

Cleaner, Greener & Safer
MAURITIUS

ENVIRONMENTAL GUIDELINE FOR SMART CITIES

**Ministry of Environment, Sustainable Development, and
Disaster and Beach Management**

July 2015

Environmental Guideline for Smart Cities

1.0 INTRODUCTION

1.1 Purpose of the Environmental Guideline

This document provides general guidance for the planning and design of Smart Cities from an environmental perspective with a view to guide the conceptualization of the proposed Smart Cities towards a cleaner, greener and safer Mauritius. The aim of the guideline is to provide a set of environmental criteria which can be broadly followed in the design of a Smart City as each site for the project is different and unique.

The Smart Cities will be of **mixed use** - typically comprising residential, commercial, office and entertainment components. Developers are informed that any activity within a Smart City, listed as an undertaking as per the Environment Protection Act will require an Environment Impact Assessment (EIA) Licence or a Preliminary Environment Report (PER) as applicable.

1.2 Background

A smart city is one where capital, resources and knowledge are managed in a wise manner, with a focus on innovation, sustainability, efficiency and quality of life. This requires a clear vision and long term planning with innovative, practical and effective approaches. Smart city needs to forge the way towards socially inclusive communities with a low ecological footprint. People within smart cities will enjoy a quality of life in a clean, green living environment where public and open spaces are pristine and waterways and water features including natural/artificial lakes, wetlands, ponds and rivers are lifestyle attractions for all. The smart cities will demarcate themselves by their individual signature. They need to be futuristic but sustainable in all dimensions. The thrust of the smart city will be to:

- Enhance and valorize the intrinsic environmental asset of the area such as lake/river/wetland/forests amongst others and use it as a centre of attraction within the master plan;

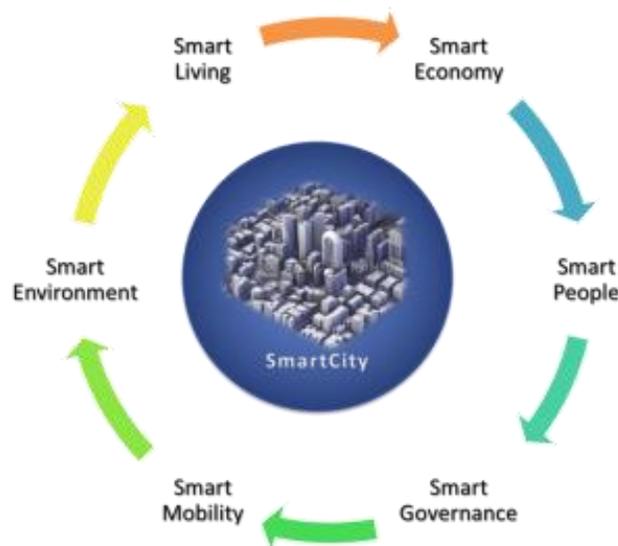
- Promote socially inclusive development around the valorized asset which may become a vibrant focal point for communities enjoyment of the area through recreational, sports, open air, social, cultural and entertainment activities;
- Develop each smart city around a specific theme for it to have its own identity and character that will valorize the environmental assets of the area (forest, natural park, beach, mountain, wind, viewpoint);
- Create working, living and leisure space that will be environment-friendly and socially inclusive;
- Promote environmental ethics, code and conduct for citizens to have a green culture and attitude;
- Promote people enjoyment and appreciation of a pleasant, clean living environment free from any pollution and nuisances such as odor, noise, dust, pests, stray dogs, eyesores, litters and bare lands;
- Generate its own resources in terms of energy and water;
- Promote storm water harvesting and storage into natural or artificial lakes/wetlands/reservoirs/ponds:
 - As a water conservation measure to reduce pressures on our surface and groundwater resources;
 - As a form of climate change adaptation to flood mitigation and disaster risk reduction;
 - To give way to greeneries for communities' enjoyment of same and nature;
- Capitalise on rainwater harvesting for the creation of landscape architectural water features to further enhance the centre of attraction and/or focal point within the master plan for communities' enjoyment;
- Create and maintain continuous green belts with parks and endemic gardens/open spaces to promote biodiversity corridors with health and/or bicycle tracks within for human enjoyment of nature;
- Promote state of the art connectivity;
- Promote energy conservation in buildings in a way so as to protect the environment and be more sustainable;

- Promote smart, modern and sustainable mobility and reduce traffic congestion across the island;
- Adopt sustainable lifestyles and sustainable consumption patterns through waste minimization, composting, rooftop rainwater harvesting and modern communication technologies;
- Integrate people of all social fabrics including those within the surrounding areas through job creation including green ones;
- Consider green agriculture and organic farming.

1.2.1 Characteristics of the Smart Cities

The Smart Cities will be based on the Smart City Model, which is a combination of the following six characteristics:

SMART CITY MODEL BASED ON SIX CHARACTERISTICS



Six basic concepts are used to describe specific parameters when planning for a smart city:

Environmental Sustainability	Sustainable Lifestyle	Smart Governance
<ul style="list-style-type: none"> ▪ Judicious land use planning; ▪ Attractivity of natural conditions; ▪ Environmental protection and pollution control; ▪ Smart energy including renewables and energy efficiency; 	<ul style="list-style-type: none"> ▪ Quality health conditions; ▪ Individual safety; ▪ Cultural and educational facilities; ▪ Accessibility to good quality housing (green buildings); tourist attractions, and social integration; 	<ul style="list-style-type: none"> ▪ Involvement of the public in decision-making; ▪ Public and social service; ▪ Government transparency;

<ul style="list-style-type: none"> ▪ Sustainable buildings; ▪ Waste recycling; ▪ Water efficiency. 		
<p style="text-align: center;">Smart Economy</p> <ul style="list-style-type: none"> ▪ Entrepreneurship and productivity spirit; ▪ An overall culture of innovation based on e-business and e-commerce; ▪ Promotion of local products. 	<p style="text-align: center;">Sustainable Mobility</p> <ul style="list-style-type: none"> ▪ Local and national accessibility; ▪ Safe and sustainable transportation systems for public transport, cars, bicycles and pedestrians; ▪ Access to ICT supported and integrated transport. 	<p style="text-align: center;">Smart People</p> <ul style="list-style-type: none"> ▪ A culture of life-long learning; ▪ Social and ethnic diversity; ▪ Flexibility; ▪ Creativity; ▪ Community participation. ▪ Citizen awareness

2.0 Environmental Parameters

The effective implementation of the smart cities requires an integrated and interdisciplinary approach to sustainable development. To ensure a low carbon, a low water and low ecological footprint with infrastructure designed to adapt to the present and future impacts of climate change, developers need to consider the following at the very design and planning stage of the project:

- Land Use Planning
- Green Buildings and Energy Conservation
- Disaster Risk Reduction
- Water efficiency, re-use and recycling
- Waste Management
- Sustainable Transport
- Greening and Biodiversity
- Community

3.0 Land Use Planning

3.1 Objectives

Efficient land use is a major concern for Mauritius due to limited land size, its already relatively high population density of 630 per km² and its economic growth. Built-up areas are estimated to cover about 20% of the land in Mauritius.

Land use planning in the Smart Cities may be driven by sustainable concepts, based on good urban planning practices. The objective is to ensure that:

- The most sustainable sites are used for development and that quality of life is enhanced through proper zoning and siting of activities;
- Environmentally sensitive areas are protected and conserved;

- Key ecological assets of the site (e.g rivers, wetlands, lakes, forests) are valorized and development carried out around the specific asset;
- Development is appropriate to the local context and supports a sustainable community.

3.2 Measures

In determining the type and layout of the Smart Cities, the following elements may be considered:

3.2.1 Location & Context

When designing a Smart City, consideration may be given to the following:

- ***Location and context of site***

The context of a development is the character and setting of its surrounding environment. An analysis of the context is particularly important to understand the site's limitations and opportunities.

Developers could capitalize on:

- (a) The presence of an Environmentally Sensitive Area (ESA) such as a river/ lake/ forest/ mangrove as an opportunity to enhance and valorize same as a focal point for recreational/water sports eco-tourism/open air social, cultural and entertainment activities within the master plan.
- (b) Use the valorized asset as a centre of attraction within the master plan to promote socially inclusive development through the planning of public amenities and the creation of connections between the centers of attraction.

Where a Smart City is proposed within or adjoining ESA's, the proposed development may demonstrate how it will contribute to maintain and enhance the environmental character of the area.

- ***Extent of development***

The nature and scale of the Smart City has to be in harmony with its surroundings and its architectural quality has to be in harmony with the seascape/landscape to enhance the character of the area. **A Smart City project has to provide for an integrated and large-scaled mixed-use development on a land area exceeding 50 arpents.**

3.2.2 Accessibility and Infrastructure

Successful integration with existing connections plays a key role in physically and visually integrating a new development with its surroundings. Proposed sites for Smart Cities may be easily accessible and capable of connecting to transport networks.

The following elements may be considered:

- Linkages and connections (roads and utilities)
- Modes of travel
- Parking capacity and layout
- Traffic management
- Road gradient
- Land drainage of the site to the proper approved outlets

3.2.3 On plot services

The design of Smart Cities may be guided by the standards and technical requirements of the Planning Policy Guidance of the Ministry of Housing and Lands. Design guidance for urban design principles, residential morcellement development, commercial development, residential coastal development, tall buildings, sustainable development and Energy Efficiency amongst others may be consulted and complied with. A series of Technical Sheets as hereunder have also been provided in the Planning Policy Guidance on Design Guidance and reference may be made to these. These Technical Sheets include:

- Drainage
- Electricity
- Main Sewerage provision
- On-plot sewage disposal
- Telecommunications
- Water Supply
- Combined Utilities Summary Plans

For development on sloping sites, developers are advised to consult Planning Policy Guidance Development on Sloping sites and Landslide Hazard Zones.

3.2.4 Setbacks, Visual and Acoustic Privacy

Setbacks serve to protect the amenity of adjoining properties, promote visual and acoustic privacy and assist in establishing street character by defining edges. The siting and scale of buildings depend on the way the buildings relate to their boundaries, and their overall massing. By adjusting setbacks and proper orientation, buildings can be designed to ensure an adequate daylight to habitable rooms, sufficient ventilation and private open space.

Setbacks normally increase with additional building height and also in relation to the particular requirements of an existing context.

Visual and acoustic privacy can be provided by a judicious use of setbacks, siting of buildings and introducing landscaping elements. These considerations are important when designing tall buildings or where sites are small.

3.2.5 Parking

The provision of parking and service areas has to be adequate to cater for the needs generated by the Smart City. As a Smart city will be a relatively dense development, the provision of basement or multistorey parking to serve the development may be desirable. All underground parking may take into consideration safety, security aspects and alert systems in case of flash floods.

In order to create high quality road frontages and public spaces, the provision of forecourt parking may be discouraged. Where forecourt parking is unavoidable, the development may be clearly defined by a hedge in continuity with adjoining development to provide a high standard of visual appearance from the road.

4.0 Green Buildings and Energy

4.1 Objective

The main objective is to minimize use of fossil fuels and decrease CO₂ emissions. Sustainable buildings have the highest contribution towards lowering GHG emission. With buildings being responsible for 40% of our carbon emissions, promoting sustainable buildings is a central challenge in meeting climate change targets.

Due to the tropical climate of Mauritius, the cooling load may account for a large portion of the energy demand. As such design of buildings must be sustainable and efficient by design and preferably passive means.

4.2 Passive Design and Energy Efficiency

The following measures aimed at maximizing the benefits of passive design may be considered:

- Where possible, the longest façade of a building may be oriented towards the North and South to minimize heat gain inside the building from the rising and setting sun along the east-west axis.

- In order to ensure the objectives of comfort and functionality to its users, combining techniques, estheticism, durability and energy saving, bioclimatic design of the building may be considered.
- The cross ventilation may be facilitated by dominant winds of the area (in Mauritius, winds originate mainly from the east). Facades facing these directions will ensure a minimum porosity rate to allow natural ventilation and natural light indoor.
- Building roofs and walls may provide effective thermal insulation. The roofs may be finished to have high emissivity and reflectivity (“Cool Roofs”) in order to comply with the requirements of the Building Control Act 2012.
- Buildings may use natural lighting during day time by providing appropriately sized and shaded, well placed windows.
- Buildings may use energy efficient lighting.
- Trees and other vegetation on the north and west of the buildings may be used for providing direct shading. Sun breakers may be sized in addition to surrounding masks to protect openings of the buildings from direct solar radiation.
- The use of local materials for the constructions may be considered.

Under the Building Control Act, buildings and constructions have to abide to the following 'Basic Sustainability Criteria'.

1. *Building site;*
2. *Water efficiency;*
3. *Energy efficiency;*
4. *Materials and resource efficiency;*
5. *Indoor Air Quality; and*
6. *Management and Innovation.*

In addition, buildings have to meet the guidelines developed in the Green Building Rating System in order to meet the standards with respect to:

1. *Site assessment with consideration to eco-systems,*
2. *Land drainage and ESAs;*
3. *Water efficiency through use of devices such as rainwater harvesters;*
4. *Recycling of the construction and demolition wastes;*
5. *Compliance with the Energy Efficiency Building Code.*

Guidelines for energy efficient buildings

In order to make buildings energy efficient, buildings within smart cities may abide by the guidelines for energy efficient buildings for residential and non-residential purposes. These guidelines include illustrative examples of design principles that must be adopted to promote energy efficiency and make the most of natural resources.

4.3 Renewable Energy

In order to encourage the use of renewable energy within a Smart City, the following measures may be adopted:

- Buildings may be fitted with solar water heating system.
- Based on the latitude of Mauritius and its location, solar collectors may ideally be oriented towards the north and inclined at 20° ideally to the horizontal, although inclinations up to 45° can be used without significant decline in system performance.
- Solar panels and/or photo-voltaic panels may be encouraged for residential and commercial areas, bus stop, traffic light, advertisement/road signage and street lighting.
- Renewable energy systems may be installed on various parts of buildings including the roof, walls and windows to ensure that it does not affect the townscape and aesthetic value of the building.

5.0 Disaster Risk Reduction

5.1 Objectives

The main objective is to ensure that sites and developments take into consideration the cyclone and flood risk and appropriate measures to mitigate the risk of flooding on adjacent areas of land and all areas lower down or higher up the watershed. The risk of flash flooding may be taken into account in drainage arrangements for development. Fire safety measures will have to be taken within the smart city.

5.2 Measures to be implemented

- Storm water harvesting and water storage into natural or artificial lakes/wetlands/ponds present opportunity to adapt to climate change for disaster risk reduction by reducing floods and damage to infrastructure through reduced peak flows. Reduced run off and soil erosion lead to reduced sedimentation of our water bodies including our lagoons thus protecting biodiversity, corals and white sandy beaches.
- Sustainable drainage measures such as porous surfaces (grasscrete, gravel), grass swales and attenuation ponds may be used so as to manage the rates of surface water runoff within the curtilage of the development and to minimize the proportion of impervious surface.
- Wastewaters may be canalized to onsite treatment plants.
- The treated water may be used for irrigation of common areas.
- A minimum of 20% of the plot may be under soft landscaped areas, particularly where situated on slopes.
- Drainage channels may be provided with soakaways at regular intervals where the porosity of the ground permits aquifer recharge.
- Existing natural drains across the site may be maintained or re-routed as appropriate. They must not be simply filled in.
- Where the development includes basements, the developer may demonstrate measures to prevent accident or injury in case of flooding.

6.0 Water Autonomy, Efficiency, Re-use and Recycling

6.1 Objectives

The objective is to manage water resources sustainably for future generations through reducing the overall consumption of clean water for non-potable uses and to manage the run off of rain water from the site.

6.2 Measures

The following water efficient measures may be taken into consideration within the Smart Cities:

6.2.1 Water Efficiency:

- Buildings may be fitted with water efficient plumbing and appliance such as faucet water aerators.
- Water meters may be installed in buildings;
- Provision may be made of leak detection facilities and monitoring for early detection of leaks within water infrastructure.
- Native/indigenous species with low water requirement may be planted so to form at least 50% of the vegetated area.

6.2.2 Water Re-use and Recycling

- Storm water harvesting and storage into natural or artificial lakes/wetlands/reservoirs/ponds may be considered;
- Rainwater harvesting systems may be integrated in the design of buildings to collect rainwater from roof as well as site runoff. The water collected may be used to supply water for flushing of toilets, car washing, garden watering and washing of surfaces.
- Rainwater harvesting and the overflowing water from storm water ponds may be recuperated in an underground tank for re-use.
- Grey water recycling – Water from baths, showers, washing machines and wash-hand basins may be captured and recycled within a building.
- The treated water may be reused for non-potable use such as toilet flushing or garden irrigation.

7.0 Waste Management

7.1 Objectives

Mauritius is generating around 450,000 tonnes of solid wastes annually, which requires an extent of nearly 3 hectares of land at an average depth of 20-25 metres for landfilling. The quantities of wastes are increasing annually at a rate of nearly 2%.

The Smart cities must focus on reducing the volume of waste directed to landfills based on the 3'Rs' (Reduce, Reuse and Recycle) approach, involving a complete shift in the mindset of users from simple waste disposal to waste avoidance and prevention.

7.2 Measures

In order to ensure sustainable waste management practices within the Smart Cities, the following specific measures are recommended:

- Provision for waste segregation at source, down to household and commercial levels by providing separate bins for recycling and composting purposes.
- Composting of organic wastes may be encouraged both at household and community level by providing separate collection for organic waste. Facilities for a centralized composting may be provided at community level.
- Various ecopoints (collection points) may be provided for the centralized storage and collection of recyclables within a community or where appropriate within a Smart City. A centralized collection facility may also be provided for e-wastes such as batteries, electronic appliances and computers.
- For commercial developments, provision may be made for the collection, segregation and safe storage of hazardous wastes as well as the containment of spillages through the use of oil separators and grease traps.
- As far as practicable, the adoption of PET bottles free and plastic bags free policies need to be adopted within the smart cities.

8.0 Sustainable Transport

8.1 Objectives

The transportation sector in Mauritius is the second highest contributor of GHG emission; contributing about 969.5 Gg of CO₂ in 2013. The Smart cities may require sustainable transport that will improve access and mobility while decreasing congestion and increasing productivity.

The Smart Cities may be structured in such a way so as to avoid or reduce trips through integrated land-use and transport planning. These integrated networks may be planned comprehensively to link together the numerous public facilities, social amenities and commercial centres with the residential areas in the cities.

8.2 Measures

Planning towards the Smart Cities requires the following sustainable transportation measures:

- Walking and cycling may be encouraged as a mode of travelling by providing the necessary facilities:
- Provision may be made for an integrated and safe network of pedestrian and cycling paths within and between developments;
- Provision for cycle storage may also be made.
- A bike sharing system using electric bicycles to provide a practical, easy to use, sustainable service for short everyday journeys around the city can be introduced.
- Dropped curbs will have to be provided at crossing points to facilitate access for the elderly, disabled and pushchairs. Bicycle and pedestrian paths will have to be accessible to persons with reduced mobility.
- The safety and security of pedestrian and cyclist must be a priority in order to encourage users to shift from automobile usage to walking or cycling around the community.
- Switching from fossil fuel to renewable energy source is one of the effective actions to be adopted in the smart cities. The use of electric vehicles and hybrid vehicles may be promoted by planning supporting facilities such as service station.
- Carpooling/sharing may be promoted.
- An Integrated Public Transportation System may be designed to economically move people on time. It is important to have a good network to connect public transportation within the cities in order to ensure a better connection from one location to another and reduce the time spent for waiting.
- To reduce reliance on private transportation through promotion of “ hop on hop off” LPG or electric driven public transportation covering strategic places of residence, work, and commercial areas within the smart city.

- A park and ride system may be introduced at the peripheries of the smart cities.

9.0 Greening and Biodiversity

9.1 Objectives

Biodiversity provides us with life-sustaining systems such as clean air and ecosystems. The residents of smart cities must be provided with the opportunity to experience greenery, nature at their door steps. These green areas help to reduce heat islands effect, provide carbon offset, conserve biodiversity and enhance the aesthetics of development. The overall objective would be to ensure that there is no reduction in biodiversity due to development and wherever possible, a net gain.

9.2 Measures

The following measures may be taken:

- The ecological value of a development site may be conserved and enhanced, maintaining biodiversity and protecting existing habitats, which contribute to and enhance the amenity of a particular area.
- Capitalise on storm water harvesting to allow for the creation of artificial lakes/wetlands/reservoirs/ponds to give way to greeneries for communities enjoyment of same and nature;
- Continuous green belts, parks, open space, endemic gardens, health and/or bicycle tracks and biodiversity corridors may be created and maintained for human enjoyment of nature, open air activities and sports.
- Capitalise on views of natural features and landscaped open spaces and greeneries as a form of value creation within the master plan to reinforce and enhance the development character for citizens.
- Development impacting on Environmentally Sensitive Areas must be in accordance with the requirements of the national policy on ESAs based on the level of ESA classification.
- The development may be based on the Garden City Concept having planned urban green areas in the form of parks and green spaces.

9.3 Urban Landscape Design

- Road reserves must be wide enough to allow for landscaping and greening with trees.
- Endemic species of trees may be planted around suitable areas such as along the pedestrian walkways, the roadsides and parks.
- The ecological value of the site and existing habitats may be improved through the use of strategic landscape planting.
- Green agriculture with roof top gardening may be considered.

10.0 Community

10.1 Objectives

Sustainable communities depend upon the effective delivery of community infrastructure, which if well planned and designed may provide places for people to meet and interact. The objective is to ensure that the proposed development encourages and supports a vibrant, diverse and inclusive community spirit, which can integrate with the surrounding communities.

10.2 Measures

- The development may be planned around a key asset of the site. It may be the focal point where people will be able to meet and socialize to create socially inclusive communities and encouraging positive interaction between groups and the fostering of an enduring community spirit.
- Developers may capitalize on the presence of an Environmentally Sensitive Area such as a river, lake, forest and/or mangrove as an opportunity to enhance and valorize same as a focal point for recreational/water sports/social/eco-tourism activities within the master plan.
- The valorized asset may become a vibrant focal point for:
 - communities enjoyment of the area through recreational, sports, open air social, cultural and entertainment activities;
 - the planning of public amenities The set up should allow for social interaction and conviviality amongst citizens, irrespective of their social class and ethnicity while converging towards or passing by this vibrant pole of attraction.

- Capitalise on storm water harvesting:
 - To allow for the creation of artificial lakes/wetlands/reservoirs/ponds around which greeneries will attract all communities for enjoyment of nature,
 - For the creation of landscape architectural water features to further enhance the centre of attraction and/or focal point within the master plan for all communities' enjoyment and promotion of communities gathering irrespective of their social class and ethnicity.
- Create and maintain continuous green belts with parks and endemic gardens/open space to promote biodiversity corridors with common health and/or bicycle tracks within, for collective communities' enjoyment of nature.
- Integrate people of all social fabrics including those within the surrounding areas through job creation.
- The development may ensure that there are available facilities within the neighbourhood, which are appropriate to the existing and new communities that will be developed such as community halls, sport pitches, gymnasium, open space, picnic areas with waste facility, indoor and outdoor game facilities.

Regulations and Standards to be complied with:

- The Environment Protection Act
- Building Control Act
- Planning and Development Act
- Town and Country Planning Act
- Wastewater Management Authority Act
- Public Health Act
- Ground Water Act
- Rivers and Canals Act
- Forest and Reserves Act
- Planning Policy Guidance from the Ministry of Housing and Lands

Standards

- Drinking water Standards
- Environment Standards for Noise
- Standards for Air
- Standards for Effluents for use in Irrigation
- Standards for Effluent Discharge