Landscape Guidelines





8.0 Landscape Guidelines

8.1 Introduction

8.1.1 Purpose of this guide

The Landscape Guidelines have been developed to provide further detail on the materials, finishes, planting and irrigation of the parks, open space and public realm throughout Duqm City. The design guidelines should be read within the context of the wider Detailed Master Plan (DMP) with particular note of Chapter 6 Landscape and Public Realm . The landscape guidelines chapter will provide third party designers, developers and project managers with:

- Design parameters for selecting materials and products;
- Guidance on planting and environmental considerations.

Design consultants are expected to utilise the guidance set out in this document to justify the decision-making process and the selected material and planting palettes.

Developers will be expected to reference the guide during

8.1.2 How to use this guide

This guide has been setout to provide the design guidance for finishes, materials and planting within the landscape and public realm of Dugm City. The chapter is broken down into the following main headings:

- Design Principles
- Furniture and Materials Palette
- Planting Palette and Irrigation

The sections on Design Principles setout the framework from within which the specific design guidance has been developed.

The sections on Furniture and Materials Palette, Planting Palette and Irrigation setout the specific design guidance and outline to be followed for each open space typology. This will provide appropriate guidance on materials, products and planting and design parameters for each of the different open space typologies.

The design guidance should not be seen as a prescriptive set of rules, but rather as best practice design parameters that allow for some flexibility and individuality in designs coming forward. These parameters are needed to ensure a lasting design legacy, quality standards and the future success of Dugm City.

be referred to.





For further detail on the overarching design strategy Volume 1 Chapter 6 Landscape and Public Realm should

8.1.3 Key Design Principles

Omani Culture

Responding to Omani culture and understanding the function of an area enables designs to articulate its character, context and use.

Green Infrastructure

Fundamental to ensuring the long term health and quality of life of sustainable communities, green infrastructure comprises all the public and private areas of open space that contribute to environmental and ecological processes.

Inclusive

Accessible and connected places and streets must consider users of all ages and abilities whilst simultaneously increasing opportunities for wheelchair users, pedestrians and cyclists.



Environmental Sustainability

Spaces and streets must be sustainably designed for Oman's desert climate and ecology, address the needs of its communities, and enable Dugm to fulfil its environmental obligations.



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Safety and Security

Safety and security achieved through the management and control of motor vehicles and the design of public realm to reflect the requirements of the street type, size, current and future volumes of pedestrians and cyclists.

Future Proofing

A fundamental design consideration is one of ensuring longevity and adaptability to local needs and requirements by ensuring designs are fit for purpose, now and in the future.





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DUQM CITY - Sultanate of Oman February 2019



Connected Infrastructure

Providing an accessible, legible and well-connected network of sustainable transport including public transport, pedestrian, cycle and highway connections.



Quality and Innovation

Incorporate the highest quality of design standards, materials and construction to be recognised worldwide as the latest in landscape and public realm design.





8.1.4 City Wide Materials and Furniture Palette

The majority of the public realm's streets and spaces will utilise the City Wide Palette. This comprises a preferred and coordinated palette of off-the-shelf hard materials and furniture items. All elements must be selected to be economic, attractive and exceptionally durable and robust. This will help establish the brand for the City and create a unified visual identity for the street and open space network. This will include elements such as:

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8.1.5 Key Nodal and Feature Areas Materials and Furniture Palette

Key nodal and feature areas such as main intersections and district parks will comprise of furniture and materials that is unique for the particular scheme, creating a sense of drama and interest. Elements should be artistic and unique as well as being readily available and affordable from the suggested supplier range listed. These elements should compliment everything in the city wide palette. The faded boxes are using the same materials as the City Wide palette.

























8.1.6 High Use and High Profile Materials and Furniture Palette

Within high use and high profile areas such as the Beach Park, City Boulevard and Civic District, designers should seek to use high quality and often bespoke items, developed specifically for the local context and requirement. These areas are also suitable for creative paving design and a higher amount of natural stone. The faded boxes are using the same materials as the City Wide palette.





















8.2 Surface Materials

Overview

Visual continuity will be developed through a common palette of paving materials that will be used across the whole of the city. Material usage and application will also relate to the future anticipated use of the site. Paving patterns and colours should vary and provide a means to create an individual sense of place and identity. Special treatment should be given to the beach front, city centre, promenades, plazas, squares and key nodal points within the city.

Surface material palettes should be suitable for the context and considered under the following categories:

- Footpaths and footways
- Carriageways
- Amenity space and play areas •
- Slopes, ramps and steps

Key Objectives (Layout)

- Create a legible layout by ensuring paths link between key locations, such as squares and key focal buildings.
- Consider installation of new footpaths by observing desire lines (informal pedestrian routes), where people are cutting across green areas to achieve the most direct route from A to B.
- Ensure a seamless integration of materials by careful detailing alignments that minimise unnecessary technical complication.
- Ensure that all formal provision for walking and cycling is accessible, sustainable and inclusive.
- Provide sufficient capacity to accommodate all users comfortably, whilst attempting to minimise the area of hard surfacing.
- Inconsistency of materials should be avoided by conforming to the standards.

Key Objectives (Materials)

- Where possible the use of local materials is encouraged. This makes replacement and maintenance easier and also reduces the energy consumption required to transport materials to site.
- Lifecycle and maintenance of all materials proposed in the landscape design is to be considered.
- Select appropriate materials for the context: for example shared cycle / footways on the City Boulevard are expected to have high pedestrian and cyclist usage, so require durable surface materials.
- Pedestrian routes should be smooth, stable and slip resistant, including where they transition to road crossings.
- Selected materials need to be robust, durable and • appropriate for the context.
- Patterns within the footpath can be perceived as a level change and bespoke surfacing should be carefully considered.
- Areas not required for pedestrian movement should be left unpaved to reduce heat gain. A gravel mulch provides an appropriate solution for preventing windblown sand.
- Asphalt is not suitable except on carriageways due to its high heat absorption characteristics.
- Highly polished surfaces such as marble should be avoided because they can cause glare and can become slippery.



















8.2.1 Footways and Footpaths

Key Objectives (Layout)

- Footways are to be provided adjacent to both sides of all carriageways to ensure safe and legible routes are provided in all circumstances.
- Footpaths should be provided within all parks and open spaces. Connecting key destinations or following desire lines.
- Create a legible layout including locating tactile paving and uncontrolled crossings on desire lines.
- Designs should accommodate the needs of all users including wheelchairs and mobility scooter users, which can require relatively large spaces in which to turn.
- Ensure a seamless integration between changes of materials - align joints in a harmonious way through detailed design and avoid creating slivers and unnecessary cuts.
- Footpaths should be located on desire lines, linking ٠ directly through open spaces to key areas of interest.

Key Objectives (Materials)

- Materials should be selected to be appropriate for the setting. For example within the large open spaces, materials should have more of a parkland character than conventional urban streets to help create a sense of pedestrian priority.
- Where budget allows there is a general preference for the use of natural materials over concrete products, due to their superior durability and robust gualities.
- High quality concrete units can still be used as they provide as cost effective design solution - these are likely to be used for the majority of pedestrian and shared surfaces.
- Provide consistency in the use of materials such that footways tie together visually, even when different units are used adjacent to one another.
- Minimise the number of different materials used to create visual coherence and aid ongoing maintenance.
- Use appropriate construction depths to accommodate vehicle overrun adjacent to the kerb edge.
- The City Wide palette comprise muted tones with simple and elegant layout pattern.

- Creative patterns and use of materials should be • reserved for high profile areas where designers are encouraged to create unique and exciting floorscapes.
- Ensure a seamless integration between changes of materials - align joints in a harmonious way.
- Gravel only to be used in low footfall areas to reduce ongoing maintenance and safety issues.

Performance Requirements

- Footways to comprise firm and slip resistant surface materials.
- Utilise materials that are durable and robust, capable of withstanding the harsh desert climate.
- Footpaths to comprise materials fitting for the • character of the setting, such that loose surfaces such as unbound gravel may be permissible on flat areas of footpaths which do not form major routes.
- Footpaths to comprise materials that have a high albedo rating that mitigates against localised hotspots.
- Provide sufficient widths for very high footfall. Minimum path width should be 3m on main routes and 2m on secondary routes.
- Maximum acceptable cross fall on footpaths to be a 1:40 gradient.
- Loose surfaces such as self binding gravel may be considered for flat areas of footpaths which do not operate as major walking and cycling routes.
- Unbound gravel not to be applied on sloped footways greater than 1:50.
- Edge treatments to act as an appropriate containment for loose material and to provide structural support as required.
- Paving units to be laid firm and flush with surrounding units to minimise risk of trip hazards.
- Maximum joint size between units to be 10mm.
- Units not to be cut down smaller than 1/4 of their • original size.
- Depth of units and compaction of sub-base to be suitable for occasional vehicular overrun / use in carriageway as required and to prevent settling.

City Wide Palette





PCC Slabs / Blocks Pre-cast concrete units laid in simple patterns with muted tones

Self Binding Compacted Gravel Informal footpaths through parks and open spaces - locally sourced

Key nodal and feature areas



PCC Blocks - Modern Layout Concrete units arranged to create visual interest and define feature areas



Patterned Tiles Detailed patterned tiles can be used to define zones within parks and open spaces

High use / High profile areas



Creative Bespoke Designs Bespoke artistic layouts are encouraged to create a distinctive and memorable sense of place



Vivid Colours Bold contrasting colours used to create eye catching areas when set against the primary palette of muted tones

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Loose Gravel Useful for low footfall areas and path edgings. Not suitable for cycle or wheelchair access.



Bespoke Cut Units Bespoke shaped concrete or stone units can be used to create a dramatic design at focal points

Natural Stone

A variety of natural stone should be the primary material due to its durability such as sandstone, granite and porphyry

8.2.2 Carriageways

Key Objectives

- Ensure consistency in the use of carriageway materials to help define the street hierarchy and send a clear message to motorists about the character of the road and the expected behaviours associated with its use.
- Promote pedestrian movements through the use of materials and colour palettes that reference footway materials.
- Reinforce speed limits through traffic calming measures including vertical deflections and perceptual narrowing, as appropriate.
- Refer to the typical street cross sections within the Urban Design Chapter 7.

Performance Requirements

- Select materials that are robust and suitable for the anticipated levels of traffic - Asphalt will be the primary material for road surfacing.
- Highly permeable asphalts are only suitable for low trafficked routes.
- Unbound surfacing is not suitable for carriageways. •
- All road markings to comply with Oman Highways regulations and standards.
- Flush kerb demarcations for parking and bus stops etc are preferred over painted or thermoplastic alternatives due to their superior robustness and longevity.
- Block pavers laid in a herringbone pattern should be used within Homezones and considered for other shared space areas in the city centre and parking zones.

Pedestrian Crossings

- Locate formal controlled crossings on major pedestrian desire lines.
- Uncontrolled dropped kerb crossings are to be • provided at all minor side roads.

Cycle Infrastructure

- Consider the need for delineated space for cycling adjacent to the majority of carriageways as part of a wider cycling strategy.
- The cycle lane will generally be segregated from the carriageway by a landscape buffer.
- The City Boulevard, District Avenues and Urban Streets should all have dedicated cycleways separate from footpaths.
- Cycle lanes not required within Homezones as the • speed of traffic here means it is a safer environment for cyclists to be on the carriageway.
- Shared footpaths and cycleways should be provided on greenways and on the City Boulevard adjacent to the Highland Park.



Concrete block pavers to Homezone carriageways



Paved parking bays with flush kerb delineation bays











8.2.3 Amenity spaces and play areas

Play Spaces

Play spaces are to be accessible for all children and provide a range of opportunities to interact with each other. They should be designed to enhance the local setting through the choice of materials and the style, scale and character of the layout. Parks and play can be used to tell a story of the place and reference natural elements to enhance the attractiveness of the facility.

Amenity areas should be located in highly visible parts of open spaces, so that they are easily accessible and there is also a constant level of passive surveillance.

Play facilities should look to have partially or fully shaded features to allow safe play throughout the day.

Designers are encouraged to use a mix of surfacing materials depending on the setting:

- Natural materials should be used within the Rock Garden, Highland Park, Wadi Parks and Coastal park to reflect the natural landscape character of these areas. Layout and design should make creative used of the undulating topography.
- More traditional off the shelf equipment with colourful rubber wet pour safety surfacing is more appropriate for use on play spaces within urban areas such as the City, District and Neighbourhood Parks.

Safety Standards

- All playground safety surfacing including layout, materials and build ups must comply with Omani required standards.
- All surfacing must be laid as per manufacturer's instructions with particular consideration for the build up depths and critical fall height.

Inspections

Amenity areas should be reviewed and maintained regularly to ensure that facilities are safe and performing as intended. All play surfaces and equipment must comply with The Royal Society for the Prevention of Accidents (RoSPA) guidance or equivalent.

Any new play elements require a post installation RoSPA inspection prior to usage.

An in depth annual inspection is required for all play spaces. This should be carried out by a specialist not connected with the playground operator or manager.

Rubber Crumb Wet Pour

Bark Chippings

Play grade bark

chippings is an

materials

economic and rustic

Bright colours useful for creating exiting patterns, designs and in ground play features





Artificial Grass Should be considered for multi-use games areas pitches and feature areas within public spaces to reduce water usage for real grass









Fine white beach or river sand (not crushed rock). Use for play areas within the naturalistic parklands

Sand







8.2.4 Slopes, Ramps and Steps

Key Objectives

- Provide an accessible environment for all users.
- Provide consistency in the palette of materials for all slopes, ramps and steps to ensure they are instantly recognisable.
- Maintain desire lines where possible, whilst providing accessible routes.
- Any footpath steeper than 1:21 is defined as a formal ramp. Any footpath between a gradient of 1:21 and 1:30 is defined as a slope.

Performance Requirements

- Steps and ramps must comply with all relevant Oman standards and guidance.
- Where possible changes in level should be dealt with using slopes (with a gradient shallower than 1:21), meaning no handrails or tactile pavings are required.
- Slopes must be laid in a contrasting material (colour and texture) to its surroundings. This must be fully slip resistant with no loose aggregate.
- Handrails and tactile paving must be provided to all steps and ramps.
- Steps and ramps should be a minimum of 2m width with an minimum unobstructed width between handrails of 1.8m. Where wider steps than 2m are required, a central handrail will need to be provided (maximum width between handrails 2m).
- It is recommended that slopes along main paths are at least 3m wide. Where verges are provided, a 2m path may be sufficient.
- Cross falls must be no steeper than 1:50.
- Steps that taper are a trip hazard and should generally be avoided.
- Steps should have a colour contrasting nosing strip.

Natural Stone Steps For use in high profile areas or feature areas requiring bespoke designs



Pre-Cast Concrete Steps Non-slip texture, anti-graffiti coating. Contrasting grey band on nosing - City wide

palette



Rock terracing Use of local rock for terracing of slopes and edges to wadis



In Situ Concrete Pale grey with angle grooved non slip finish for a durable slope solution in feature areas





Tapered steps should be avoided due to the inherent trip hazard



Bespoke natural stone terraced steps / seat walls. Suitable for high profile areas



Hazard Warning Paving Concrete tactile paving to be used for all steps and ramps city wide



In Situ Concrete Steps Should be used for shapes or forms where PCC isn't an option





Block paved ramp to compliment surrounding materials - for use with the city wide palette



8.3 Street Furniture

8.3.1 Overview

Along with surface materials, street furniture in the city can be categorised into three main areas, each of which should use a different furniture suite:

- City wide street furniture
- Key nodal and feature areas
- High use and high profile areas

The majority of the public realm space will be categorised as city wide street furniture. This will comprise a preferred and coordinated palette of off-the-shelf furniture items, with bespoke elements only used in exceptional circumstances. This will help establish the brand for the City and create a unified visual identity for the street network. This will include elements such as:

- Benches / seating
- Boundary treatments
- Litterbins and bicycle racks
- Tree grilles and guards •
- Bus stops and shelters
- Shade structures
- Signage

Special designs commissioned from public artists are encouraged, especially using the involvement of the local community. These should be used to enrich the pedestrian experience at key locations, for example, in public squares at the heart of district and neighbourhood centres.

8.3.2 Design

- The design and selection of the street-scene elements should reflect the character and identity of the neighbourhood it passes through.
- Preferred furniture should follow a contemporary design, with some allowances for more naturalistic features in specific areas.
- The preferred products share a simplicity of form that helps to ensure good durability.
- Furniture should be in-keeping with the character of the area and enhance the ambience through consistency and subtlety.

- The city wide suite should primarily comprise a natural colour palette of concrete, stone and treated timber, with accent colours used to tie in with specific developments.
- Feature materials and colours are to be used in key nodal and high profile areas.
- Products should be selected to ensure maximum durability, comfort, safety and security.
- All materials and products must comply with the relevant Oman standard.

8.3.3 Materials

Materials and their finishes must be carefully considered to ensure maximum longevity. The preferred materials for most furniture elements is concrete or stone due to its durability and robustness in the harsh desert climate. In general metal objects should be avoided due to the glare caused by reflection and its heat retention which can cause burns. Metal should only be used when treated with a suitable coating that significantly reduces heat conductivity. Timber can be used in moderation to add a contemporary softness to furniture but will not have the same longevity as stone.

8.3.4 Placement

Effective distribution of furniture across the city is essential for creating usable spaces and promoting an active use of facilities.

- Designers should avoid creating overly cluttered spaces by providing adequate space around furniture.
- The number of items provided should be consistent with anticipated demand.
- Insufficient provision of furniture can impact on the • usability of the space, reducing accessibility and safety.
- Aligning furniture in zones along the long profile of a path can help to reduce clutter.
- The arrangement of furniture should consider social and interactive behaviour patterns.
- Furniture should be grouped together where possible, ٠ for example at the junction of pedestrian routes and within the 'furnishing zone' in the main street type.

8.3.5 Pedestrian Realm Zones

The pedestrian realm in the cross-section of a street type contains four clear zones:

- **The Frontage Zone** is immediately next to the building or property line and provides space for door openings, changes in level, shaded window shopping and café tables.
- The Through Zone is an obstacle free space for pedestrian movement. It must remain clear and provide a firm smooth, slip-resistant surface.



Cross section through Pedestrian Realm



• The Furnishing Zone – is where street furniture, trees, transit stops and shelters are positioned to maximise public use and benefit.

• **The Edge Zone** – is the interface with the travel lane or on-street parking. This zone contains traffic related furniture such as traffic signs, signals and street lights. It is also a refuge for pedestrians waiting to cross the road. The edge zone should be extended or combined with the furnishings zone at bus stops or taxi lay-bys.

8.3.6 Seating

Key Objectives

Seating should be chosen to suit the setting and maybe off-the-shelf or bespoke. It can help to encourage active use of a space and promote a range of activities such as performance and play spaces.

Seating should be provided at least every 50m along primary thoroughfares and within public spaces to ensure that all areas are accessible for people who require regular rest points.

The following design considerations should be used to help in the selection and placement of seating.

Performance Requirements

- Seating should be durable and use natural and sustainable materials. Concrete and stone are the preferred materials city wide.
- Seating should be able to withstand the harsh desert and coastal climate with dust laden winds.
- Selections should be resistant to corrosion/ degradation.
- Designs should consider a wide range of user requirements and comply with Inclusive Design Standards, including providing backrests and armrests at intermediate points.
- Seating should be arranged in different ways depending on the situation i.e to encourage social interaction or to provide a quiet private space.

Maintenance

- Seating can be maintained through protective treatments such as sealants and coatings.
- Seating should be monitored regularly for surface cracking / scaling / splintering / flaking / spalling and shrinkage.
- Manufacturers' maintenance requirements are to be followed.

City Wide Palette



Concrete block benches Simple, cost effective, robust and durable. Textured finish in light grey or beige

Key Nodal and Feature Areas



Single seats concrete cubes To match the style and colour of the concrete blocks to create a product family Be Us



Contemporary forms Angular formed benches can be used to create focal points whilst also providing many opportunities for social interaction

High Use / High Profile Areas

Fibre reinforced concrete



Reinforced concrete benches create elegant features

due to the thinness of material it is possible to achieve

Sculptural seats Striking sculptural forms should be used to create iconic focal points



Bespoke in situ concrete Bespoke seating is encouraged. This seat's organic curves and crisp white render make it really stand out

Bespoke natural stone Natural stone seats are encouraged to compliment the concrete range in high profile areas





Bespoke use of local stone and concrete Use of local stone is encouraged wherever possible. Should be used in the same style across the city to prevent ad-hoc usage



Timber inserts Timber should be used in moderation to create a softness to the concrete furniture





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8.3.7 Boundary Treatments

Fencing and Railings

- Knee high fencing can be used as a temporary measure to protect newly planted areas in busy public spaces without affecting line of sight.
- Security weldmesh fencing should be provided where access to the public must be prevented, such as surrounding electric / gas kiosks.
- Walling should be provided along the edge of plot boundaries to create a defensive line and sense of ownership this can have railing inserts.

Knee Rail Fencing | Diamond Rail Fencing



Walls and Screens

- Walling should be used as a device to deal with level changes, however, consideration should be taken to see if the wall can also act as a decorative feature, a focal point or usable element, such as a seat.
- In-situ and pre-cast concrete walling should be used city wide as an economic and durable option that creates a consistent materiality.
- Solid natural stone walling can be used in high profile and feature areas to match the surrounding palette.
- When using natural stone for low walling, a solid wall is preferable over cladding due to the robustness and minimising construction costs.
- Designers are encouraged to use local stone within the production of low walls.
- Walling can be used as a retaining edge for soil and planted areas. A suitable geotextile should be used in these situations.
- Any drop higher than 500mm must have a balustrade or guardrail.

Bollards

- The use of bollards should be minimised so as to reduce clutter.
- In most locations, multi-functional street furniture positioned to achieve the same barrier effect as a line of bollards would be preferable.
- Concrete should be the primary material used to tie in with the rest of the street furniture palette.

Concrete bollard - rounded Contemporary minimal bollards to be used to prevent parking where necessary

Stone wall low walls







Reinforced concrete bollard - angular Contemporary chunky concrete

bollards used for vehicle mitigation



Ha ha wall

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Rendered concrete wall Clean and minimal concrete walls used as property defensive boundaries





Retaining walls

• Design of retaining walls and their build up and foundations must be designed and approved by a gualified structural engineer.

Designers are encouraged to utilise local stone to produce



8.3.8 Litter bins, Cycle Racks, Signage, Tree Pits & Planters

Litter Bins

Placement

Litter bins needs to be available, accessible and visible. They should be placed in prime locations such as along pedestrian pathways, and in areas where people will spend time and group together such as seating areas in parks or at key road junctions.

Design / Use

- Maintenance is essential to ensure bins are regularly emptied.
- Ashtrays to be provided near public buildings as required.
- Litter bin design should be contemporary and attractive to encourage people to approach and use them.
- People should be able to use the bin without physically touching it and therefore it should not have a closed top.
- Concrete is the preferred outer material to prevent accidental burns.
- Recycling bins should be provided in addition to regular waste bins.

Cycle Racks

Placement

- Locate cycle parking within furnishing zone out of the through zone or driveways.
- Ideally located within 15m of main entrance of key buildings.
- Provide long stay bike parking in convenient, well lit, shaded and secure locations.
- Provide directional signage if parking is not readily visible to visitors.
- Bicycle lockers should be provided where possible to encourage commuting.

Design / Use

- The frame must be able to be supported in at least 2 places.
- Below ground fixing preferable.
- Preferred spacing of cycles stands is 1000mm centres to allow two bikes to be stored on each rack. 800mm is the absolute minimum.
- The end of a stand must be no closer than 550mm from a building.
- A reinforced concrete 'Sheffield' style stand is preferable due to its simple and proven design.

Signage and Wayfinding

Signage and wayfinding should establish a distinct identity and memorable sense of place in the street network. Refer to the Oman Highway Standards for further information.

Design / Use

- Establish consistent design standards and guidelines for all signs across the city (materials, colour, scale, type, location etc.).
- Enhance visitor experience with key placement of signs.
- Totem signs and fingerposts to be used at key decision points.
- Signs to be positioned so as to maintain required footway width requirements.
- Minimise number of signs (or use multiple signs on a single post) where possible to reduce street clutter.
- Avoid conflicts with underground utilities.
- The location of signposts should be planned to enable effective maintenance.

Types of Signage

- Information signage and maps
- Fingerpost wayfinding signage
- Identification signs
- Directions road signs
- Regulation road signs (must conform with Oman • Highway Standards)
- In-ground signage

Litter Bins

Contemporary litter bin design to tie in with the whole street furniture strategy







Wayfinding Signage

Simple elegant fingerposts should be used at key junctions and decision making points for pedestrian



frames will be required. City wide the preferred material to use for tree pit surfacing is locally sourced gravel contained within a minimal metal edge restraint. Aggregate to be small regular sized for consistency. This can be applied loose in low footfall areas and where there will be no vehicular overrun, or resin bound where higher footfall is expected.

In feature and high profile areas, the paving material should be inset within grilles to create a seamless and high quality surface finish. Bespoke artistic solutions would also be considered.

Within parks and open spaces, trees may be placed within planted or play surface areas. In these situations designers should look to provide a suitable tree pit surfacing/system that matches the surrounding material.



Tree Pits

Tree pit surfacing and materials should vary depending on the character of the setting and must be suitable for the structural loading that they will be subject to. If they are going to be subject to exceptional loading, heavy duty

Planters

Raised contemporary concrete planters should be considered for feature planting at strategic locations:

- To highlight feature areas / junctions
- In place of bollards as protection measures
 - To delineate movement routes
- As sculptural elements within public spaces

Planters

Chunky concrete planters to compliment other furniture





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8.3.9 Shade Structures

The design of the public realm and selection of streetscene elements will need to attenuate the extreme temperatures and humidity during the summer months. Thermal comfort and shade and shelter from the sun will be critical in creating a comfortable public realm that encourages multi-modal travel.

Thermal comfort is influenced also by the additional heating effects caused by direct and reflected sunlight and heat radiating back from warm surfaces. This urban heat gain can be reduced by passive shading measures that lessen the exposure of pavement and wall surfaces and the selection of materials that retain and radiate less heat.

The landscape design should provide shade along primary pedestrian routes, within parks and open spaces and also at key nodes such as crossing points where people may be standing still for some time.

Key Objectives

- Building layout and street widths should be designed to ensure that shaded routes can be used to travel between main destinations throughout the majority of the day, with supplementary shading devices used where necessary. These devices can take many forms including as free standing canopies, trees, trellises and vertical screens.
- Detailed sun / shade studies are required for all • projects to effectively inform the need for shading provisions.
- Use appropriate materials to minimise or mitigate urban heat gain.
- All designs and forms of shading should be appropriate for the setting. For example, sculptural canopies used as unique and exciting features within District Parks, and smaller free standing tensile canopies within Community Gardens.
- Air to flow through canopies for passive ventilation.
- Consider possibility of integrating efficient radiant cooling and solar photovoltaic systems within the architecture or shade structure.
- Locate shade devices strategically to frame views and not hide building entrances.

Architectural (connected to buildings)



City Wide - canopies integrated into the building minimise street clutter and can provide linear shaded routes. Should be considered for main pedestrian thoroughfares along ground level building façades

Free standing structure



City Wide - Smaller freestanding structures suitable for areas such as seating spaces within parks and open spaces and waiting areas such as street crossing points

Sculptural canopies

Covered walkways

and spaces





High Profile & Feature Areas - Creative patterns, artistic forms and bright colours should be used to create memorable focal points

Feature Areas - Covered walkways to be used as required

along the edges of open spaces to connect key buildings









Feature Areas - To be used for immediate shade for pedestrians in areas where sun will reach at low angles. Opportunities for creating privacy, use within waiting areas and providing transparent security

City Wide - Where possible trees should be used as a preference over other shading structures as they provide additional environmental benefits

8.3.10 Play Equipment and Public Art

Key Objectives

- Consider the dynamics of play some facilities can be just as stimulating for children when designed as a quiet and contemplative space, not just an active one.
- Always consider users with specific needs and aim to provide for a range of abilities and ages.
- Risk taking and challenge is an important element of play and a balance needs to be struck between safety and fun.
- Allow for convenient changes to be made to the layout not just for maintaining and replacing furniture, but so as to be able to swap or provide new facilities that keep children interested.
- In most instances play spaces within parks and open spaces are not to be fenced off so as to create permeable facilities that blend in naturally with their surroundings.
- Design play spaces and use equipment that will be inclusive for all users.
- Community consultation and engagement is greatly encouraged for the design of any new play spaces.
- Provide imaginative play elements for both individual and social play.
- Create facilities that encourage a range of different forms of play including climbing, spinning, swinging, electronic, sliding and role play.
- Seating and tables should be provided to enable parents / carers to sit nearby while children play.
- Informal play is encouraged through the use of natural materials such as large stones and rolling topography outside of the more formal play spaces.
- Off-the-shelf products are generally preferred over bespoke items as the ongoing maintenance and replacement parts becomes far less costly in the long run.
- Bespoke features should still be considered for feature play areas within key public spaces to create a unique identity and exciting play space.

Materials and Finish

There should be a limited colour palette within each play space to ensure consistency - primarily this should be the natural colour of the material such as timber or stone, with colour used in moderation to tie in with surrounding palettes. Bright colours are encouraged to enhance children's senses.

It is essential that any metal parts are finished with a suitable paint / protective coating to ensure that heat conductivity is reduced to a safe to touch level. Placing metal equipment in shaded areas or beneath shading structures is also encouraged to reduce these risks.

Informal play opportunities and natural play materials are encouraged within the larger parks as they enhance learning through smell and touch, such as playing with sand and water. Rocks can be creatively used to form play features such as climbing structures.

Public Art Design Intent

Public art should be used at key nodes to create areas of interest and focal points which aid navigation and inspire creativity.

Art in the public realm is encouraged to:

- Reflect Oman's rich culture and history.
- Create a sense of wonder, excitement and creativity. •
- Establish and reinforce a distinct character to an area.
- Animate a space and promote related activity through events and regular updates.
- Embrace creative use of temporary spaces.
- Enable local artists to exhibit their work and to continue to support a wide network of the art community.
- Engage the local community in educational activities and promote skills and knowledge sharing.



Creative, bespoke equipment for high profile areas



Utilise local stone to create sustainable bespoke and exciting play features



Provide for all ages including toddlers





Off the shelf equipment suitable city wide



Provide areas of sand and natural play



Landscape Guidelines

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8.4 Lighting Strategy

Site wide lighting will consist of street, pedestrian and architectural lighting regimes. The quality of lighting proposed will depend on the land use and associated operations, desired effect and night time safety and security. It is envisaged a higher level of recreational lighting be incorporated for the open space areas of the city centre, district centres, parks and key focal points.

The approach taken for lighting the public realm zones of the community is to create a 'family' of lighting elements that are all related to one another yet at the same time provide for a district design dependant on what part of the open space hierarchy the user is located.

Street lighting should be complemented by a pedestrian realm landscape lighting system which could vary slightly between character areas and also from space to space depending on the designated use, site context and user. Solar lighting luminaries are to be introduced to key parks and civic spaces.

Other considerations such as reducing light pollution in residential areas by only lighting areas required for safety and comfort should be developed and integral to the development, along with low cost, robust, locally manufactured options.









City Wide Palette

Highway lighting columns Simple, unfussy and elegant LED Highway lighting columns. Pedestrian scale lights to use same column to minimise clutter









Key Nodal and Feature Areas

Light bollards Concrete light bollards to accentuate key movement routes and spaces



Up-lighting Tree, bench and building up-lighting create a sense of drama in the night scene



in-floor leds







High Profile Areas

Feature columns and Bespoke feature lighting helps create vibrant and distinctive places







8.5 Planting and Irrigation

8.5.1 Existing Conditions

The natural setting of Dugm, incorporating rock escarpments, wadi formations and coastal features, creates a unique landscape with varied opportunities for landscape development. It is situated in an area of the eastern Oman, in one of the driest parts of the country, characterised by a hammada landscape of stone pavements with exposed ridges typical of limestone desert landscape.

The Duqm locality has a hot but dry climate in summer with a reduced humidity, which makes it an environment more pleasant for human activity but less conducive to growing humid-loving plants. It is subject to dry winds during summer which will be a constraint to the variety of species grown. The plants most suited to these conditions are clearly those with leaves that reduce transpiration or, by other means, are tolerant to drought and it is essential they are used to form the structural framework of the landscape. A palette of plants is therefore to be developed incorporating species from similar African and Asian climatic zones, besides those indigenous to the area.

A different microclimate is likely to prevail in different parts of the site. The wadi formations with their characteristic drainage patterns are likely to provide the most conducive conditions for plant growth. The higher formations are subject to greater exposure and it is highly probable that they will experience a very different climatic environment. Here, the landscape emphasis will be toward xeriscapetype planting. The coastal areas will be subject to reduced levels of evaporation, and will offer a benefit to cultivation on account of the shelter afforded by the surrounding escarpment and the more humid environment.

8.5.2 Possible Future Conditions

The project areas will necessarily develop both 'intensive' and 'extensive' planted areas according to land use. 'Intensive' landscapes are frequently directly associated with human activity: the landscape of streets and areas of pedestrian access, where lush green and shade are high amongst the requirements, as well as in gardens and parks, where a sense of enclosure and privacy are effected by vegetation. 'Extensive' landscapes refer to those areas where a sparser vegetation can be effected with a reduced amount of water expended. They include arterial roads and peripheral areas of the site, where natural vegetation can become a key feature. Formal carriageway planting is not proposed but a transition toward the built environment will be recognised in the design of the landscape.

8.5.3 Intensive Landscapes

'Intensive' landscape development will make a primary distinction between residential requirements and focal points of significance such as the civic and regional centres. Shade trees and hedge plantings are essential to reduce the impact of the climate on recreational participants. Such species as Terminalia arjuna and Zizyphus jujube and Z spina-christi, as shade trees, together with arid tolerant palms, would be suitable, as would Pithecolobium dulce and Dodonea viscosa as hedges. The more familiar colourful flowering species, such as Bougainvillea and Caesalpinia, may be used within the complex to give a sense of enclosure. These will include gardens for family activities with lawns and flowers, which have been chosen to be safe for children.

8.5.4 Extensive Landscapes

Amongst the 'extensive' landscapes are those designed to permit the gradual change from ornamental plantings into the desert landscape. This includes the development of wildlife refuges, and the promotion of shelter planting to mitigate wind and dust. The main species will be those of indigenous origin, in particular Acacia tortilis, able to survive the climate with minimal assistance but augmented by species of a similar climatic background, such as the desert adapted species Tamarix aphylla . Amongst the indigenous plants of Oman are some very attractive smaller species which should be grown for public education and cultural reasons. They include Lycium shawii and Calotropis procera as shrubs, and Calligonum comosum, Rhaza stricta, Blepharis ciliaris, and Aerva javanica as small shrubs and herbs. Their use could be more widely planted as many indigenous herbs greatly add to stabilising dust, provided the land is fenced against grazing.

The rock garden and cliff-edge topography of Duqm creates unique opportunities for landscape within the scale and extent of the project. Paramount in determining the landscape potential of the site, is to bring together the regional sources of information related to geology, hydrology, ecology, and the local microclimates. This will inform the development of the site and encompass accommodating nature conservation, the run-off from streams, and the protection of local wadis from human activity.



Extensive sparse arid planting - Reference M&t landscape architects



Intensive lush green planting - Reference M&t landscape architects





8.5.5 Design Guide Principles for Planting

- 1. Framework planting as part of a green infrastructure strategy needs to be carried out in advance of other development as arid land trees are slow growing especially under reduced irrigation. Advance planting promotes age differentiation in plant material adding to a sense of maturity.
- 2. Plant introductions are likely to focus on trees and shrubs. Ground cover material should be sourced from indigenous species. In introducing plants to new areas, care should be exercised. Some may grow too fast and become weeds affecting colonies of native plants.
- 3. Species differentiation can be used to provide future characterisation of districts and areas and avoid homogeneity of landscape use, as well as form regional features such as landmark planting to location specific places.
- 4. Integrating functions uses the plant material to maximum effect and leads to dual use of the land. For example, combining shelter belts/green belt planting with their use as picnic sites and camping grounds.
- 5. Avoiding the monotony of emphasizing the built environment is important to recognise in the landscape. As far as possible, the landscape design should contrast with the city development, reflecting nature in all but the most central parts, favouring the informal over the formal, the responsive over the rigid and the curve over the straight.

- 6. Use the landscape design strategy to provide a spatial context by working in varying scales, increasing the scale to match the element it supports. For example forming a landscape concept for roads and highways which exceeds the scale of the development proposed in order to place them within a wider landscape context.
- 7. Enrich the natural environment to form a matrix of metropolitan ecology into which landscape interventions in the form of parks and open spaces can connect. For example in the use of greenways to link blocks and squares of green space, or in the use of wadis to provide ecological and pedestrian connectivity to housing areas by way of raingardens.
- 8. Establishing early community involvement based on the tradition of cultivating plants in the region to foster ownership and care and develop educational opportunities as part of the programme of landscape implementation.
- 9. Observe the following key design themes:
 - o Provide enclosure for families.
 - o Use scented plants en masse.
 - o Allow access to the open environment to pedestrians.
 - o Use tropical trees sparingly as highlights not everywhere.
 - o Use sunken walkways and raised beds to enhance the appreciation of native ground flora.
 - o Keep in mind the long term goals to create a setting for the city. Landscape architecture has a long time lag compared with architecture.

Planting Layout Principles



× Formal species





Species Distribution and differentiation of character areas

Formal infrastructure contrasting with species drift

Reduced emphasis on road layout

Green infrastructure separate from roads infrastructure

8.5.6 Landscape Horticultural Considerations

Water is an overriding consideration in designing landscapes and besides the correct choice of drought tolerant species, in order to reduce water usage in areas where it is appropriate, a number of other combined landscape/irrigation design considerations can be made to offer water efficiency to the project. These include some or all the following techniques which can be employed project wide:

- The use of mulch over the surface of the soil to slow evaporation, surrounding the plants typically with clean crushed stone.
- Matching water applications to the expected growth rates - not all plants need to be grown at the same rate and a succession of plants being brought to maturity is a great advantage.
- Use of treated sewage effluent (TSE) to improve sustainability where it can potentially deliver 90% of the plants' nutrient needs as well as a saving the need for potable water.
- Watering in the evening and night, avoiding daytime irrigation to reduce loss by evaporation.
- Using xerophytic and drought-tolerant plants in transitional and extensive landscapes between cityscape and desert, where evaporation rates are highest due to exposure.
- Liaison between the irrigation engineer and the landscape designer at an early stage to discuss efficiencies in plant groupings and layout, optimising sizes for lawns and ground cover to avoid water wastage, and select sprinkler/bubbler/emitter preferences and options.

The development has the potential to create a more controlled microclimate through the use of glasshouses or shade structures, perhaps as a botanical garden, to partially protect plants and offer an opportunity to add to the interest and broaden the range of species.

The arrival of both spring/summer and autumn/winter should be recognised in the planting designs as each season has its particular species of merit. The summer is limited in flowering plants but is dominated by the date palm and its fruits, a feature of cultural significance. The winter/spring encompasses many flowering plants including annuals which delight at a period of the year conducive to outdoor activity.

8.5.7 Environmental Constraints

The hot but dry summer climate of this part of Oman described above presents several climatic constraints on the potential planting opportunities. Besides the low humidity occurring in summer, the annual seasonal response is the second most important climatic factor to take into consideration. However, the temperature difference between summer and winter, although varying greatly does not drop down to endanger subtropical plants species and is not likely to be a constraint.

Another major constraint to the growth of plants in hot climates is the potential build-up of salinity. In hot climates water evaporates at a greater rate than rain falls, which causes a residual level of salt to build up in the soil. The margins of planted areas accumulate a large amount of salt, which can flow into the rootzone of plants under circumstances of heavy rainfall or flooding by wadi flow, potentially killing the trees. The periodic flushing or washing-away of salts using the irrigation system circumvents this occurrence and is a sustainable solution to retaining permanent planting in situ. The salinity levels in the soil need to be monitored as do the soil moisture levels, both possible with digital technology, as a precaution against excessive salt build up.

A significant factor influencing landscaping decisions will be the consideration of specific location, as different microclimates are likely to prevail in different areas of the site, as described above. Recordings of evaporation should be carried out in each locality and plants must be selected according to their ability to thrive.

8.5.8 Recommendations

A summary of recommendations from the opportunities and constraints described throughout this chapter:

- Identifying 'intensive' and 'extensive' landscapes according to land use.
- Select plants with recognition of their water requirements, making reference to an African database of plant material, largely unexplored in the arid to subarid categories in order to limit the use of those species which have high water demands, whilst recognizing larger trees with higher water requirements are necessary for feature and focus areas.

- Creating balanced landscape environments by placing seasonally high water-demanding species and varieties within sheltered environments of lower water-demanding plants to provide shelter and reduce transpiration.
- Environmental targets to locate opportunities for water economy and co-irrigation (watering plants together on a mutual basis) and by maximising water re-use according to its salinity content, including filtering any recovered drainage water for re-application.
- Assessing the sources for irrigation water, the quantity and amount available and the likely impact on the existing hydrology that the applied irrigation water will have, especially the widespread use of treated sewage effluent (TSE), which may lead to contamination.
- Recognition of the individual water requirements for each plant species change according to season and the adjustment of the estimated evapotranspiration rates need to be made.
- Considering the habitats of indigenous plants to be part of the landscape and develop a programme of maintenance and propagation for these species.
- Providing fully or partially protected environments to afford the cultivation of plants further protection from frost and heat.
- Undertake dust suppression by artificial and vegetative means to reduce wind and dust.
- Identify opportunities for rainwater harvesting from run-off from hard surfaces in order to sustain indigenous and other vegetation on the site.
- Incorporating fencing to reduce grazing on the periphery of the site to protect indigenous flora as necessary.
- Utilize the evaporative opportunities of the ambient relative humidity in summer to cool greenhouses and other facilities to grow a wider number of humid plants for passive enjoyment.

















8.5.9 Street Trees and Pits

Street trees can form an attractive and functional element of urban streets, from boulevards to Home Zones. Street trees make cities more liveable, providing shade and shelter from the sun and filtering airborne sand and dust. Resilience to the hot temperatures during the summer months and irrigation water requirements will dictate the choice of species. The suitability of a species root structure for planting close to buildings and underground utilities are also important considerations.

It is proposed that the City Boulevard and avenues within new residential districts are planted with a limited palette of evergreen shade trees, for example, Ficus species. Important junctions in the street network could be highlighted with the contrasting form of date palms.

Within Home Zones the narrower streets are more suitable for smaller flowering trees. Each Home Zone could have a dominant species to help create its own visual identity.

8.5.10 Shelterbelts

Shelterbelts are 'extensive' landscape elements proposed along the main arterial roads (2 and 3) and National Highway 32. They can also be used to provide shelter in the main public parks. Where space allows they should be combined with shallow sloping earth berms. Shelterbelts have a valuable role to play by:

- Reducing wind speeds and providing shelter from windblown sand and dust.
- Separating or defining different activities or zones.
- Visually linking the elements of the new community.
- Combining with berms to create a visual and physical framework within which development takes place.
- Protecting more ornamental and intensively planted areas.

Dust storms and drifting are a general phenomenon and can be mitigated at a macro level by the introduction into the plan of strategically placed stabilised sand banks or protective berms which can be reinforced with planting. These will divert dust around or over the site and can reduce the nuisance factor to some extent, Local shelterbelt planting and other forms of planting and screening such as low walls etc should also be incorporated.

8.5.11 On-Site Nurserv

The SOM 2014 Master Plan identified a site for a tree nursery on the southern boundary of the Rock Garden

- enhanced.

The calculation for water usage for each species or groups of species is thus expressed as the following: Epan x Drought Resistance Tolerance x Plant Growth Factor. This calculation may have to be calculated for each season in order to provide the annual amount in which to allocate to the planting, since winter will be a period of reduced transpiration and summer a high one, and the seasonal calculation must also take into account the individual plants growing season and rest periods, since hot periods of the year are often associated with dormancy in many indigenous plants which can be reflected in the irrigation quantities applied.

Trees and shrubs, ground covers and woody plants perform acceptably at extended frequency of irrigation application depending on rooting depth and soil water holding capacity and therefore monitoring of plant performance needs to be an integral part of the landscape maintenance.

An assessment of plant species response to irrigation will indicate indigenous plants of local provenance or those of similar climates prefer more irrigation at a particular time of year in order to enhance their performance. This can also be part of on-going research.



geological site. This is one of the lowest parts of the project area next to the main wadi. The establishment of an on-site plant nursery is endorsed and will bring a number of benefits:

• Plant trials will help to determine the most effective and adaptive palette of plant material for the city.

Plants the prove the most successful can then be propagated at scale to meet the phased demand as new neighbourhoods are developed.

• The use of local indigenous species, indigenous plant material will help ensure the biodiversity of the city is

• The nursery can also function as a garden centre providing plants for residents.

8.5.12 Irrigation

Under identical weather conditions, different plant species will have different evapotranspiration. It is important to select those indigenous species adapted to the prolonged summer periods in order to reduce water consumption. A basis for calculating this amount can be to factor the evaporation from open water placed in the local environment (pan-evaporation or Epan) by the individual plants according to their drought tolerance and growth rate or performance required to obtain their theoretical daily usage. A further factor can be used to address planting density in the landscape design.

8.5.13 Street Tree Spacing

Tree spacing will very in different areas of the masterplan and will reflect dominant use of the space and amount of water available.

Dense tree planting in tourism zone creating pleasant walks and aesthetic value.

City streets with dense building layout require more trees to mitigate high temperatures and sun exposure.

Residential areas with narrower streets and greenery from gardens require less dense tree layout on access roads.

Industrial zone where access and parking is desired the most will have limited planting.

Tree Sp	acing	City C	entre Areas				Tourism Ar	eas *			Industrial A	rea			Residential	Area				
Tree spacing	Existing Highway	CBD	Boulevard	Avenue	Street	Lane	Boulevard	Avenue	Street	Lane	Boulevard	Avenue	Street	Lane	Boulevard	Avenue	Street	Lane	Shared Street	Wadi Edge
10m	Buffer planting		•				•							-	•			Occasional tree		
15m	- IOW water demand									•				-				planting / about 80m apart	•	
20m	trees				•				•					-				apart		
25m				•									•	-			•			
30m		•				•		•						-		•				•
40m											•	•		-						

*depending on amount of water available



City Centre Areas

Boulevard planted densely to create natural shade canopy.

TourismAreas

Lanes planted with small trees or big shrubs. Relatively dens tree planting will depend on amount of water available.

Industrial Areas

Less dens planting on boulevard. Lanes should be clear of trees due to narrower road access.

K L



Residential Areas

Lanes planted with few trees due to narrower road access, footway and greenery from gardens.



8.5.14 Planting Palette

The City has been split into four broad planting character areas; Naturalistic, City Wide, Feature and High Profile. Each of these will utilise a different palette of plants which relate to the amount of water they require. This is to ensure that the total volume of water available per day will

comfortably supply the trees and shrubs proposed for their optimum survival.

Each character area palette contains a different percentage mix of Arid, Semi-Arid, Sub-Humid and Humid plants. These are set out in the table below. The following pages provide preliminary species lists for each of these categories. They are not yet fully inclusive but give an idea of the type of planting that should be used, and will be subject to additional indigenous species in due course. The use and reasoning for using alternative species must be agreed with the approving authority. Other important factors to consider are using a mixture of exotic and indigenous species, the latter making up the majority of ground cover plants. It is also essential that the planting design reflects the character of the district it is within and the specific microclimate of that area, for example naturalistic coastal species would not be suitable for the more formal, tropical layouts of the City Park and Plaza.

	Humid	Sub-Humid	Semi-Arid	Arid	Totals
Naturalistic	-	-	-	100%	100%
City Wide	-	-	50%	50%	100%
Feature Areas	-	20%	50%	30%	100%
High Profiles Areas	30%	40%	20%	10%	100%







8.5.15 Arid Planting

Trees









Acacia tortilis

Salvadora persica

Prosopis cineraria

Tamarix aphylla

Shrubs



Aerva artemisoides subsp. batharitica (endemic)





Ochradenus harsusiticus (endemic) propagation difficult



Ziziphus leucodermis

Groundcover (indigenous grasses)



Aeluropus lagopoides



Arundo donax



Cenchrus ciliaris



Desmostachya bipinnata



Halopyrum mucronatum



Panicum turgidum

Pennisetum

setaceum



Groundcover (indigenous sub-shrubs)



Anabasis setifera



oppositifolius

Echiochilon sp



Heliotropium fartakense



Limonium stocksii







Suaeda moschata

Suaeda sp.









Phragmites australis Sporobolus ioclados



Sporobolus ioclados





8.5.16 Semi-Arid Planting

Trees











Boswellia sacra



Moringa peregrina

Acacia salicina

Shrubs (Indigenous)







Balanites aegyptiaca Calotropis procera





Leptodenia pyrotechnica







cephalopodus

Arabia)

Groundcover (Indigenous flowering)

Prosopis farcta (to Tamarix aucheriana



christi

arabicus





Halocnemum strobilaceum





Citrullus colocynthis Convolvulus



Zilla spinosa (Arabia, not Oman)



Limonium axillare

Taverniera lappacea









Rhanterium epapposum (Arabia, not Oman)



















Ochradenus

arabicus



















Pulicaria undulata



Sesuvium portulacastrum









Tephrosia apollinea



Tribulus arabicus

8.5.17 Sub-Humid Planting









Brachychiton populneus









Washingtonia filifera

Adansonia digitata (grows well from seed; OBG have surplus of young plants)



Anogeissus dhofarica

Brachychiton

populneus



Olea europaea subsp. cuspidata











Lawsonia inermis



Washingtonia filifera



Clerodendrum inerme



Cestrum nocturnum



Nannorrhops ritcheana



Senna artemesiodes



tolerant)

Arthrocnemum macrostachyum (salt



Euphorbia tirucallii



Brahea armata







Clerodendrum inerme











Ficus cordata subsp. salicifolia (causes problems to irrigation pipes, water by bowser)



Delonix regia



Acacia cyanophylla



Saccharum ravennae (grass)



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8.5.18 Humid Planting

Trees











Conocarpus lancifolius

Terminalia arjuna Dalbergia sissoo

Thespesia populnea Coccoloba uvifera

Shrubs



Caesalpinia pulcherrima



Hibiscus rosasinensis

Malvaviscus

arboreus



Tabernaemontana divaricatus

Thevetia perviana



Tecoma stans

Groundcover



Antigonum leptopus (in fact a climber but will scramble



Ipomoea pes-caprae Lantana (on mounds) monavidensis



Setcresia Purple Heart



Wedelia trilobata



8.5.19 Irrigation Consumption Guidance Table

The below table provides an indication of the volume of irrigation that will be required for all of the communal roads, parks and public spaces in Duqm. This is not a definitive quantity of water that will be consumed and should be referred to as an indicative guide. There are many variables including heat, wind, shelter, planting type, size, soil condition and positioning that would affect the water consumption of each individual plant.

To reduce future volume of water consumed within Duqm the percentage green coverage can be reduced or the percentage amount or arid and semi arid planting increased with the semi humid and humid planting in turn reduced. This will impact the amount of greenery and look of Duqm. Any reductions in planting should focusing on roads first and parks second.

Based on the projected population and the TSE available the table 8-1 provides a guide on the typical percentage green coverage and suggested planting type mix types.

Parks

Reference	Туроlоду	Area (ha)	Green	Green Cover (ha)	Landscape Type	Coverage %	Coverage area (ha)	(m ³ per day per ha)
					Arid	20	0.15	3.15
					Semi Arid	25	0.19	9.45
1	Rock Garden	744	0.1	0.74	Semi Humid	45	0.33	15.75
					Humid	10	0.07	130
					Lawn	0	0.00	80
					Arid	20	0.38	3.15
					Semi Arid	40	0.75	9.45
2	Highland Park	1887	0.1	1.89	Semi Humid	30	0.57	15.75
					Humid	10	0.19	130
					Lawn	0	0.00	80
		241	10		Arid	0	0.00	3.15
				24.10	Semi Arid	30	7.23	9.45
3	Coastal Park				Semi Humid	45	10.85	15.75
					Humid	25	6.03	130
					Lawn	0	0.00	80
		21	60		Arid	0	0.00	3.15
					Semi Arid	10	1.26	9.45
4	City Park			12.60	Semi Humid	40	5.04	15.75
					Humid	20	2.52	130
					Lawn	30	3.78	80
					Arid	0	0.00	3.15
			60	19.80	Semi Arid	10	1.98	9.45
5	District Park	33			Semi Humid	40	7.92	15.75
					Humid	20	3.96	130
					Lawn	30	5.94	80



The table has been separated in to four sections:

- Parks
- Civic Areas
- Roads
- Combined Total

Total Water Usage (m ³ per day)	Total Water Usage Mega Litres
17.17	0.02
41.77	0.04
1022.38	1.02
721.29	0.72
1133.45	1.13



Reference	Туроlоду	Area (ha)	Green Cover %	Green Cover (ha)	Landscape Type	Coverage %	Coverage area (ha)	Water Rate Use (m ³ per day per ha)
					Arid	0	0.00	3.15
					Semi Arid	20	2.76	9.45
6	Neighbourhood	23	60	13.80	Semi Humid	40	5.52	15.75
	TAIK				Humid	20	2.76	130
					Lawn	20	2.76	80
					Arid	0	0.00	3.15
	Local Park/ Community Garden	15	60	9.00	Semi Arid	20	1.80	9.45
7					Semi Humid	40	3.60	15.75
					Humid	20	1.80	130
					Lawn	20	1.80	80
		1			Arid	0	0.00	3.15
			20	0.20	Semi Arid	0	0.00	9.45
8	Civic Plaza				Semi Humid	50	0.10	15.75
					Humid	50	0.10	130
					Lawn	0	0.00	80
					Arid	30	8.03	3.15
					Semi Arid	50	13.38	9.45
9	Wadi Parks	535	5	26.75	Semi Humid	20	5.35	15.75
					Humid	0	0.00	130
					Lawn	0	0.00	80
	Parks Total:	3500	-	108.88	-	-	108.88	-



Total Water Usage (m ³ per day)	Total Water Usage Mega Litres
692.62	0.69
451.71	0.45
14.58	0.01
235.94	0.24
4330.90m ³	4.33ML

Civic Areas

Reference	Typology	Area (ha)	Green Cover %	Green Cover (ha)	Landscape Type	Coverage %	Coverage area (ha)	Water Rate Use (m ³ per day per ha)
					Arid	0	0.00	3.15
					Semi Arid	20	1.44	9.45
10	Hospital	18	40	7.20	Semi Humid	50	3.60	15.75
					Humid	20	1.44	130
					Lawn	10	0.72	80
					Arid	0	0.00	3.15
					Semi Arid	10	1.23	9.45
11	Mosque	20.5	60	12.30	Semi Humid	50	6.15	15.75
					Humid	30	3.69	130
					Lawn	10	1.23	80
					Arid	0	0.00	3.15
					Semi Arid	20	2.50	9.45
12	Sports Stadium	25	50	12.50	Semi Humid	50	6.25	15.75
					Humid	20	2.50	130
					Lawn	10	1.25	80
	University				Arid	0	0.00	3.15
			50	8.63	Semi Arid	10	0.86	9.45
13		17.25			Semi Humid	40	3.45	15.75
					Humid	25	2.16	130
					Lawn	25	2.16	80
		98	40		Arid	0	0.00	3.15
				39.20	Semi Arid	20	7.84	9.45
14	District Centre				Semi Humid	60	23.52	15.75
					Humid	20	7.84	130
					Lawn	0	0.00	80
					Arid	0	0.00	3.15
					Semi Arid	20	14.00	9.45
15	Neighbourhood	175	40	70.00	Semi Humid	60	42.00	15.75
	Centre				Humid	20	14.00	130
					Lawn	0	0.00	80
					Arid	0	0.00	3.15
					Semi Arid	20	3.04	9.45
16	Local Centre	38	40	15.20	Semi Humid	60	9.12	15.75
					Humid	20	3.04	130
					Lawn	0	0.00	80
	Civic Areas Total	391.75		165.03			165.03	



Total Water Usage (m ³ per day)	Total Water Usage Mega Litres
315.11	0.32
686.59	0.69
547.06	0.55
515.30	0.52
1463.73	1.46
2613.80	2.61
567.57	0.57
6709.15m ³	6.71ML



Roads Green Cover % Green Cover (ha) Water Rate Use Reference Landscape Type Coverage area (ha) Typology Area (ha) Coverage % (m³ per day per ha) Arid 0 0.00 3.15 20 67.04 9.45 Semi Arid 70 234.64 15.75 17 Arterial Road 1676 20 335.20 Semi Humid Humid 33.52 130 10 Lawn 0 0.00 80 Arid 0 0.00 3.15 Semi Arid 10 0.60 9.45 50 18 City Boulevard 15 40 6.00 Semi Humid 3.00 15.75 Humid 40 2.40 130 0 0.00 80 Lawn Arid 0 0.00 3.15 20 18.32 9.45 Semi Arid 19 District Avenues 458 20 91.60 Semi Humid 60 54.96 15.75 18.32 130 Humid 20 80 0.00 Lawn 0 Arid 0 0.00 3.15 20 52.04 9.45 Semi Arid Semi Humid 60 156.12 15.75 20 Urban Streets 1301 20 260.20 Humid 20 52.04 130 80 0 0.00 Lawn Arid 0 0.00 3.15 Semi Arid 20 28.30 9.45 Greenways/ 283 50 Semi Humid 60 84.90 15.75 21 141.50 sikkas Humid 20 28.30 130 0 0.00 80 Lawn 1108.41 1108.41 Combined Total 7624.75

Table 8-4: Proposed Planting Mix by Typology and Character Area



Total Water Usage (m ³ per day)	Total Water Usage Mega Litres
8686.71	8.69
364.92	0.36
3420.34	3.42
9715.87	9.72
5283.61	5.28
27471.45m ³	27.47ML
38511.51m ³	38.51ML

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ATKINS Member of the SNC-Lavalin Group

