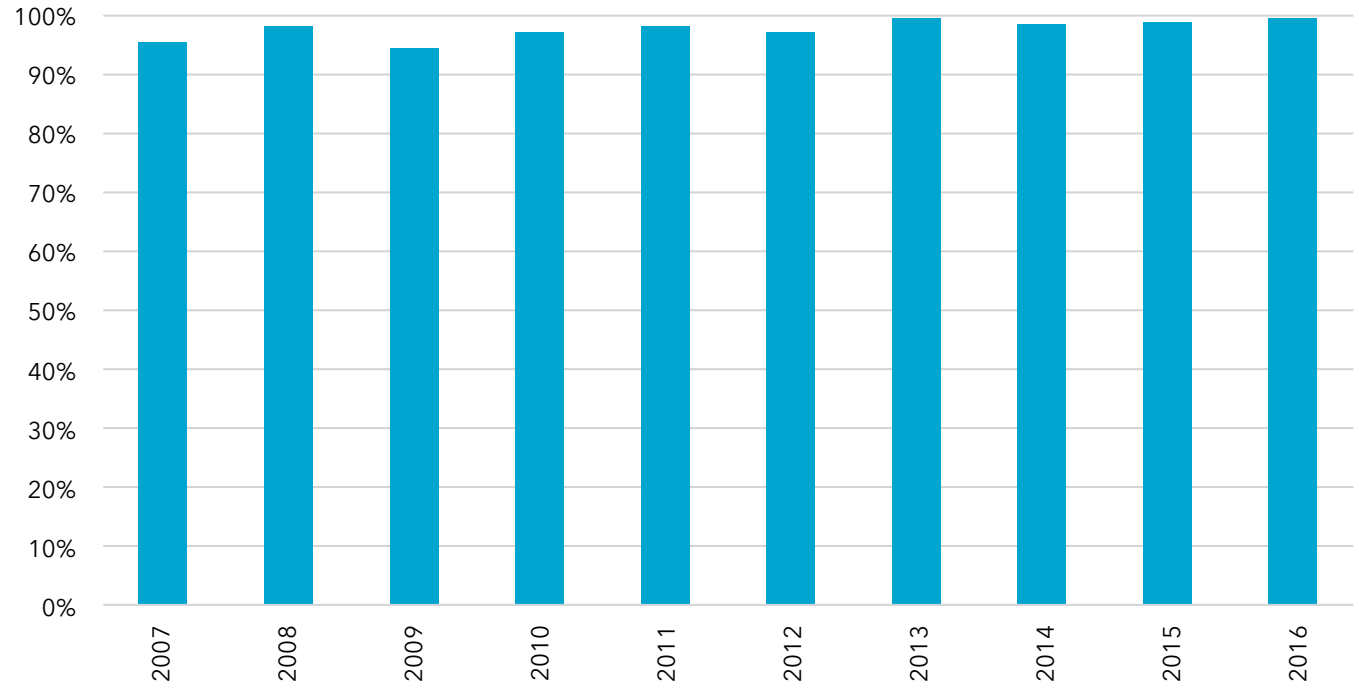
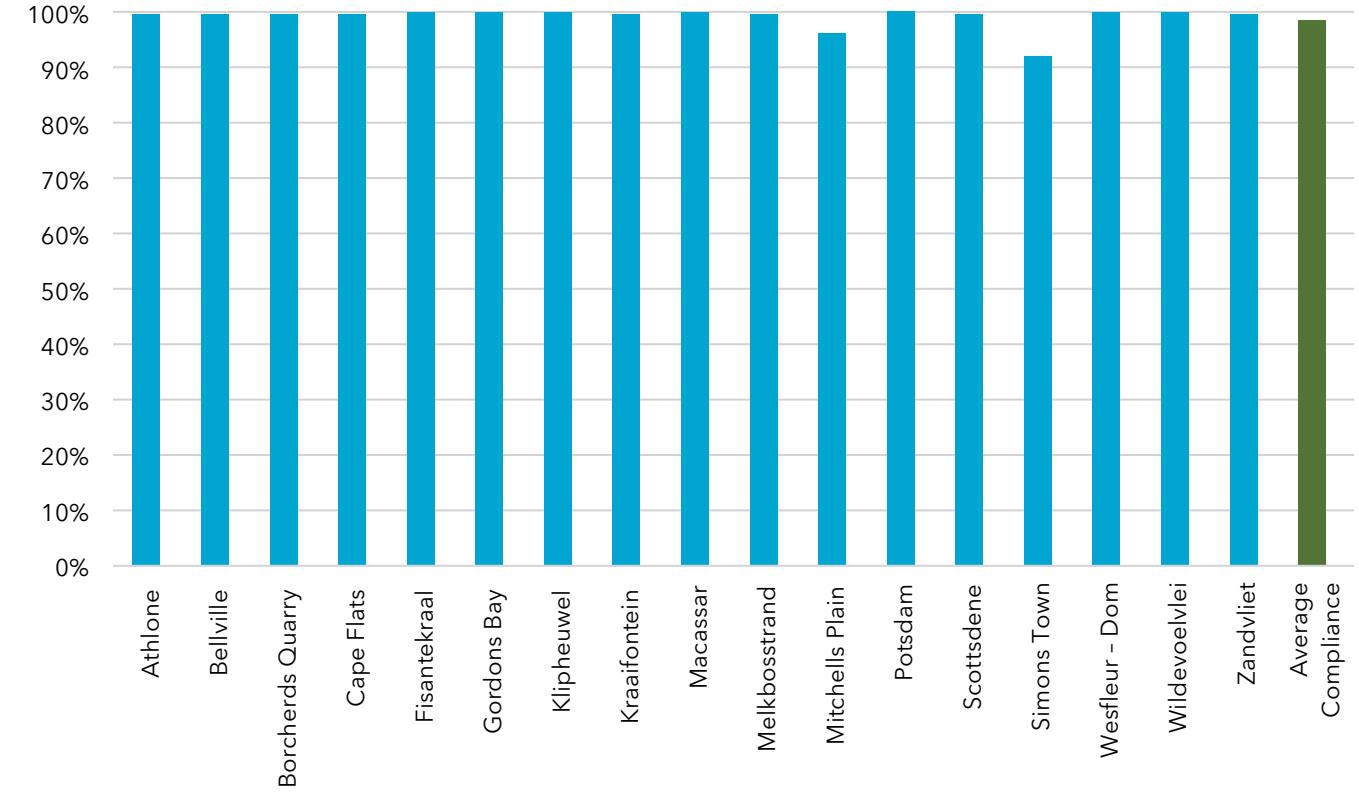


Figure 17: Compliance with DWS standards for conductivity, 2016



Chemical Oxygen Demand (COD)

Compliance with COD standards is shown in Figures 18 and 19. Compliance has ranged between 76% and 86% over the past decade, which does not meet standards deemed acceptable by the City. COD standards have steadily decreased since 2014. In 2016, 10 of the 17 WWTWs scored above 90% compliance, three scored between 50 and 89%, and four scored less than 49% compliance. The lowest-scoring sites were Macassar (27%) and Simon's Town (0%). Simon's Town has been a poor-scoring site over the past 10 years, having previously scored in a range between 2% and 38%.

Figure 18: Average compliance of all WWTWs with DWS standards for COD, 2007-2016

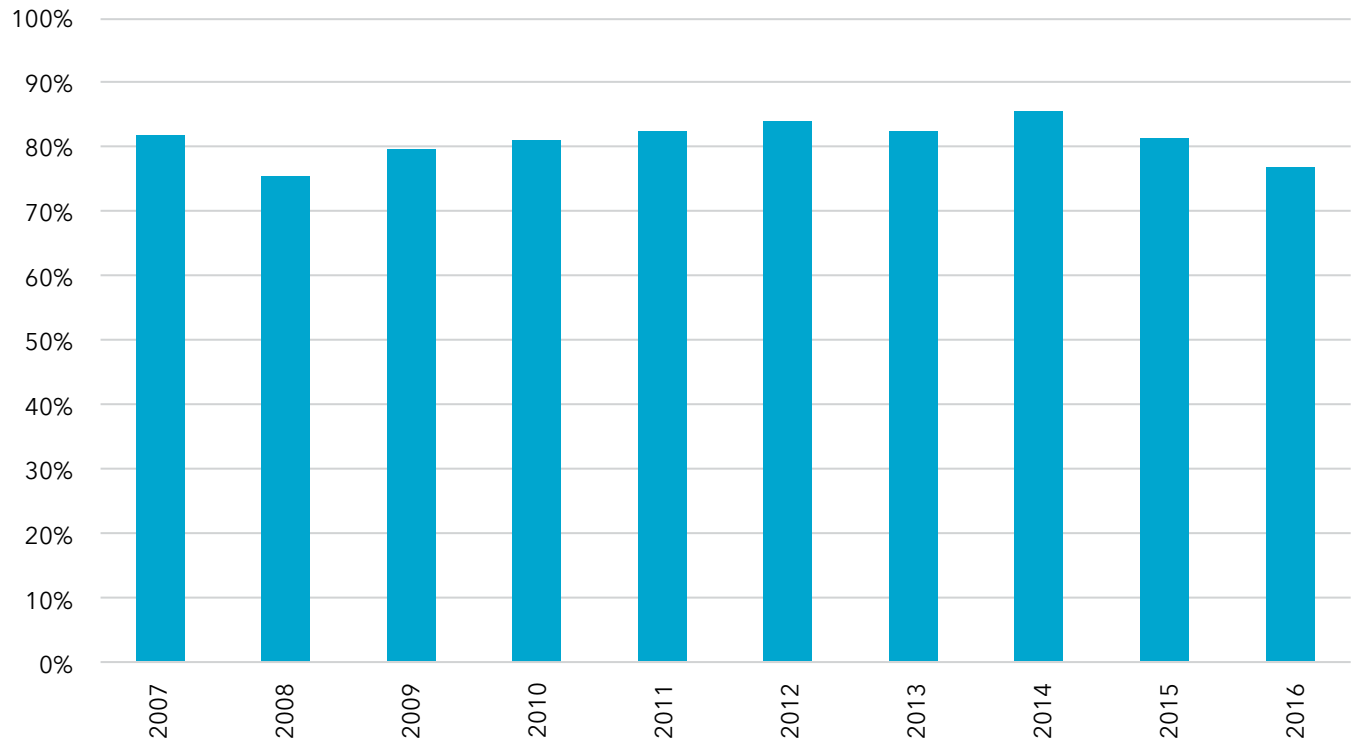
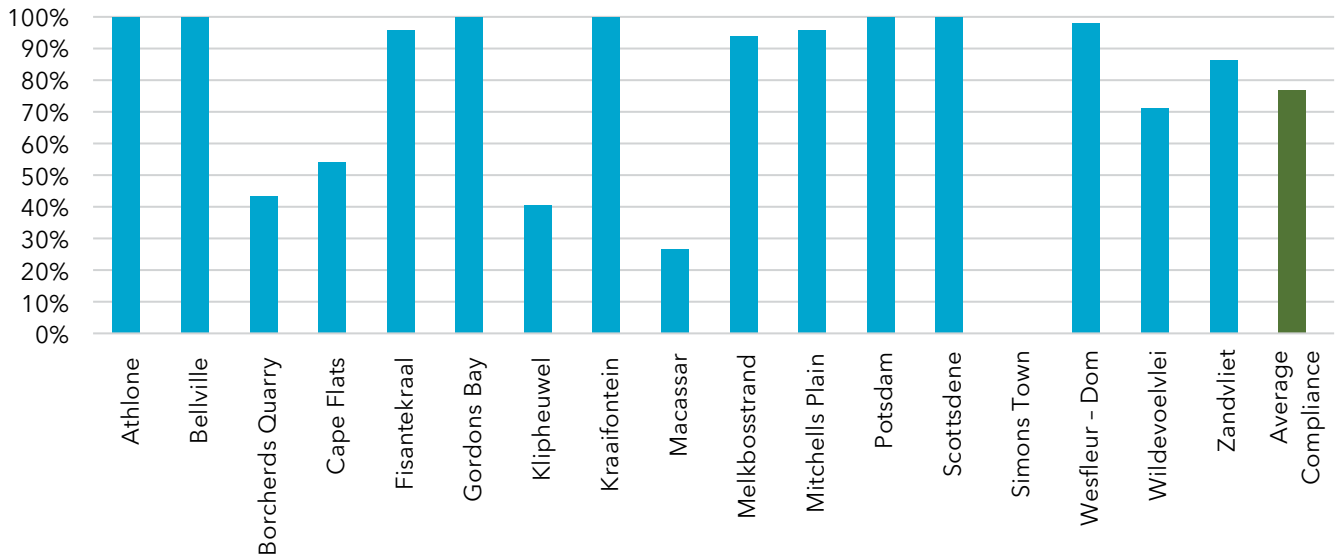


Figure 19: Compliance with DWS standards for COD, 2016



Ammonia

Compliance with ammonia standards is shown in Figures 20 and 21. There has been a general decrease in compliance with ammonia standards since 2012. In 2016 compliance to ammonia standards are notably the worst in five years and the figures indicate a steady downward trend. Average compliance with ammonia standards across the city in 2016 was 58.7%. Eight WWTWs had acceptable compliance standards of above 90%, while two sites scored between 80 and 89%, seven sites scored less than 40% of which five had less than 10% compliance. Zandvelit and Klipheuwel had 0% compliance, Cape Flats had 2% compliance, Wildevoelvlei had 6% compliance and Macassar had 7% compliance.

Figure 20: Average compliance of all WWTWs with DWS standards for ammonia, 2007-2016

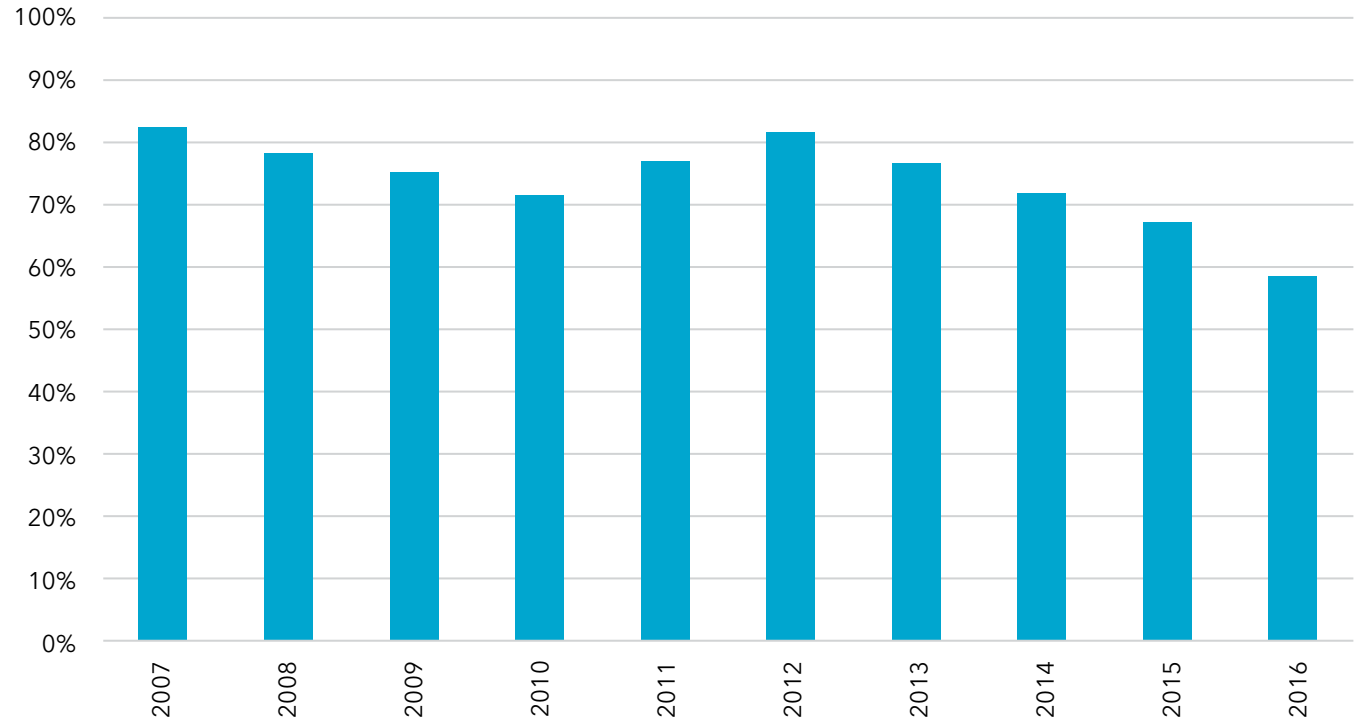
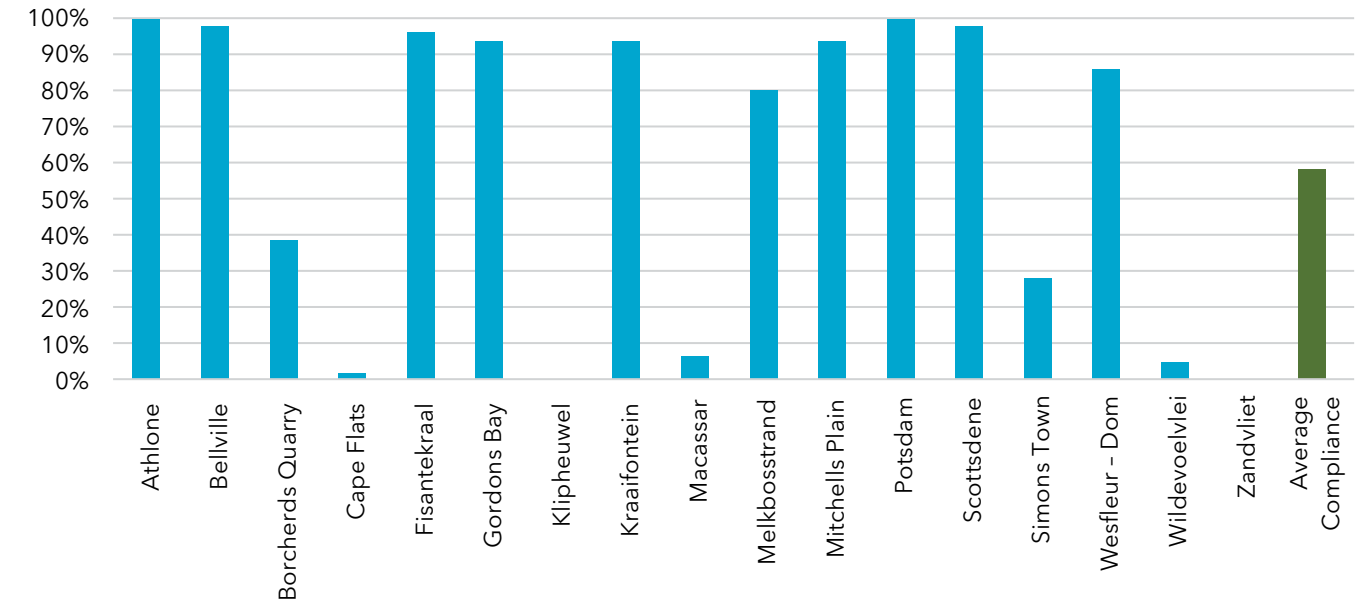


Figure 21: Compliance with DWS standards for ammonia, 2016



Orthophosphate

Compliance with orthophosphate targets is shown in Figures 22 and 23. The compliance levels have been steady since 2011 with acceptable levels of above 90%. Notably, before 2011 orthophosphate compliance levels were increasing incrementally annually. In 2016 the average compliance was 97%. This encouraging compliance standard is evident across all WWTWs, with 15 of the 17 sites achieving above 90% and 13 scoring 100% compliance.

Figure 22: Average compliance of all WWTWs with DWS standards for orthophosphate, 2007–2016

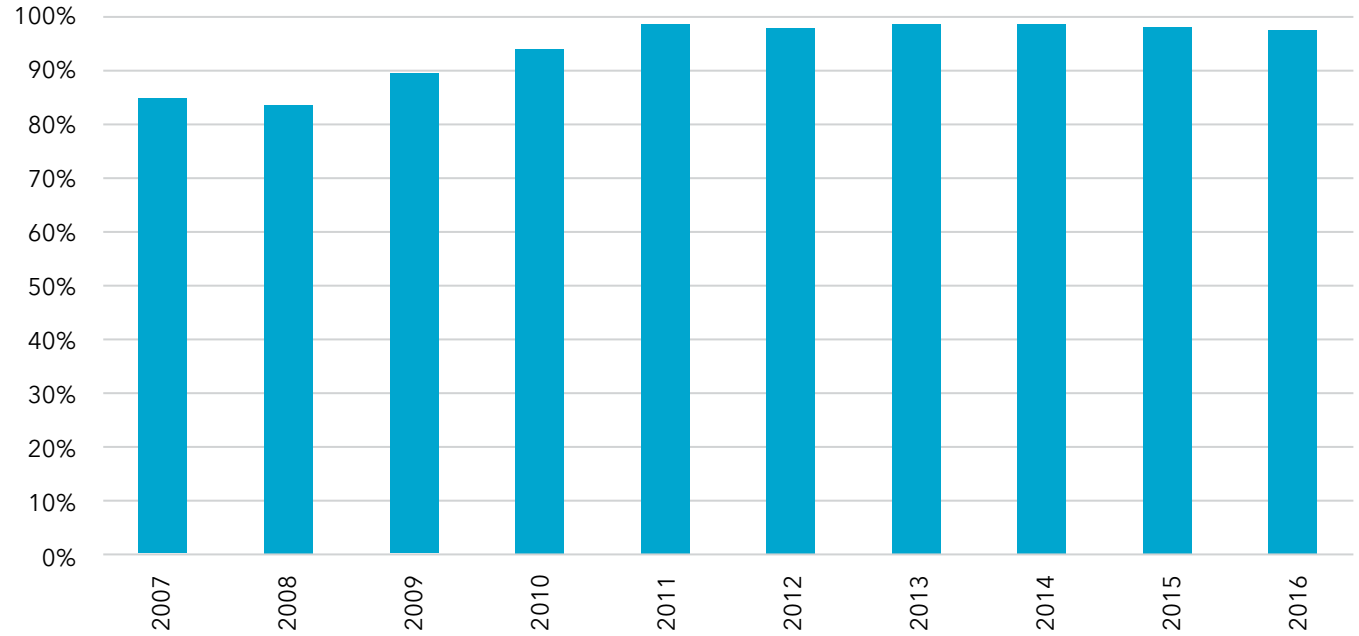
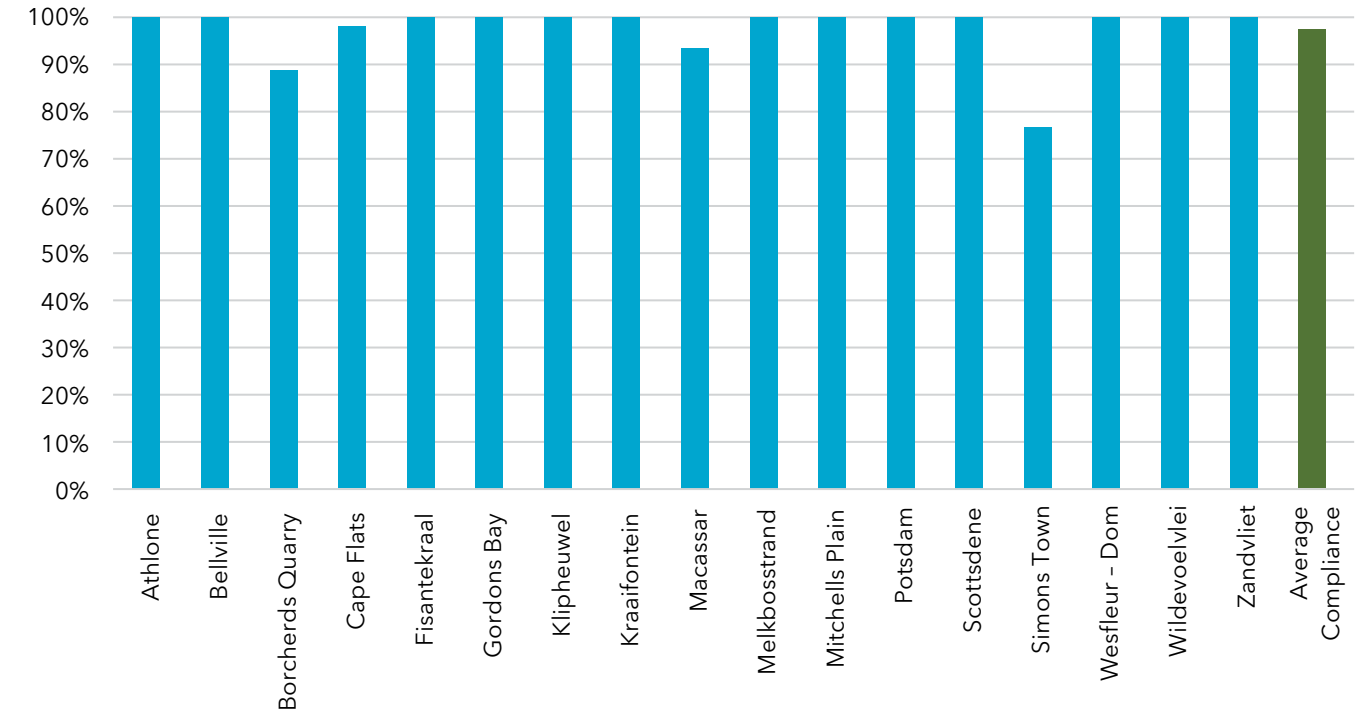


Figure 23: Compliance with DWS standards for orthophosphate, 2016



Nitrates/Nitrites

Compliance with nitrate/nitrite standards is shown in Figures 24 and 25. Compliance with nitrate/nitrite standards over the past 10 years have been relatively stable, mostly between 80% and 89%, while 2011 and 2015 achieved higher compliance levels of 91% and 92% respectively. 2016 had an average compliance of 87%. Simon's Town has had very low compliance levels of below 10% in the past 10 years.

Figure 24: Average compliance of all WWTWs with DWS standards on nitrate/nitrite, 2007-2016

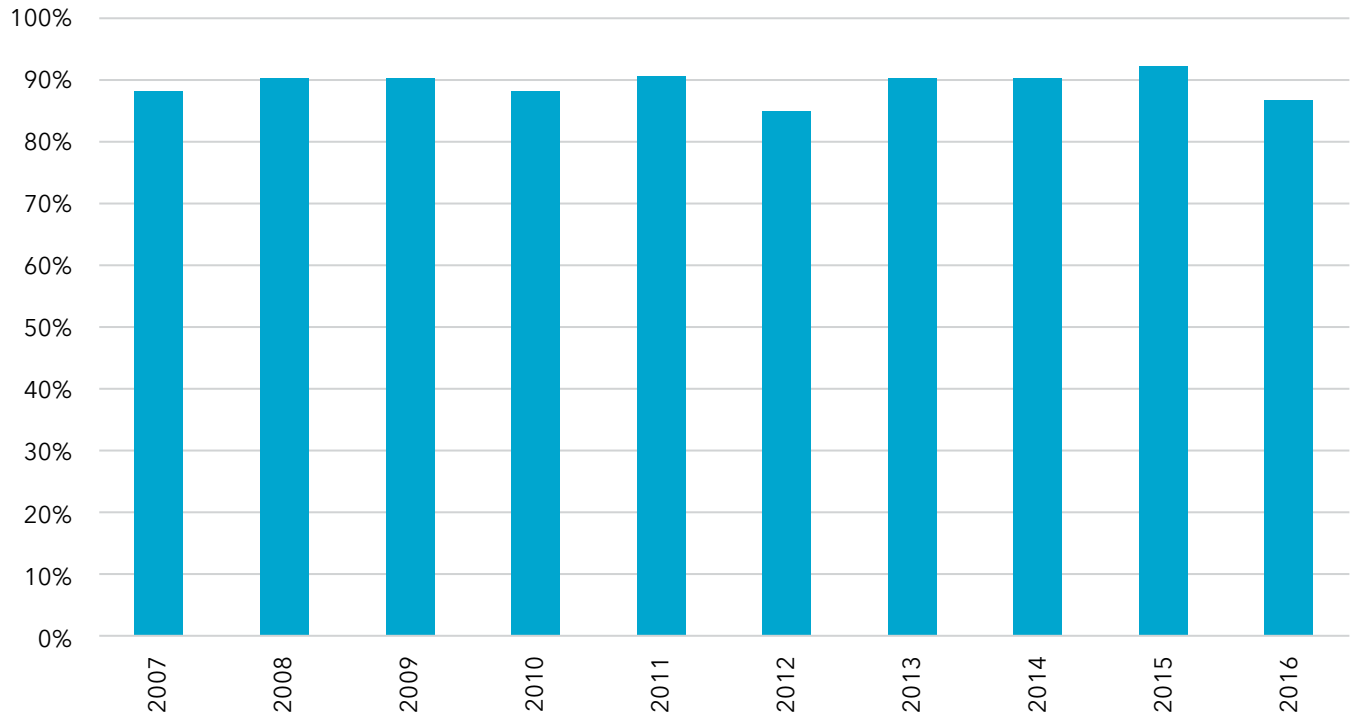
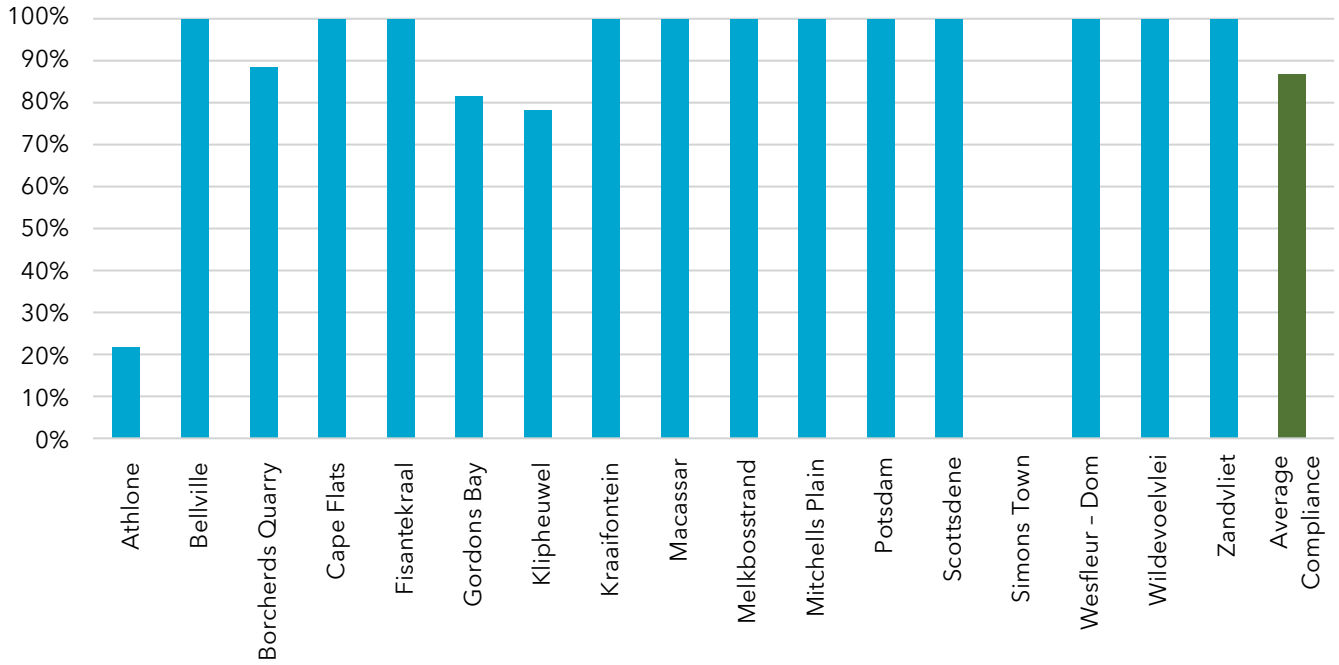


Figure 25: Compliance with DWS standards for nitrate/nitrite, 2016



E. coli

Compliance with *E. coli* standards is shown in Figures 26 and 27. The average compliance with *E. coli* standards over the past 10 years has varied. Between 2007 (69%) and 2008 (64%) there was a decrease in compliance levels, rising again steadily up to 2011. Between 2011 (82%) and 2013 (75%) there was a decrease once again, with compliance increasing slightly in 2014 (76%) and remaining at similar levels in 2015 (76%) and 2016 (75%). In 2016 only two WWTWs achieved 100% compliance, Wesfleur-Domestic and Wildevoelvlei. The lowest three scores were at Cape Flats (42%), Borcherds Quarry (15%) and Macassar (20%).

Figure 26: Compliance of all WWTWs with DWS standards for E. coli, 2007-2016

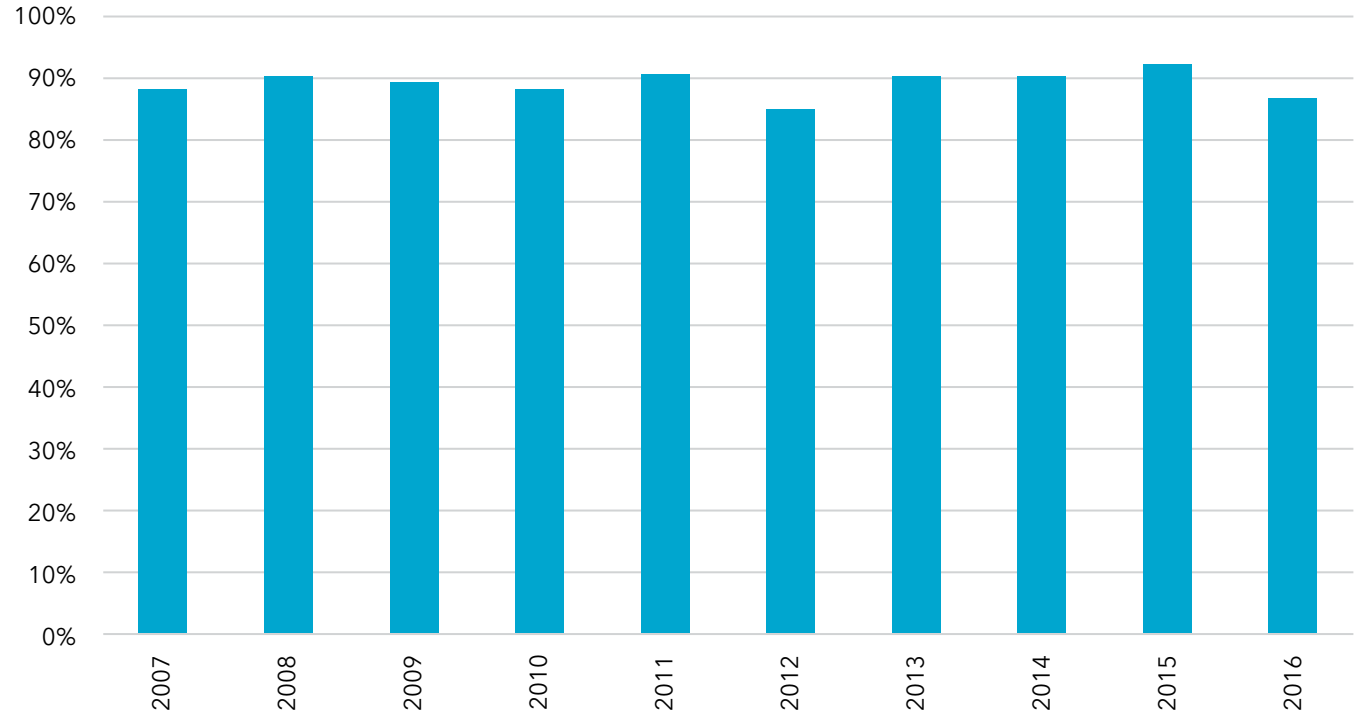
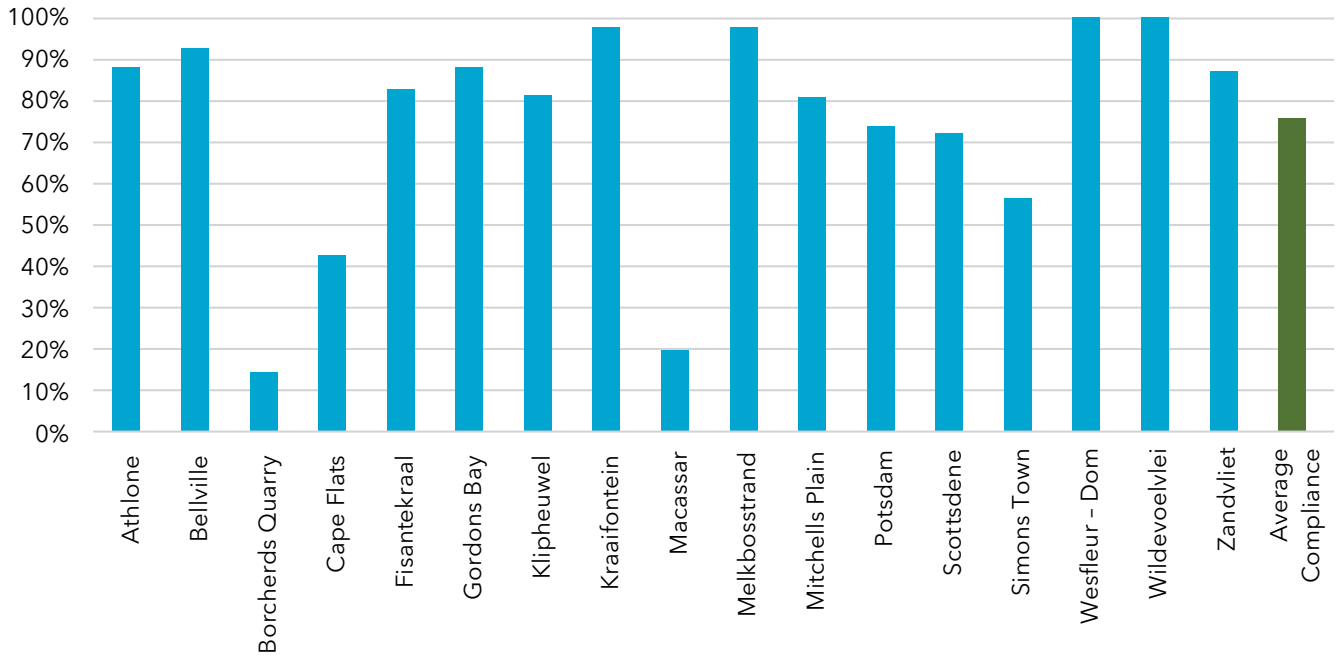


Figure 27: Compliance with DWS standards for E. coli, 2016



Key management responses

Effluent discharged from industrial sites, as well as non-complying and polluted trade effluent, negatively impacts wastewater treatment processes. This results in poor quality effluent being discharged into Cape Town's rivers. The City has increased the size and efficiency of its inspectorate over the past few years to enforce the recently consolidated and rewritten Water, Sanitation and Effluent By-laws. However, cooperation from consumers remains problematic[33].

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. Additionally, the City uses this water for irrigating parks and flower beds along the integrated rapid transport routes[34].

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 left-over food off plates and place food scrapings in the bin or compost it – do not throw it down the drain.
- Check your property for illegal storm-water connections from the storm water to the sewerage system – gutters and downpipes should not drain into the sewerage system, as extra rainwater can overload the sewage systems.

Public awareness videos can be found on the CCT website in English, Afrikaans and isiXhosa. These outline Water System Management, Water By-laws, leak prevention and more.

Trend and target

Trend: Average overall compliance with DWS standards over the years has been above 80%. There have been slight variances over the years.

Target: Compliance with DWS standards.

Current: In 2016 overall compliance with wastewater standards was 84.85%

Policy linkages

IDP: Strategic Focus Area 1—The Opportunity City

National Water Act of 1998

Green Drop Audits

Water Services Development Plan

Water Conservation and Demand Management Strategy

Water By-law

Treated Effluent By-law (2010)

Treated Effluent Amendment By-law (2015)

Wastewater and Industrial Effluent By-law

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 it 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.

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

Globally, cities are increasingly taking action in reducing 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 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 and help the city transition towards a low-carbon economy.

Alongside mitigation measures, cities in South Africa and around the world are working to implement climate change adaptation measures. Climate change adaptation measures aim 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, transport, water, wastewater and other infrastructure upgrading and maintenance; protection against and response to extreme weather events, and integrated responses to the projected effects on health, food systems, livelihoods, development, biodiversity, coastal management and the economy.

Both mitigation and adaptation projects fundamentally seek to develop a more sustainable and resilient urban system. As such, potential positive interaction between mitigation and adaptation actions should be actively promoted and maximised.

The City has recently approved a Climate Change Policy, which addresses issues of climate change adaptation and mitigation. The policy aims to consolidate an integrated approach to climate change through a principle-based focus on adaptation and mitigation. It provides an updated framework for addressing and responding to climate change in Cape Town. The policy supports integrated and comprehensive action plans to address climate change adaptation and mitigation. The City's efforts towards more climate-friendly development are also informed by the Energy2040 Goal that sets a target of reducing city-wide carbon emissions by 37% off a projected business-as-usual path by 2040.

State of the environment

It is currently challenging to present statistics related to climate change adaptation as a monitoring programme is not yet in place. However, these areas of work will be expanded on in future State of the Environment Reports.

In order to gauge the effects of mitigation actions that have been implemented it is necessary to understand the carbon emissions profile and carbon footprint of the city. This information informs strategic planning and appropriate responses. The City does a detailed update of Cape Town's energy profile and GHG inventory every five years, the last one being the Cape Town State of Energy 2015 (based on a 2012 data year), and a high-level update every year (based on total electricity and transport fuel sales). The energy and carbon data presented is based on an interim high-level update to the 2015 data year, which is found in the City's 2017 Carbon Disclosure Project (CDP) reporting[35].

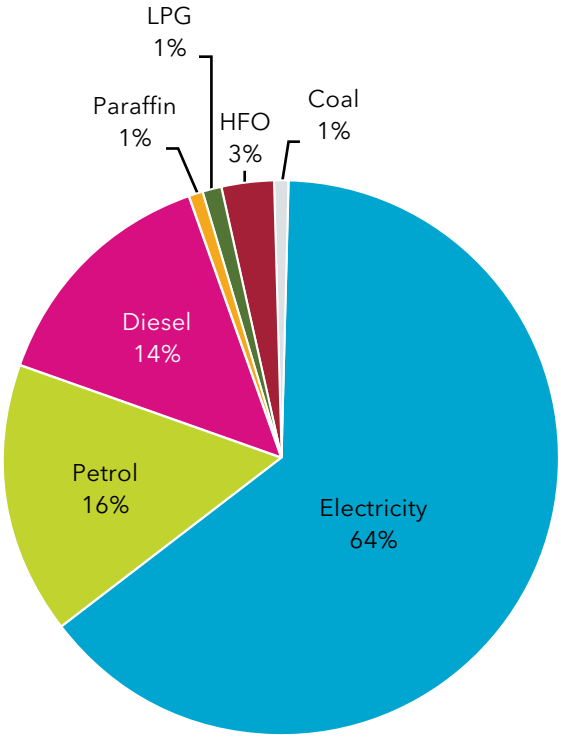
Cape Town's per capita carbon footprint was calculated to be 5.1 tonnes of carbon dioxide equivalent (tCO_2e) in 2015[36 37]. For a more detailed discussion of the City's carbon footprint and the methodology used, refer to the City of Cape Town State of Energy Report 2015.

Carbon emissions in Cape Town are best understood from an energy source and a 'by use sector' perspective. This is reflected in Cape Town's energy profile in which transport is the highest consumer of energy in the city, but electricity is the highest carbon-emitting energy source. The disproportionate amount of carbon emissions from electricity consumption is due to most of South Africa's electricity being generated through carbon-intensive coal power stations distributed by Eskom. The City purchases electricity from Eskom and does not have the authority to purchase from Independent Power Producers yet, although future options in this regard are currently being investigated with national government and the National Energy Regulator (NERSA).

Figure 28 shows that the highest proportion, 64%, of carbon emissions in Cape Town comes from electricity, with petrol and diesel together accounting for around 30% of emissions. Figure 29 shows that the residential, commercial, and transport sectors each account for approximately one-third of the city's carbon emissions.

Cape Town's carbon emissions have been reduced by 4.11% between 2012 and 2015. This is mostly due to a significant reduction in electricity consumption, despite a significant increase in transport energy use. This can be attributed to steeply rising electricity costs and the City's energy efficiency campaigns.

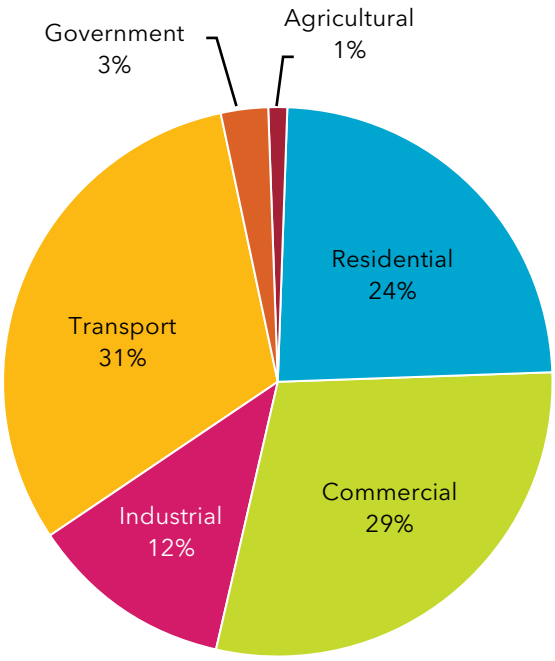
Figure 28: Carbon emissions by source, 2015[38]



Total tCO_2e: 18, 147, 862 (energy only)

**excluding aviation, international marine, electricity losses*

Figure 29: Carbon emissions by sector, 2015[39]



Total tCO_2e: 18, 147, 862 (energy only)

**excluding aviation, international marine, electricity losses*

Key management responses

The City is in the process of implementing several key programmes to respond to climate change issues. These include, but are not limited to:

100 Resilient Cities

Cape Town has recently been designated as a member of the 100 Resilient Cities, an international project that helps member cities to become more resilient in the wake of physical, social and economic challenges of the 21st century. Cape Town, and other member cities, demonstrate seven qualities that enhance and enable future resilience in the face of environmental, economic and social shocks. These include being reflective, resourceful, robust, redundant, flexible, inclusive and integrated. In order to fully utilise these qualities, as a member of the 100 Resilient Cities, Cape Town is provided with guidance and support using the organisation's Resilient Cities Framework. This framework encompasses tools, funding, technical expertise and other resources to enhance four dimensions of urban resilience: health and wellbeing; economy and society; infrastructure and development; and leadership and strategy.

A Chief Resilience Officer (CRO) has been appointed to prioritise the resilience of Cape Town. The CRO's duty is to lead a city-wide resilience-building process and engage stakeholders from public and private sectors, and various communities, to incorporate diverse perspectives and knowledge to effectively tackle city challenges. The challenges affecting resilience include ageing infrastructure, disease outbreak, economic inequality, infrastructure failure, poverty, rainfall flooding and civil unrest, amongst others.

Urban resilience

Is defined as:

"the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience" (100 Resilient Cities) .

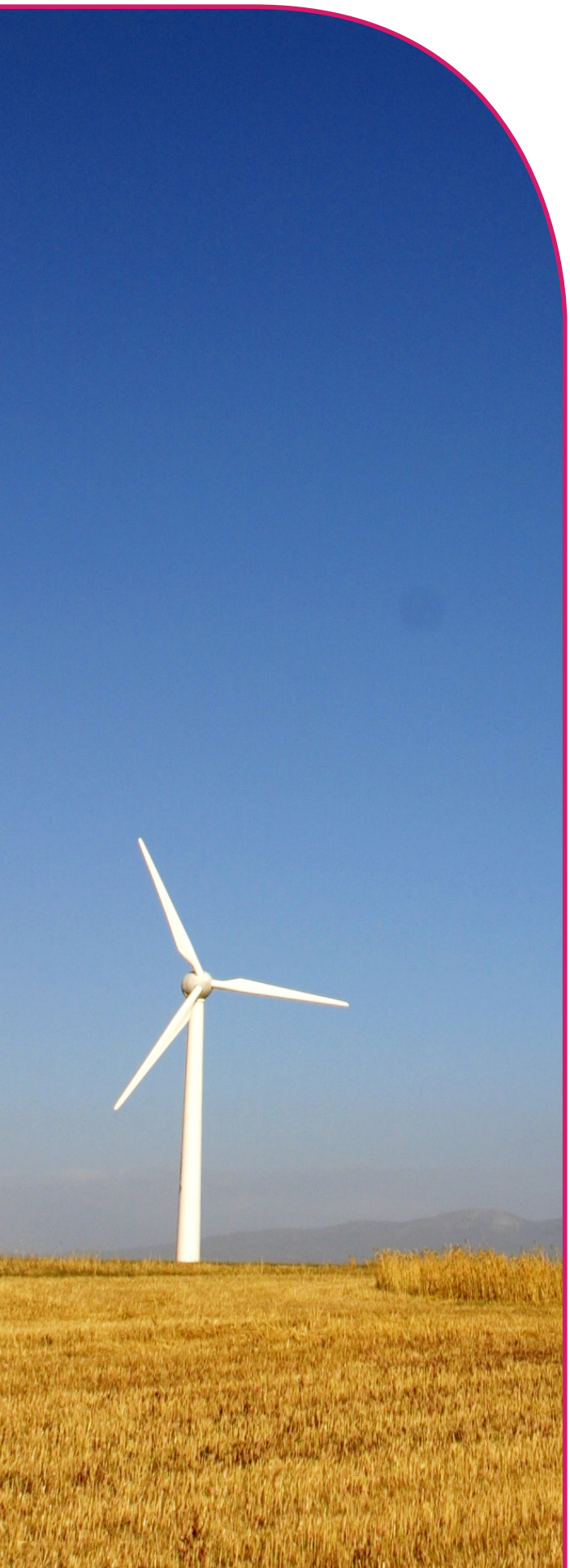
To learn more about the 100 Resilient Cities project visit their website: http://www.100resilientcities.org

Sustainable energy

The Energy2040 Goal, approved in 2015, models a more resilient, resource-efficient and equitable future and commits the City to diversifying Cape Town's energy supply and reducing carbon emissions. The City's targets embedded in Energy2040 are to achieve a 37% reduction in carbon emissions off business-as-usual by 2040, this means 13% less carbon emissions by 2022.

Reliance on coal-based electricity is contributing to high carbon emissions. The City has taken steps to enable consumption of sustainable energy by residents and businesses. The implementation of a small-scale embedded generation (SSEG) programme aims to remove barriers to the rooftop photo-voltaic (PV) electricity market by implementing a feed-in tariff which allows residential and commercial consumers to sell their generated electricity to the City. 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 which addresses energy efficiency and renewable energy.

The City also runs an Electricity Savings Campaign targeting residential and commercial consumers. It aims to reduce city-wide electricity consumption and the related CO_2 emissions, thus increasing energy security, through a wide range of behavioural and technology changes. As part of the residential component of the campaign, the Solar Water Heater Programme, the City provides easy access to receiving solar water heating quotes from accredited service providers on the savingelectricity.org.za website. The website also provides tips to help residents reduce their electricity consumption. The tips include ways to save at no cost, low cost and by investing to save. The commercial part of the campaign includes an Energy Efficiency Forum for the commercial sector which meets three times a year, and which has been in operation since 2009.



Trend and target

Trend: The carbon footprint still remains at very high levels. However, energy consumption is steadily decreasing, along with per capita electricity use.

Target: Environmental Agenda 2014 target aims to achieve a per capita carbon footprint to be reduced to an annual average of five tonnes (a total of 20 million tonnes) of CO_2.

Current: In 2015 carbon footprint per capita was 5.1 tCO_2e (excluding waste).

Future: Following the adoption of the Climate Change Policy new targets will be implemented.

Policy linkages

IDP: Strategic Focus Area 1 - The Opportunity City

SDG: Goal 11: Make cities inclusive, safe, resilient and sustainable, Goal 13: Climate Action

Environmental Agenda 2009-2014: Target 5 – Carbon Dioxide Footprint.

Energy and Climate Action Plan: A city-wide action plan that sets goals and targets for climate change mitigation and adaptation measures (Under review).

Climate Change Adaptation Plan of Action: A city-wide plan of action that is aimed at building a more resilient city and at ensuring that climate change adaptation measures are incorporated into City operations (Under review).

Integrated Resource Plan (IRP) for Electricity:
The Integrated Resource Plan (IRP) for Electricity 2010 – 2030 is a long term national government planning document that aims to calculate long-term demand, and outlines how this demand will be met in terms of electricity type, cost, generating capacity and timing.

Climate Change Policy (2017)

See also: *Chapters on Water Use and Biodiversity.*

CHAPTER 9: AIR QUALITY

Understanding Cape Town's air quality

Indicators:

Percentage compliance with Department of Water and Sanitation (DWS) standards for final effluent.

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 eco-systems.

Three main types of air pollutants are measured and reported on by the City of Cape Town, as follows:

- 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 processing materials containing sulphur are additional contributors. In Cape Town the primary source of SO_2 is from vehicle emissions and industrial activities. SO_2 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 the tiny particles in the air, such as soot, dust, smoke, pollen, ash, aerosols and droplets of liquid. PM_{10} refers to particulates that are smaller than 10 microns in size. The most common sources of PM_{10} in Cape Town are diesel-vehicle emissions, wood and fuel-burning, and dust from construction activities and unpaved roads and verges. The small size of PM_{10} enables the matter to be inhaled easily by humans. Constant inhaling of PM_{10} may adversely affect human health through lung irritation and aggravating lung disorders and diseases such as asthma and tuberculosis. Cardiovascular problems are also linked to PM_{10}.

Standards and guidelines

The National Ambient Air Quality Standards (NAAQS) were released in 2009 by the Department of Environmental Affairs. The standards contain requirements in terms of acceptable levels of pollutants permitted in ambient air and are outlined in Table 8. All municipalities are required to meet these national standards by developing and implementing air quality management plans. The aim of air quality management plans is to improve air quality, thus decreasing environmental and human health risks.

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 comparison exceeds national standards, it is indicative of possible health risks and impacts. Thus, enforcement of compliance with air quality limits in terms of the Air Quality Act is a major contributor to effective air quality management.

Pollutant	Symbol	Annual Average	Daily Average
Nitrogen Dioxide	NO_2	≤ 40µg/m^3	-
Sulphur Dioxide	SO_2	≤ 50µg/m^3	≤ 125µg/m^3, with no more than four exceedances per monitoring station annually
Particulate Matter interim standard (2009-2014)	PM_{10}	≤ 50µg/m^3	≤ 120µg/m^3, with no more than an four exceedances per monitoring station annually
Particulate Matter standard (from January 2015)	PM_{10}	≤ 40µg/m^3	≤ 75µg/m^3, with no more than four exceedances per monitoring station annually
Particulate Matter standard (from January 2016)	$PM_{2.5}$	≤ 20µg/m^3	≤ 40µg/m^3, with no more than four exceedances per monitoring station annually

Table 8: South African National Ambient Air Quality Standards

State of the environment

Due to air pollution being seasonal, localised, and significantly fluctuating at each site, general air quality trends are difficult to determine. Figures 30 and 31 highlight the NO_2 and SO_2 air quality trends in Cape Town between 2005 and 2016. Figures 32 and 33 highlight the PM_{10} air quality trends between 2009 and 2016, as the South African PM_{10} standards were officially adopted in 2009. Over the past 12 years, 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.

NO_2

NO_2 pollution has generally decreased over the years. Significantly, all sites have had NO_2 levels below the South African Standards over the past 12 years. The most significant decreasing trends in NO_2 averages were experienced at Table View, Foreshore, City Hall and Goodwood. Khayelitsha also experienced a significant decrease in NO_2 levels in 2016, compared to 2014 when a significant spike occurred. The Foreshore and City Hall, while both having decreased NO_2 pollution levels in 2016, still have the highest NO_2 levels in Cape Town. This could be attributed to high concentrations of vehicle traffic in the city bowl, as well as weather conditions in this area that cause pollutants to become trapped and recirculated within the dense, built-up areas of the city.

SO_2

SO_2 levels in the city are generally low and considerably below the legislated South African air quality standards. Most ambient monitoring sites have maintained similar trends throughout the past 12 years, with discrepancies occurring every few years. Bothasig and Wallacedene have had the largest variances in SO_2 levels over one year, significantly deviating from the overall trend in 2012 and 2014 respectively. The spike at Bothasig can be attributed to industrial activities to the north-west of Bothasig Air Quality Monitoring Station, while 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 subjected to start-up in the morning and left to idle for significant periods, causing data spikes. Additionally, 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 12 years. This is a result of the introduction of mandatory lower sulphur content in diesel fuels, which decreased from 5000ppm to 500ppm with 50ppm 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 impact a large area.

Figure 30: Annual NO_2 averages, 2005-2016

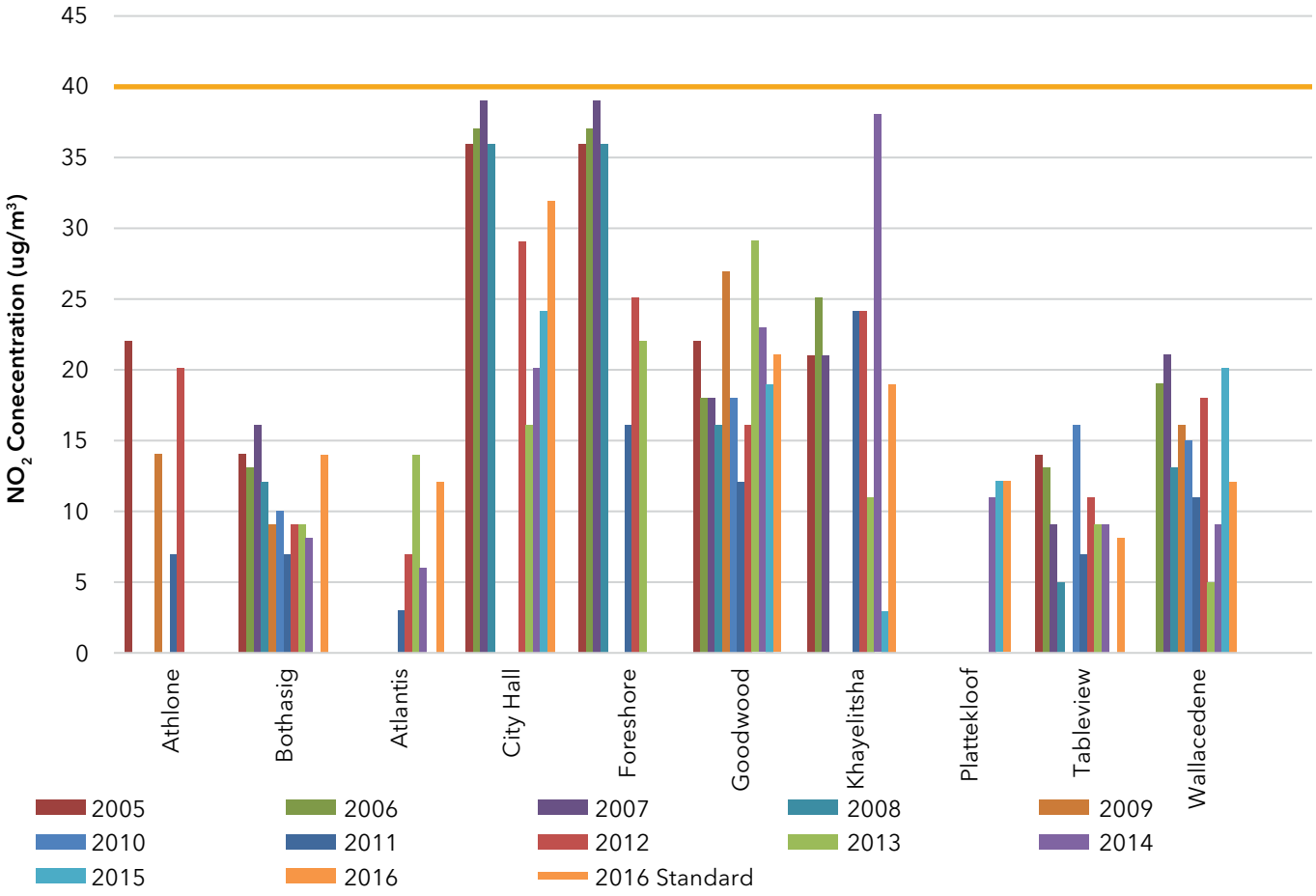
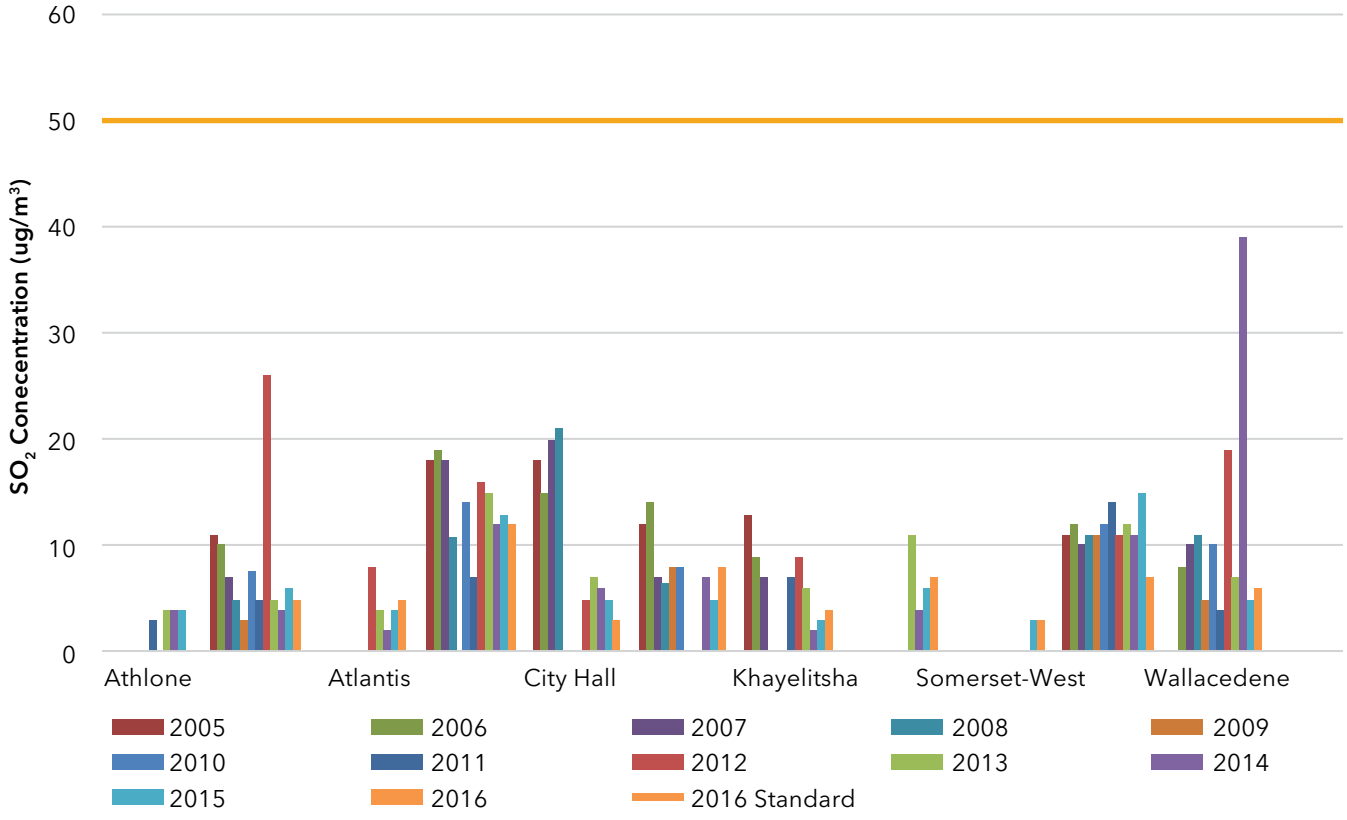


Figure 31: Annual SO_2 averages, 2005-2016



PM_{10}

PM_{10} 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 2016 and previous years. The exceedances are attributed to informal burning for cooking and heating 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 Foreshore ambient monitoring site has recorded a considerable decrease in PM_{10} since 2009, with increases only experienced again in 2015. Wallacedene and Tableview experienced significant increases in PM_{10} pollution in 2016. These trends could be attributed to a number of factors which could include the proximity of the monitoring site to a possible infrastructural development, or the season that the development underwent construction.

There are multiple reasons for poor 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 un-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 contributes to air quality exceedances.

Figure 32: Annual PM_{10} averages, 2005-2016

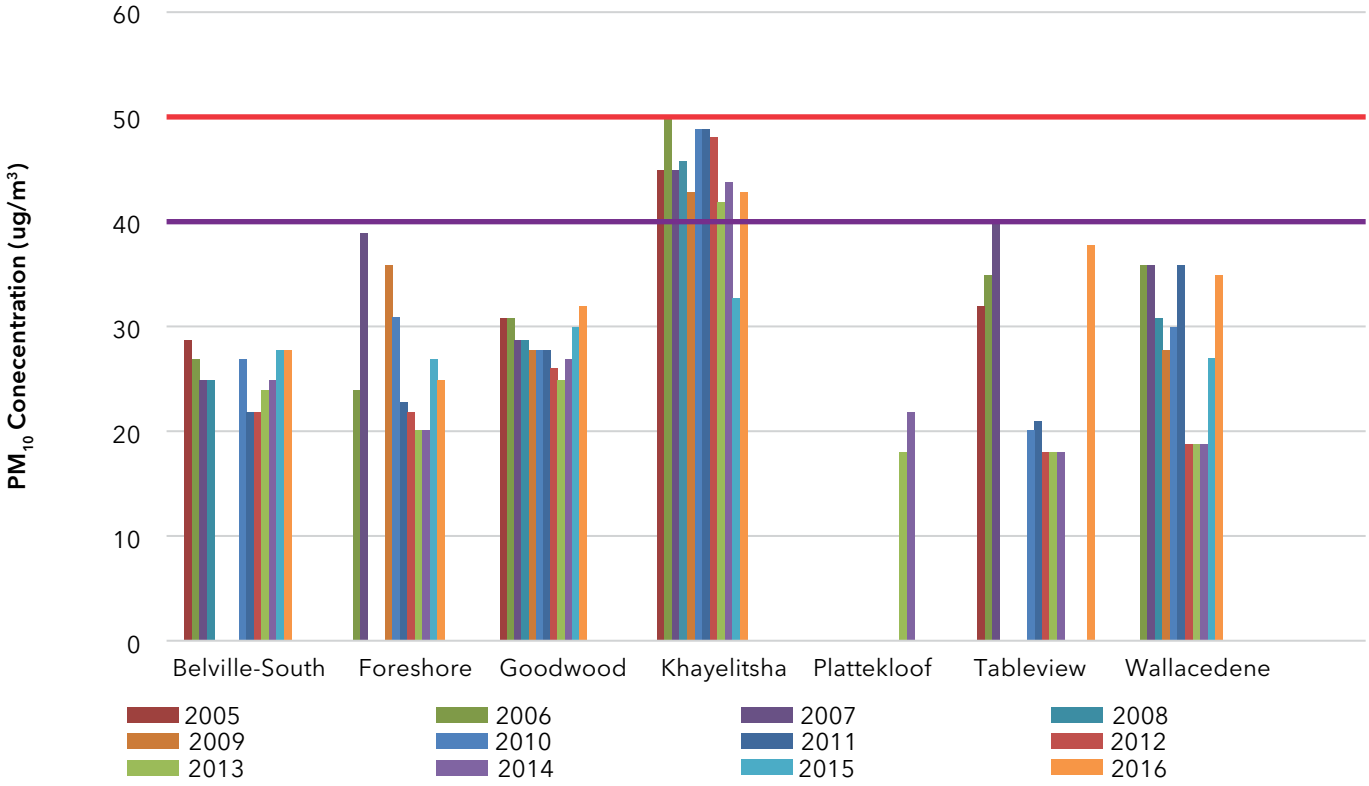
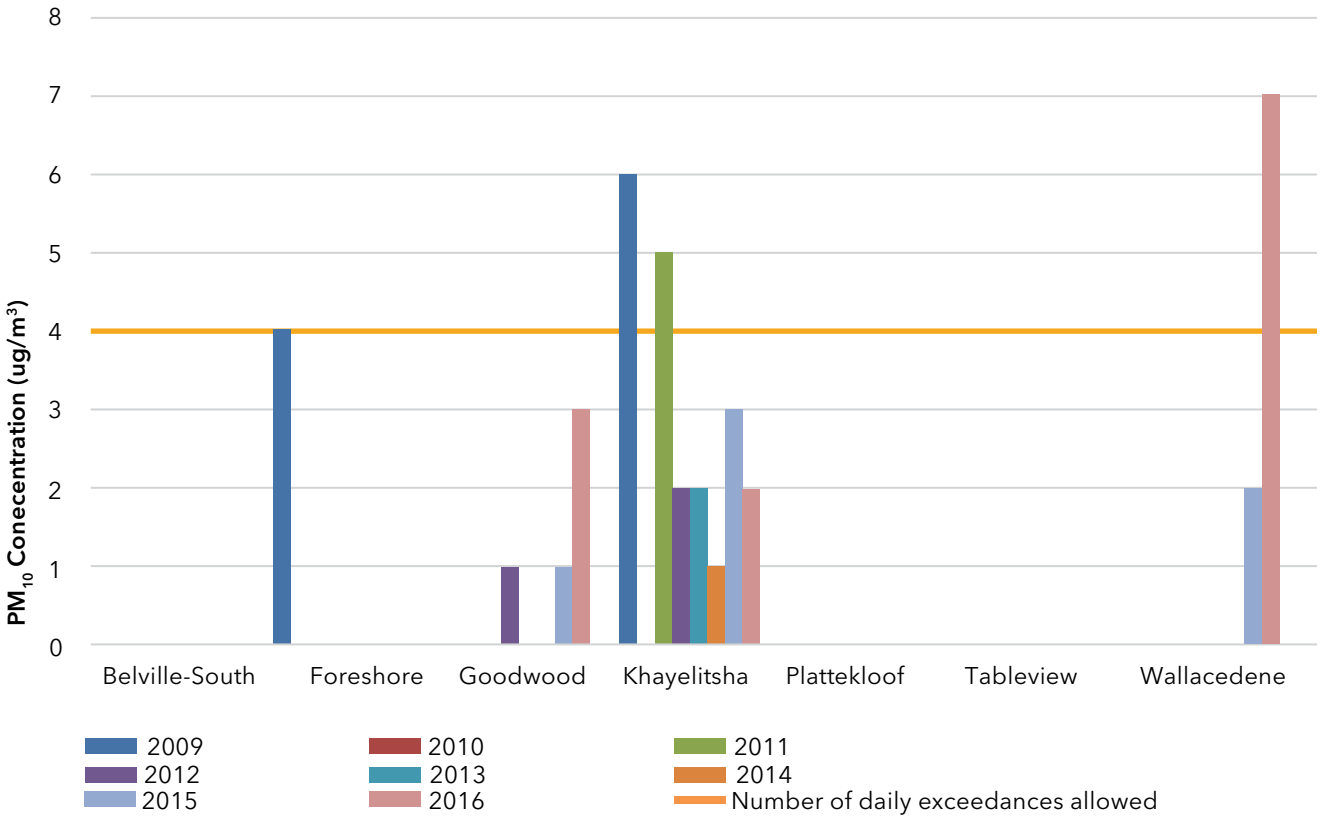


Figure 33: Number of PM_{10} exceedances, 2009-2016



Key management responses

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 City's Air Quality Management Plan (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 by 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[40].
A full list can be found by reading through the Air Quality Management Plan. 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, amended in 2016.

The Air Quality Management By-law was implemented in 2016 as an outcome of the AQMP. This legislation was drafted and implemented with the aim of enforcing the strict regulations and compliance monitoring set by national government in the context of Cape Town, as well as 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 and 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 within the Cape Town CBD. SO_2 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.

Target: Environmental Agenda target of 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 PM_{10} NAAQS.

Policy linkages

IDP: Strategic Focus Area 3 – The Caring City

SDG: Goal 3: Ensure healthy lives and promote well-being for all at all ages

SDG Goal 12: Ensure sustainable consumption and production patterns

Environmental Agenda 2009-2014: Standard 3 – Air Quality.

Air Quality Management Plan: An integrated plan for managing air quality and reducing air pollution in the city.

Air Quality Management By-law 2016

See also: *Chapter on Climate Change.*

CHAPTER 10: SOLID WASTE

Understanding solid waste in Cape Town

Indicators:

- Tonnes of waste generated
- Tonnes of waste disposed
- Kilograms of waste disposed per capita
- Percentages of waste diverted from landfill

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

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[41]. Thus, 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.

Definition of waste

Solid waste consists of waste products generated by households, businesses and industry and includes general waste, green waste, 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 to 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.

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[42]. 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 Integrated Development Plan (IDP) for Cape Town. This ensures that integrated waste management is a priority on the local government agenda. 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 developing a plan for Zero Waste by 2022. Methods are as follows:

- Provision of new infrastructure
- Educational programmes
- Public and private sector participation
- 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 implemented 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 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[43].

The City currently has 24 public waste drop-off sites, developed for the free disposal of small loads of non-domestic waste. The waste types accepted at drop-off sites include garage waste (used batteries, oil paint and brushes), clean garden waste, clean builders' rubble, and recyclable material.

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 three City landfills. This waste in some instances is initially taken to one of three different transfer stations in Athlone, Swartklip and Kraaifontein. Two of these transfer stations (Athlone and Kraaifontein) include Materials Recovery Facilities 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 train or truck. The City has operating licenses for four landfill sites, Bellville South, Coastal Park, Visserhok North and Visserhok South. However, the City views Visserhok North and Visserhok South as one landfill site, called Visserhok. The City also operates a compost plant where a percentage of the household waste is composted and sold to the public.

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

State of the environment

Figures 34 and 35 show the estimated total waste generated, based on the total waste minimised through City initiatives and disposed of at City landfill sites, between 2008 and 2016. This excludes waste minimised through private sector initiatives or disposed of at private facilities. There has been a dramatic increase in waste generated between 2012 and 2016. The years 2009 to 2012 had an average total generated City managed waste of 1,85 million tonnes. In 2013, there was a significant increase to 2,28 million tonnes, increasing again in 2014 to 2,44 million tonnes, with a small decrease in 2015 to 2013 levels, and then again dramatically increasing in 2016 to 2,67 million tonnes. The total amount of waste disposed in 2016 at City landfill sites is equal to just over 400 kgs of waste disposed per person annually in Cape Town, increasing from just over 300 kgs per person annually in 2015, shown in Figure 36.

It is necessary to note that waste generation 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. Figure 37 shows the amount of waste diverted from landfills. The estimated mid-point target of the CCT-IWMP for 2012/13 was for waste generation to be minimised by 20% as well as a 10% reduction in waste to landfill. This target was not achieved in the initial ideal timeframe of the policy, but was met in 2016.

There was significantly less waste disposed to City landfills in 2016, a total of 1,63 million tonnes, than there was in 2008 (1,83 million tonnes). Between 2009 and 2012 there were similar low trends of waste generated and disposed, while 2013 and 2014 had similar high trends of waste generated and disposed. The similar trends in the years 2009 to 2014 indicate that there were lower levels of waste diverted from City landfills, with only a maximum of 15% being diverted in 2012. In 2016, however, 22% of waste was diverted from City landfills, the most waste diverted in recent years.

Reasons for the changing trends in waste generation and disposal could be attributed to a number of local and global shocks. The low total of waste generated and disposed of between 2009 and 2012 could be a result of the global economic downturn that began in 2008 and continued into 2011. The global economic crisis may have encouraged households, companies and industries to reduce unnecessary and expensive spending, resulting in less waste generated and disposed of. Local efforts in education and awareness of the benefits in reusing, reducing and recycling could also have impacted the high waste-to-landfill diversion experienced in 2016. In addition, a reduction in waste collected and received by the City could be as a result of increased recycling programmes and successes in the private sector, prior to the waste reaching the City's waste stream.

Figure 34: Total waste generated (City disposal facilities and waste minimisation programmes only)

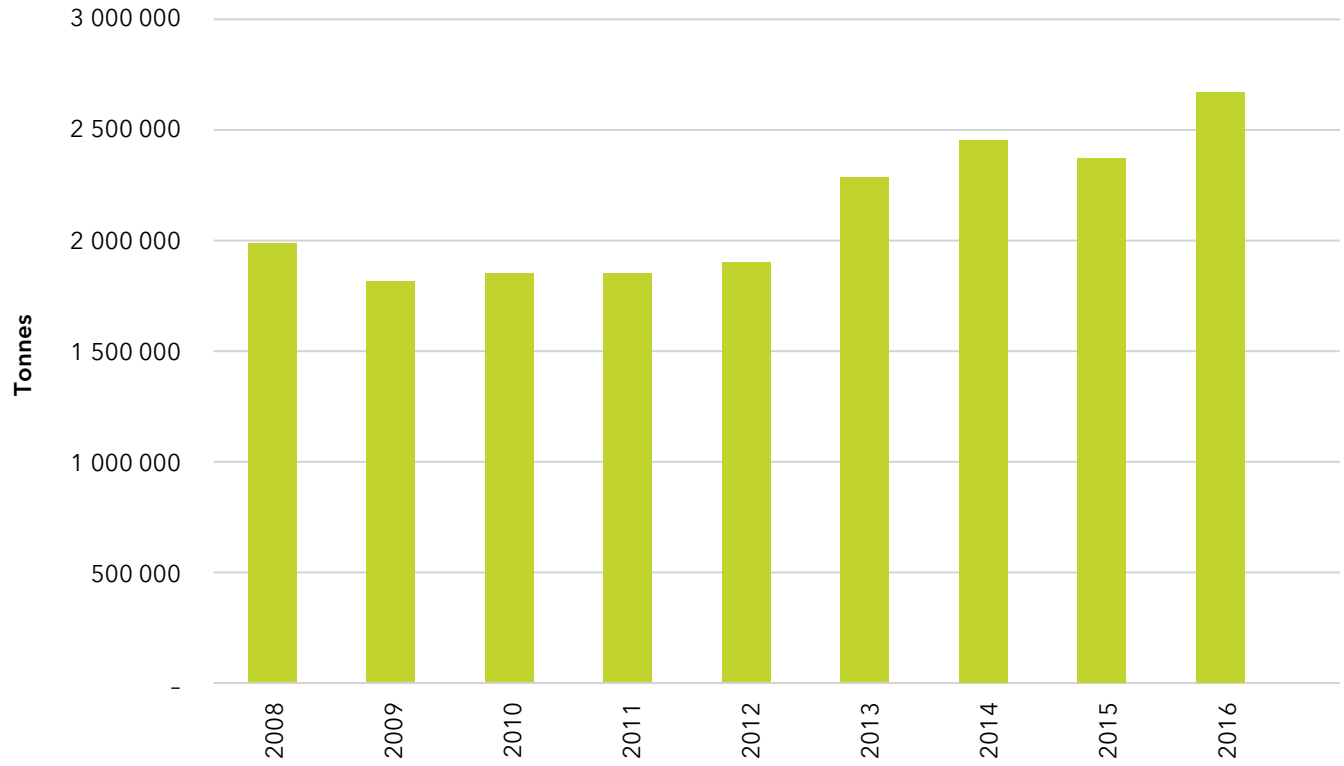


Figure 35: Total waste disposed (City landfill sites only)

Figure 36: Waste disposed per capita (City landfill sites only)

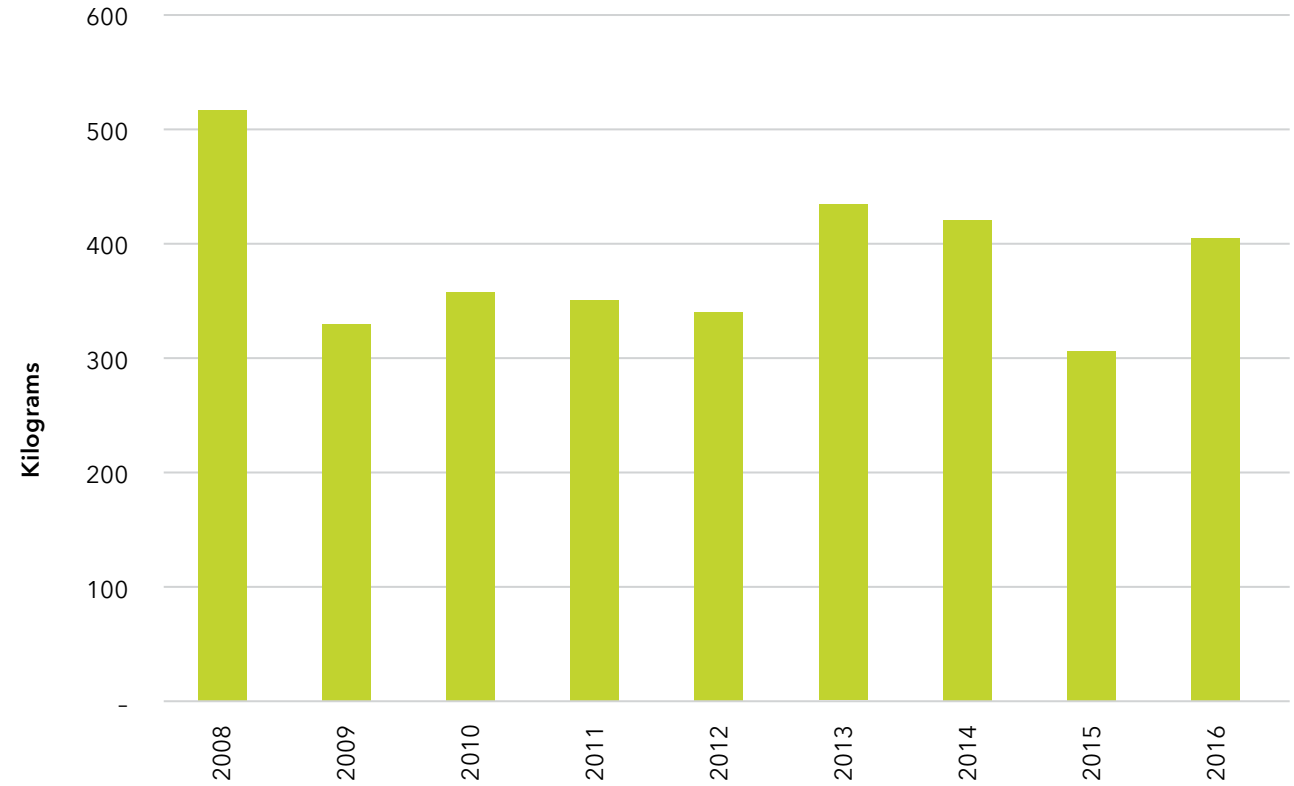
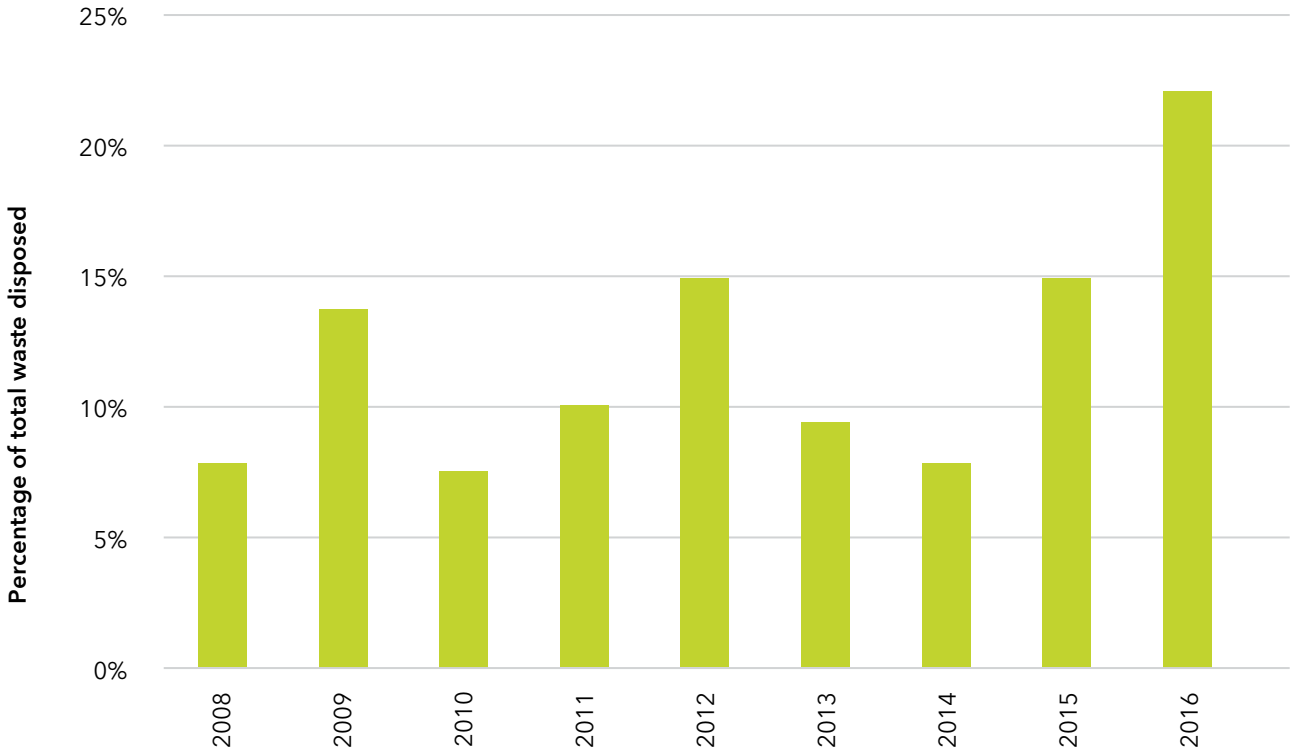


Figure 37: Total waste diverted from landfills (City disposal facilities and waste minimisation programmes only)



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 dramatic 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 the minimisation of waste in the city and use waste as sustainably as possible.

In your household, community and business

At a household and business level, the City actively encourages the minimisation of waste generation by offering multiple guides and tips on reusing, reducing and recycling. 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 offered yet. Private recycling collectors are able to register with the City and be uploaded onto the waste recyclers app for customers to easily find the nearest private recycling centre 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 also encouraged to connect with GreenCape, a sector-development organisation focussed on stimulating the green economy, and 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, materials recovery facility, a refuse-transfer station and a green-waste chipping area, thereby diverting waste from landfills and alleviating the pressure on already over-stretched landfill sites. Similar facilities are planned for other existing and future transfer stations in the upcoming years.

To creating more opportunity 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.

The CCT website offers tips and guides on:

Composting
Recycling
Hazardous Waste
Reducing waste

Trend and target

Trend: Significant decreases in the amount of waste sent to landfill since 2006.

Target: Mid-point target of the CCT-IWMP for 2012/13 for waste generation to be minimised by 20% as well as a 10% reduction in waste to landfill.

Current: Achieved the CCT-IWMP 2012/13 mid-point target in 2016 with 22% diversion from landfill.

Policy linkages

IDP: Strategic Focus Area 1 – The Opportunity City

Environmental Agenda 2009-2014: Target 9 – Waste Minimisation.

SDG Goal 12: Ensure sustainable consumption and production patterns

Integrated Waste Management Policy (2006)

Integrated Waste Management Plan

Integrated Waste Management Amendment By-law (2016)

See also: *Chapters on Climate Change, Freshwater Quality and Coastal Water Quality.*

CONCLUSION

This report has provided information in relation to a number of different themes. Although the statistics reveal that Cape Town is facing environmental challenges, it is encouraging to note that the overall trend is largely positive, with significant improvements noted in the water use, biodiversity, invasive species, climate change and solid waste categories.

The City's commitment to formally proclaiming many of its nature reserves under the National Environmental Management: Protected Areas Act, Act 57 of 2003, is a major achievement and ensures long-term biodiversity conservation. The City is on track to achieving its target of conserving 65% of the BioNet by 2019.

Invasive species continue to be a significant threat to Cape Town's biodiversity. The City's Invasive Species Unit, along with its partner organisations, is making ongoing improvements in raising awareness, removing invasive species and creating jobs that have a positive impact on communities.

Natural public green space is accessible in proximity to most residents. There are no formal provisions for the development, maintenance and operation of natural public green spaces as a cluster. However, there are targets set for the expansion of the biodiversity network, for open spaces, and coastal management, and these all contribute to the expansion of accessible public green space. The lack of access to these spaces in terms of transport routes and fees, as well as a possible entrance fee to certain parks, remains an issue.

In terms of freshwater quality, there has been some improvement. The water quality of wetlands and vleis has met 2014 IMEP targets, while the water quality of rivers has not. In terms of coastal water quality, it is also evident that there are still significant challenges to ensuring excellent water quality along the entirety of the coastline. However, a number of beaches are performing excellently.

Significant improvements have been noted in water usage. A steady decline in the amount of water used was observed for the years 2011 to 2014, and again in 2016, correlating with increased water-demand management interventions put in place. The City is working tirelessly to mitigate and adapt to the persisting water crises.

Wastewater treatment works have met their targets of compliance with DWS standards for many years. In 2016 there was a slight decrease in compliance, but it was still above target. The City is continuously trying to improve compliance in wastewater.

In terms of climate change, the City has broadened its focus on climate change issues, increasing its efforts in combating climate change impacts through a multitude of adaptation and mitigation programmes, which include adopting a Climate Change Policy and appointing a Chief Resilience Officer.

It is encouraging to know that the City continues to comply with the South African air quality standards. Measurements show that air pollution has decreased or remained unchanged in most areas. The City continues to ensure commitment to reducing the source and effects of bad air quality.

There has been a significant percentage of waste-to-landfill diversion in 2016. However, the total amount of waste generated has increased. Increased efforts in waste diversion by the City and external stakeholders provides an encouraging outlook for the future of solid waste generation and disposal.

In summary, the themes showed the following changes in 2017:

Improvement	No Change	Deterioration
Biodiversity	Invasive alien species	Coastal water quality (False Bay coast)
Coastal water quality (Atlantic coast)	Natural public green space	
Water use	Fresh water quality	
Climate change	Waste	
Solid waste	Air quality	

References

1. Republic of South Africa. 2004. World Heritage Scanned Nomination: Cape Floral Region Protected Areas. UNESCO.

2. City of Cape Town. 2013. Cape Floristic Region.

3. Rebelo, A., Boucher, C., Helme, N., Muicna, L., and Rutherford, M.C. 2006. "Fynbos Biome." In The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19., by L. and Rutherford, M.C. (eds) Mucina, 52-208. South African Biodiversity Institute: Pretoria

4. Rebelo, A., Boucher, C., Helme, N., Muicna, L., and Rutherford, M.C. 2006. "Fynbos Biome." In The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19., by L. and Rutherford, M.C. (eds) Mucina, 52-208. South African Biodiversity Institute: Pretoria.

5. South African Biodiversity Network. nd. PlantZAfrica: Vegetation of SA. http://pza.sanbi.org/vegetation/fynbos-biome.

6. City of Cape Town. 2016. Local Biodiversity Strategy and Action Plan 2016-2026.

7. City of Cape Town. nd. The Cape's animal kingdom. http://www.capetown.gov.za/Explore%20and%20enjoy/Nature-and-outdoors/Our-precious-biodiversity/The-Capes-animal-kingdom.

8. City of Cape Town. 2016. Local Biodiversity Strategy and Action Plan 2016-2026.

9. City of Cape Town. 2016. Local Biodiversity Strategy and Action Plan 2016-2026.

10. City of Cape Town. 2011. Cape Town's Unique Biodiversity Endemic Ecosystems: Peninsula Sandstone Fynbos. Cape Town, Western Cape.

11. City of Cape Town. 2011. Cape Town's Unique Biodiversity Endemic Ecosystems: Peninsula Granite Fynbos. Cape Town, Western Cape.

12. City of Cape Town. 2011. Cape Town's Unique Biodiversity Endemic Ecosystems: Cape Flats Sand Fynbos. Cape Town, Western Cape.

13. City of Cape Town. 2011. Cape Town's Unique Biodiversity Endemic Ecosystems: Lourensford Alluvium Fynbos. Cape Town, Western Cape.

14. City of Cape Town. 2016. Local Biodiversity Strategy and Action Plan 2016-2026.

15. It is important to note that all maps used in this Biodiversity section were generated in 2017 using 2016 datasets.

16. City of Cape Town. 2016. The Biodiversity Network for the Cape Town Municipal Area: 2016 Methods and Results.

17. City of Cape Town. 2012. State of the Environment Report.

18. City of Cape Town. 2016. The Biodiversity Network for the Cape Town Municipal Area: 2016 Methods and Results.

19. City of Cape Town. 2016. The Biodiversity Network for the Cape Town Municipal Area: 2016 Methods and Results.

20. Pence, G. 2011. Incorporating Climate Change Adaptation Strategies into the Updating of the City of Cape Town's Biodiversity Network Analysis. Unpublished Report, City of Cape Town.

21. The National Invasives Species Council. 2006. Invasive Species Definition Clarification and Guidance White Paper.

22. City of Cape Town. 2012. Enviroworks Special Edition: Invaisve Species. Invasive Species: A threat to our heritage. Vol 1/12.

23. Cape Town Invasives. Nd. Cape Town Invasives. http://www.capetowninvasives.org.za/.

24. Invasives Map

25. United Nations. Sustainable Development Goals. Available: http://www.un.orgsustainabledevelopment/cities/ .

26. City of Cape Town. 2013. Urban Design Policy.

27. City of Cape Town. 2011. Inland and Coastal Water Quality Improvement Strategy and Implementation Plan.

28. City of Cape Town. 2013. State of the Environment Report 2012.

29. City of Cape Town. 2011. Inland and Coastal Water Quality Improvement Strategy and Implementation Plan.

30. WESSA, nd. Available: http://wessa.org.za/what-we-do/ecotourism/blue-flag-sa/

31. City of Cape Town. 2016. Annual Water Services Development Plan Performance- and Water Services Audit Report.

32. City of Cape Town. nd. Water and Sanitation Department. Available: http://www.capetown.gov.za/Departments/Water%20and%20Sanitation%20Department

33. City of Cape Town. 2016. Annual Water Services Development Plan Performance- and Water Services Audit Report.

34. City of Cape Town. 2017. Water Services and the Cape Town Urban Water Cycle.

35. This is calculated based on the Global Protocol for Community Scale Emissions (GPC). The data represented in this report excludes international marine and aviation fuel data due to the unreliability of the data, unless otherwise stated.

36. Calculated using energy- related emissions only including aviation and international marine and excluding total waste.

37. City of Cape Town. 2017. Carbon Disclosure Project.

38. City of Cape Town. 2017. Carbon Disclosure Project.

39. City of Cape Town. 2017. Carbon Disclosure Project.

40. City of Cape Town. 2005. Air Quality Management Plan.

41. Hoorrnweg, D, and P Bhada-Tata. 2012. What a Waste: A Global Review of Solid Waste Management. Urban Development Series Knowledge Papers No. 15.

42. City of Cape Town. 2016. Integrated Annual Report 2015/16.

43. The City will be undergoing a renaming process of the Integrated Waste Management By-law in the near future.

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 force 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. Additionally, 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
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