SECTION 3 – DESIGN GUIDELINES FOR INDIVIDUAL ELEMENTS

3.1 DESIGN GUIDELINES FOR INDIVIDUAL ELEMENTS

3.1.1 Introduction

The following is a guideline to the lighting design opportunities that are offered by the design of the physical city as currently mid 2002 defined. These opportunities represent what is possible and desirable; they should be considered as benchmarks for the future lighting design opportunities that will continue to arise as the detailed design of the remainder of the city emerges.

3.1.2 Core Island Lighting Design Approach – Central Boulevard and Surrounding Buildings

- In order to achieve the objectives of Policy 1 it is recommended that the lighting to the vehicle surface of the Central Boulevard be based on the use of a light source with a high colour temperature and good colour-rendering characteristic. Typically, the source should have a colour-rendering index of not less than R^a 85 and colour temperature range of 4500K to 5300K. The use of this type of source will produce light of a cool white appearance that will contrast strongly with the lighting of the roads and streets that feed into the Central Boulevard. These should lit by light sources of warmer colour appearance with a colour temperature of 2800K to 3500K with a colour- rendering index of not less than R^a85. Correspondingly, the Central Boulevard will be strongly identified and characterised at night in relation to the network of surrounding roads and streets. Drawing 1.2.1 illustrates the overall roads and street lighting of the Core Island in relation to the lighting of roads and streets in surrounding Putrajaya. It is acknowledged that conventional roadway illuminating engineering practice favours the use of the high-pressure sodium light source. This is evidenced by its nearly universal application throughout the roads and streets of Putrajaya as constructed to date (April 2002) and its wholesale use in cities worldwide. However, being a new city, Putrajaya requires to examine cutting edge technology and the thinking that lies behind it. In the case of metal halide (HQI or British nomenclature: MH) versus high-pressure sodium (NAV or SON) there are two factors to be considered: colour characteristics and the performance of the human eye. These factors are examined in detail in Appendix D.

- Contrast the 'cool' character of the lighting of the Central Boulevard roadway lighting with the pedestrian lighting of a warmer appearance. Pedestrian lighting sources are recommended to be of warmer colour appearance with a colour temperature of 2800K to 3500K and a colour- rendering index of not less than R^a85.

- Increase Central Boulevard roadway luminance by approximately 50% to mark festive and ceremonial nights i.e. from 2 to 3 cd/m^2

- Use colour Luminous Emitting Diode (LED) clusters located at the top of the main roadway lighting columns to identify the Central Boulevard as a Protocol Road.

- The series of colonnades at ground level provides a unifying element to the Central Boulevard. In the case of those buildings that include such collonading, the lighting of the interior of these should be designed on a consistent basis from one building to the next. A luminance of between 10 and 15 cd/m^2 should be established. The light source colour temperature to be approximately 3000K with good colour rendering of not less than R^a 80.

Recommendations:

1. ***Light Central Boulevard roadway with 4500K-5300K, >R^a85 light sources***
2. ***Light Central Boulevard pedestrian lighting with 2800K-3500K, R^a85 light sources***
3. ***Increase Central Boulevard roadway lighting levels by 50% from normal code levels for festive and state occasions from 2 – 3 cd/42***
4. ***Mark Boulevard as Protocol Road by use of colour LED on road columns***
5. ***Light colonnades with c.3000K, R^a85 light sources to 10-15cd/m^2***
6. ***Light roof cornices where appropriate and possible***
7. ***Main Dataran Putrajaya Plaza level increase up to 10-12 cd/m^2 for Processional Events.***

- The rooflines of a number of the planned buildings and those under construction provide a further opportunity for visual unification.

- Linear uplighting to the cornices will emphasise the linear axial nature of the Central Boulevard at night. Such uplighting should be included wherever the opportunity occurs.

- The more intimate nature of the smaller east-west cross streets and other minor streets should be characterised at night by street lighting that is based on the use of a warm appearance light source with a colour temperature of 2800K to 3500K with a colour-rendering index of not less than R^a85.

- During state and festive periods:
  - Introduce colour to Central Boulevard colonnades – to provide pedestrian level awareness.
  - Introduce colour to Central Boulevard roofline punctuation – to provide distant/long view awareness.
  - Illuminate temporary structures.
  - Increase Central Boulevard road lighting light levels by 50% in relation to normal levels i.e. from 2 cd/42 to 3 cd/42

- Trees and other landscape planting should be contrasted with their surroundings through the use of good colour rendering metal halide light sources. The colour temperature of such sources should be selected to emphasise the colour of the planting e.g. green/blue-green foliage will benefit from high colour temperature light (4000K+) whilst planting that displays yellow/orange/red colouration will be optimised by the use of lower colour temperature light at not more than 3000K. If fluorescent light sources are used in preference to metal halide sources, the same colour temperature considerations apply.

- Light sources used to light building elevations on the Central Boulevard should include low colour temperature metal halide, fluorescent (compact and linear), mercury vapour and 'white high pressure sodium'. The use of high-pressure sodium should be avoided due to its lack of good colour rendering properties and its major use in the lighting of roadways. Lighting should distinguish buildings from their surroundings at night both in terms of local and distant views. Many will view the Core Island and the distant Central Boulevard buildings from remote locations where the ambient lighting is based on high-pressure sodium light sources. The combined use of high-pressure sodium and cool metal halide light sources directed at a common surface is acceptable.

- The Central Boulevard node points or Datarans (as shown in Figure 3.1.1, 3.1.2 and 3.1.3) present a major challenge in road and plaza lighting terms. The main requirement is to provide the requisite level of road lighting across the full extent of the plaza that each Dataran represents without imposing the presence of numerous lighting columns that would effectively bisect the Dataran in visual terms.

It is proposed that the illumination of **Dataran Putrajaya** be based on the use of a cellular mirror reflector system. The illustration of the illumination is demonstrated in Figure 3.1.4 and 3.1.5. This is an established technology that has the key advantage of providing sufficient levels of lighting without creating high levels of glare. The system was originated for the lighting of airport airside apron areas without creating disability glare to flight deck crews at night.

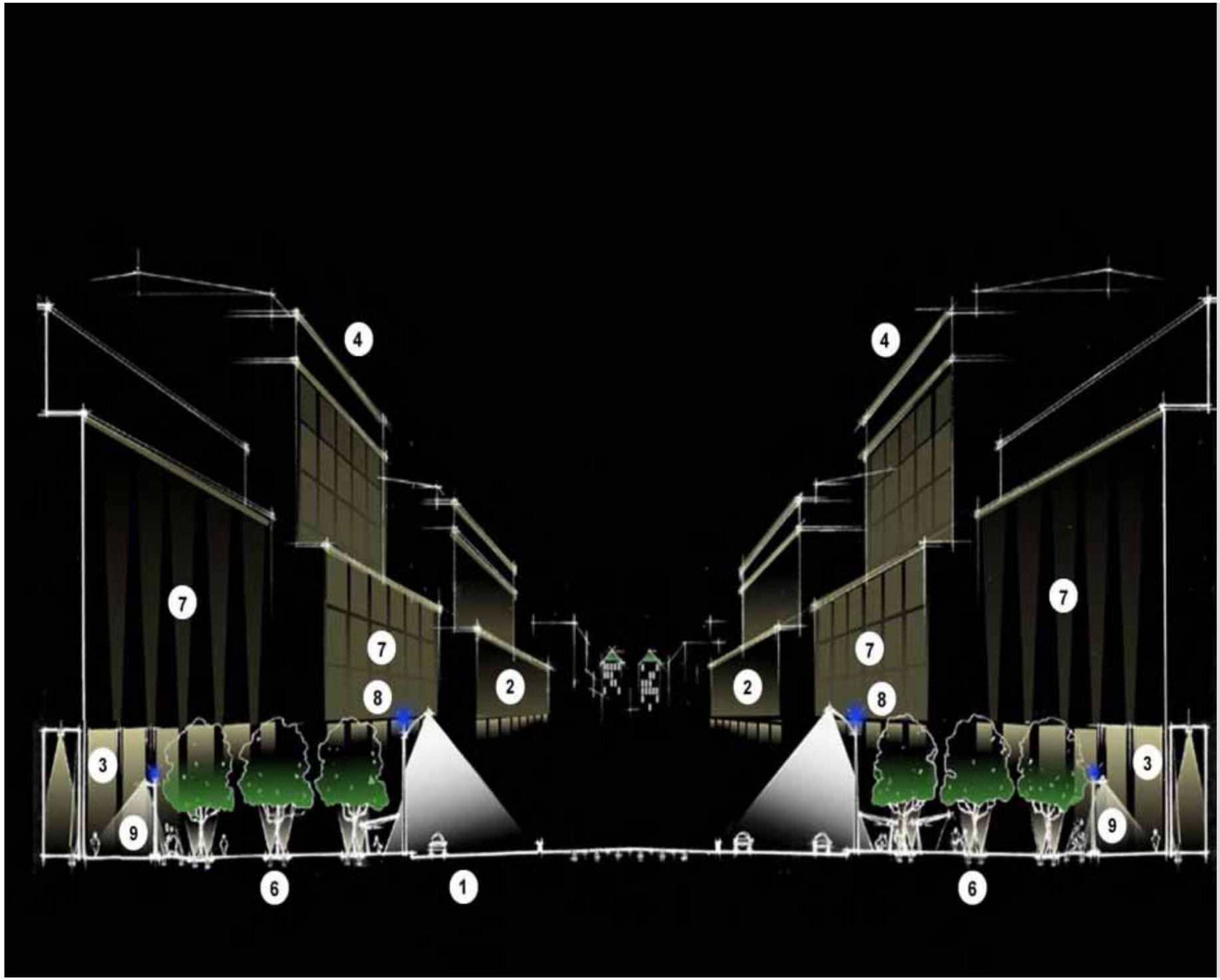
Recommendations:

1. ***Secondary roads to be illuminated with 2800k – 3500k, >R^a85 light source.***
2. ***Trees and other landscaped planting to emphasise green/blue-green foliage with 4000 k+ and planting with yellow/orange/red colouration with less then 3000k.***
3. ***High pressure sodium to light building elevations to be avoided.***
4. ***Dataran lighting to provide illumination across the full extent of the plaza.***
5. ***Dataran Putrajaya illumination to use cellular mirror reflector system.***

The current (2002) lighting of **Dataran Putra** creates a considerable level of glare and night sky light pollution. It is proposed that this problem be overcome through the re-engineering and re-design of the existing luminaires to ensure that these direct light to angles only below horizontal, which is illustrated in Appendix E (see appendix E: Example of photometric study using cellular mirror reflector system). The resulting lack of adequate lighting levels to the outer part of the Dataran could be resolved through the introduction of a second, outer, circle of road lighting columns and luminaires of a similar design to those in the central area.

Recommendations:

1. ***Dataran Putra to consider reengineering and redesign to existing luminaires.***



Central Boulevard Normal Operation

1. **Central Boulevard illuminated utilisiing lamps within range 4500 K – 5300 K with CRI Ra > 85**

2. **Buildings lit according to hierarchy- Group A Buildings to be brightest (to be categorised as buidings or groups of buildings, structures or other elements that form vista terminations, landmarks when viewed from major distances, or are categorised as landmarks buildings in DUD documents.)**

   Group B buildings to be lit less brightly (to be categorised as buildings that form thestreetwall between Group A buildings on Central Boulevard)

3. **Colonnade unified with a consistency of colour and source.**

4. **Roofline punctuation zone unified with consistency of colour and space.**

5. **Trees and landscape features illuminated utilising green/blue green – 4000K and yellow/orange/red – 3000K**

6. **Metal Halide, Fluorescent, mercury vapour, white high pressure sodium to be utilised for illuminating building facades.**

7. **Beacons mounted to top of streetlight columns denoting 'protocol road' status.**

8. **Safe lighting levels to pedestrian areas.**

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Figure 2.1.8

Central Boulevard Festive Operation

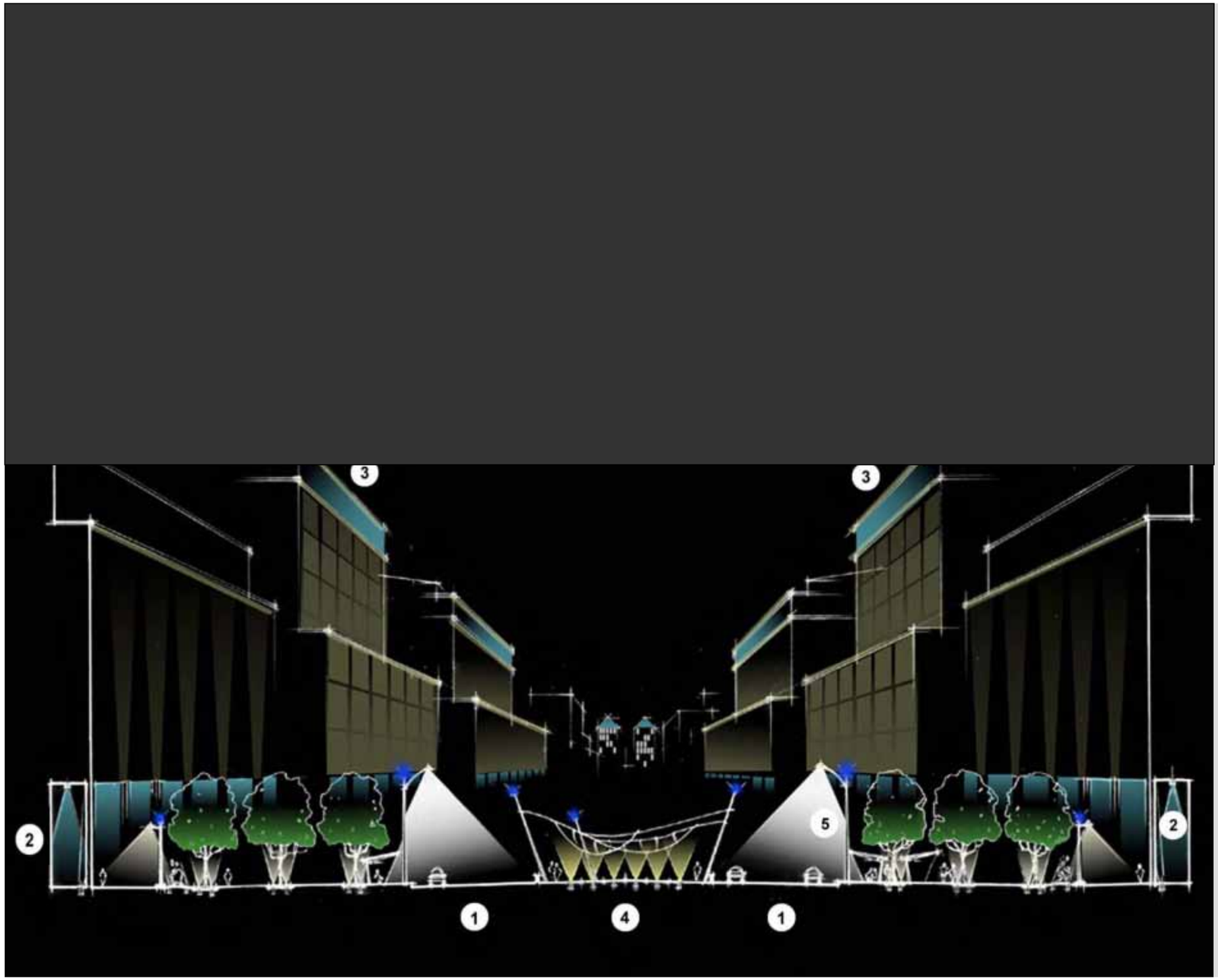

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Figure 2.1.8

Secondary Streets

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Figure 2.1.8

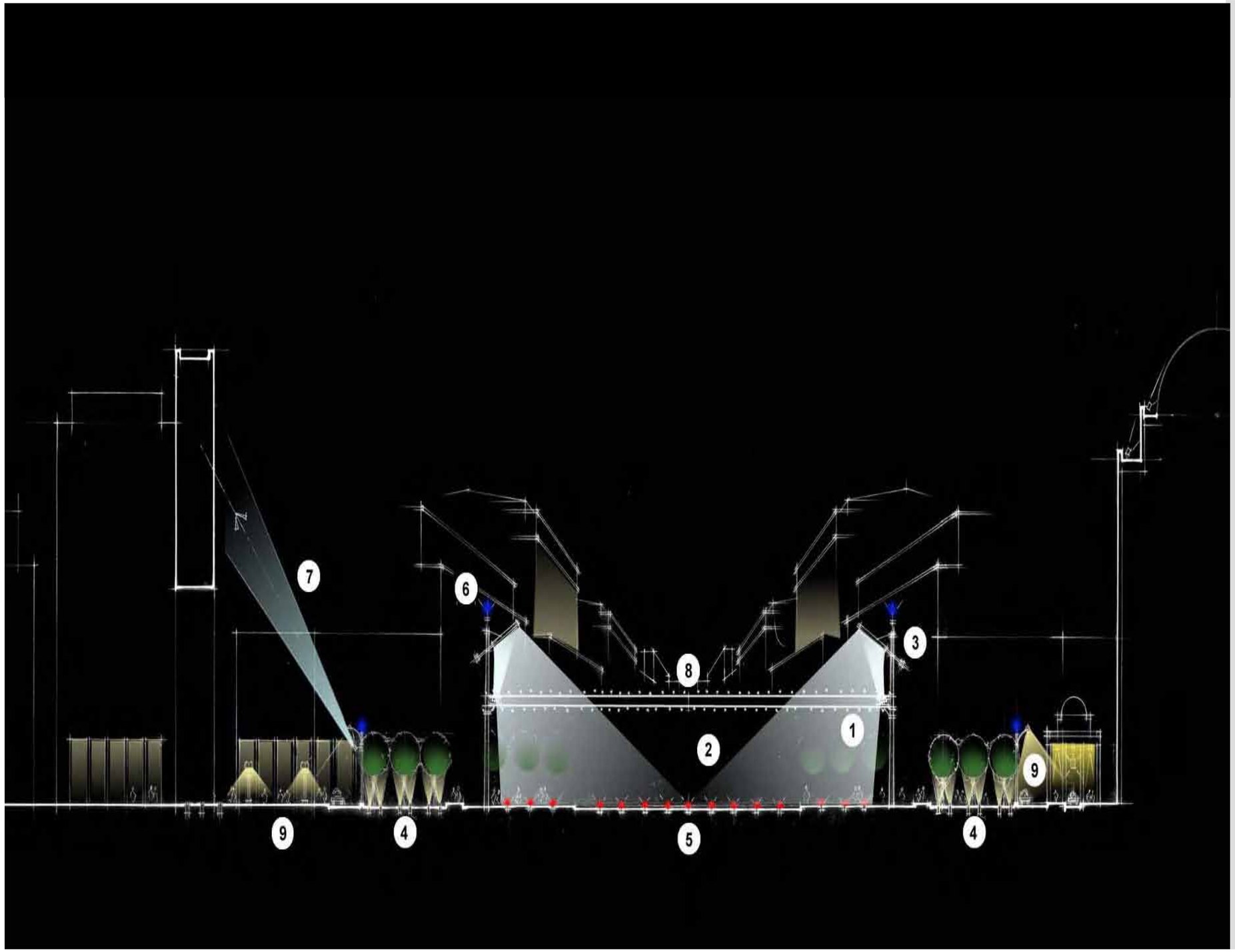
- **Dataran Wawasan** (refer to Figure 3.1.6) is designed in a manner that ensures that gathering and assemblies will take place in the landscaped plaza area to the west of the vehicular Boulevard. In view of this, the current (April 2002) design of the carriage way lighting comprising a total of 9, 12 metre, columns of the same design as is being used throughout the entire length of the central Boulevard, should be adopted.

- **Dataran Rakyat** (refer to Figure 3.1.7)

- **Dataran Gemilang** (refer to Figure 3.1.8)

Recommendations:

1. ***Light Dataran Wawasan carriageway with conventional column mounted luminaires in normal kerbside locations***
2. ***Dataran Rakyat***
3. ***Dataran Gemilang***



Dataran Putrajaya Section

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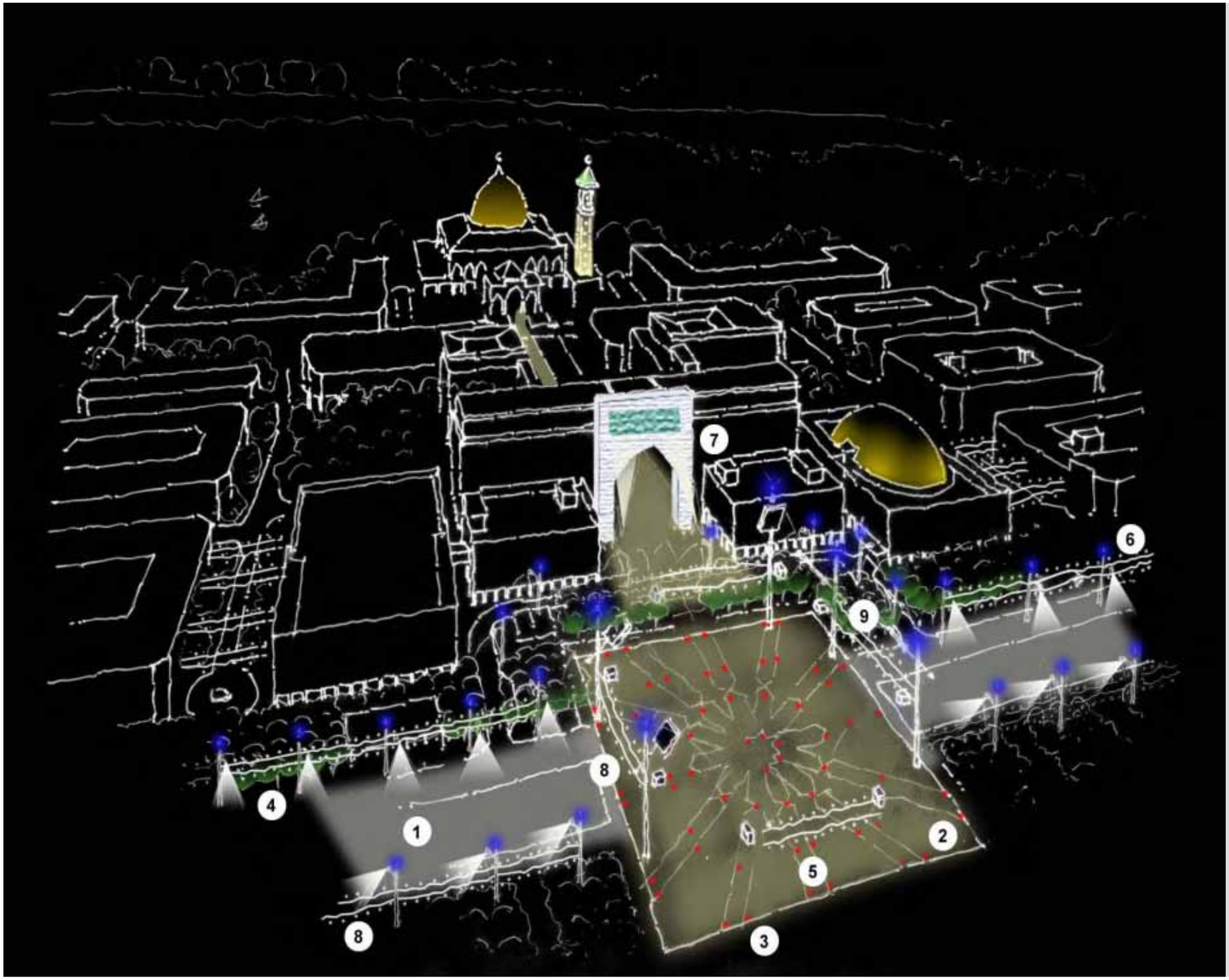
Figure 2.1.8



Dataran Putrajaya

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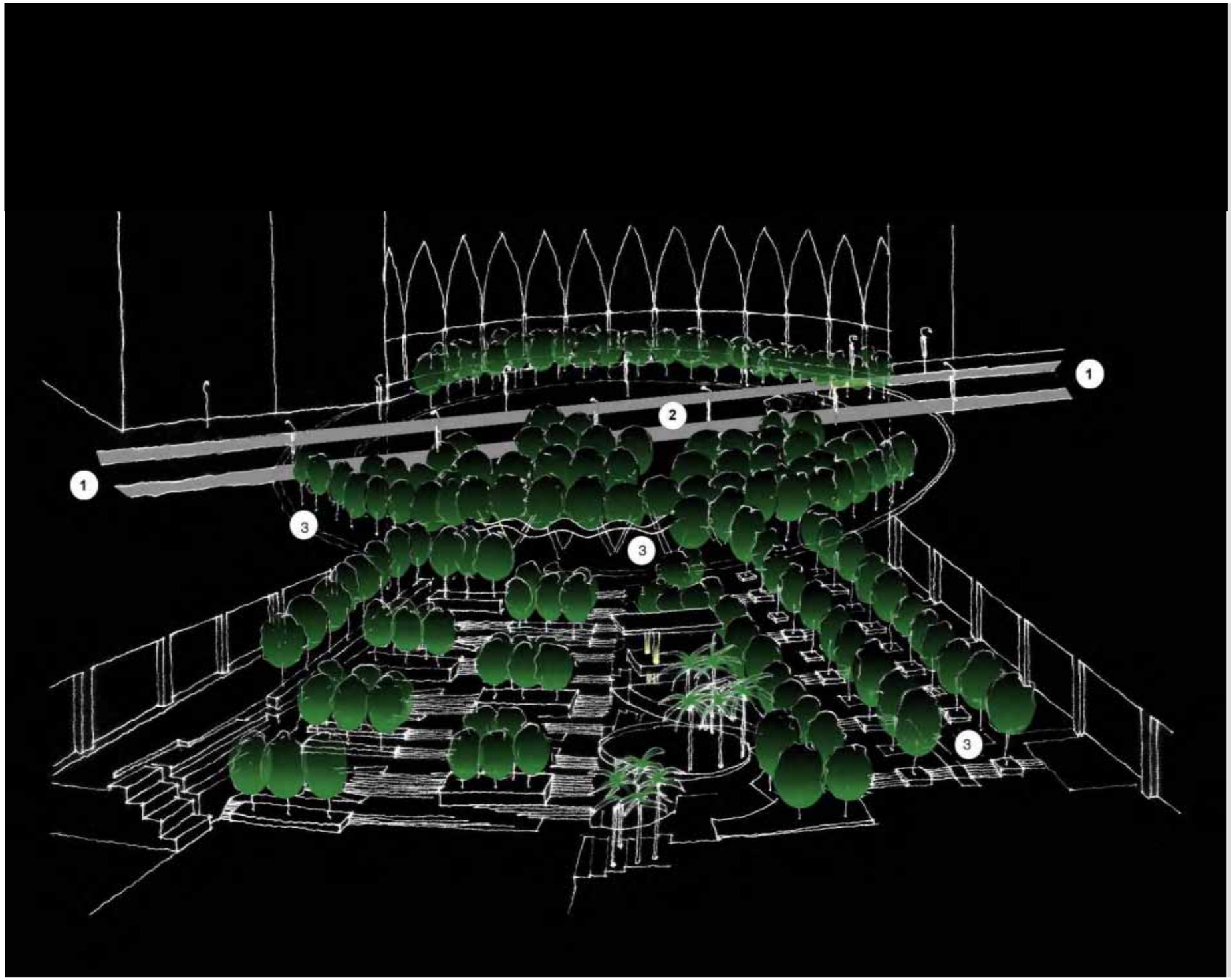
Figure 2.1.8



Dataran Wawasan

2. Central Boulevard Illuminated utilising lamps within range 4500 K – 5300 K with CRI Ra > 85

3. Streetlighting columns continue through dataran illuminating streets below

4. Trees and landscape features illuminated utilising lamps within range 4500 K-6000K with CRI Ra > 85

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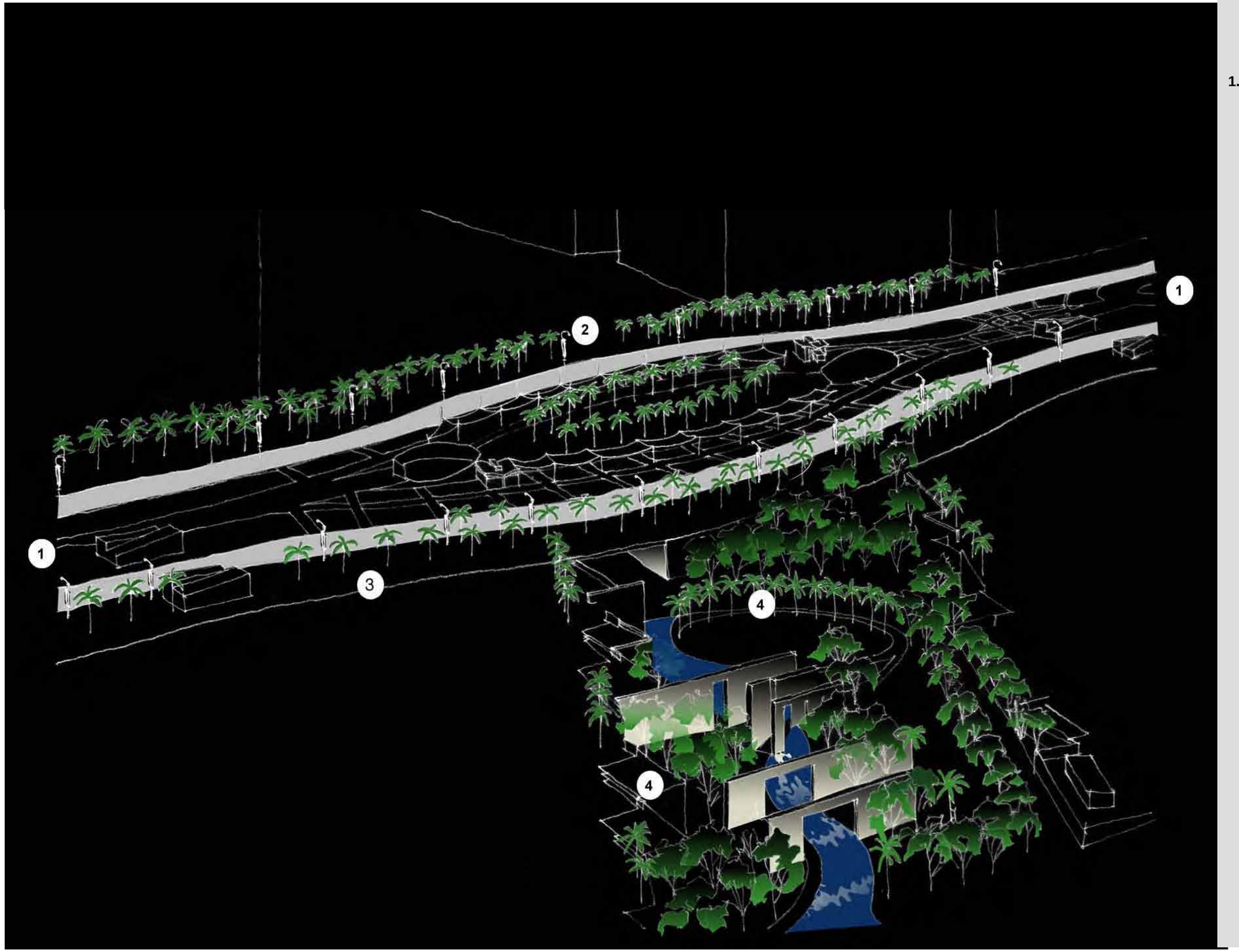
Figure 2.1.8



Dataran Rakyat

1.

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Figure 2.1.8

3.2 LIGHTING TO BUILDINGS THROUGHOUT PUTRAJAYA

- Establish a hierarchy of buildings in terms of lighting 'brightness' or luminance to exemplify their relative importance and stature at night, as illustrated in Drawing 3.2.1: This hierarchy applies to buildings, structures, monuments and other lit elements throughout Putrajaya. Luminance is the product of incident lighting levels, or illuminance measured in lux, and the reflection factor of the surface upon which the incident light falls. Luminance, expressed in candela/m² is a more important measure than illuminance since it is a metric of what the eye actually sees.

- The following recommended luminance values are based on British work carried out in the mid 1990's and published by the Institution of Lighting Engineers (ILE) and the Chartered Institute of Building Engineers (CIBSE) Lighting Division (now the Society of Light & Lighting). The values have been increased in the case of Group A buildings to take account of differing cultural attitudes to brightness between Europe and Malaysia.

Group A – Buildings, groups of buildings, structures or other elements that form vista terminations, landmarks when viewed from major distances, nodal points, or are categorised as landmark buildings in DUD documents. The majority of Group A buildings will be located on the Core Island and within Precinct 1.

Lit to average luminance of 20-50 cd/m^2 with a maximum of 200cd/m² (refer to Figure 3.2.1)

Group B – Buildings that form the 'street wall' between Group A buildings on Central Boulevard, buildings of particular architectural note, structures, landmarks, key buildings in regional centres and other elements.

Lit to average luminance of 10-25 cd/m^2 with a maximum of 150cd/m² (refer to Figure 3.2.2)

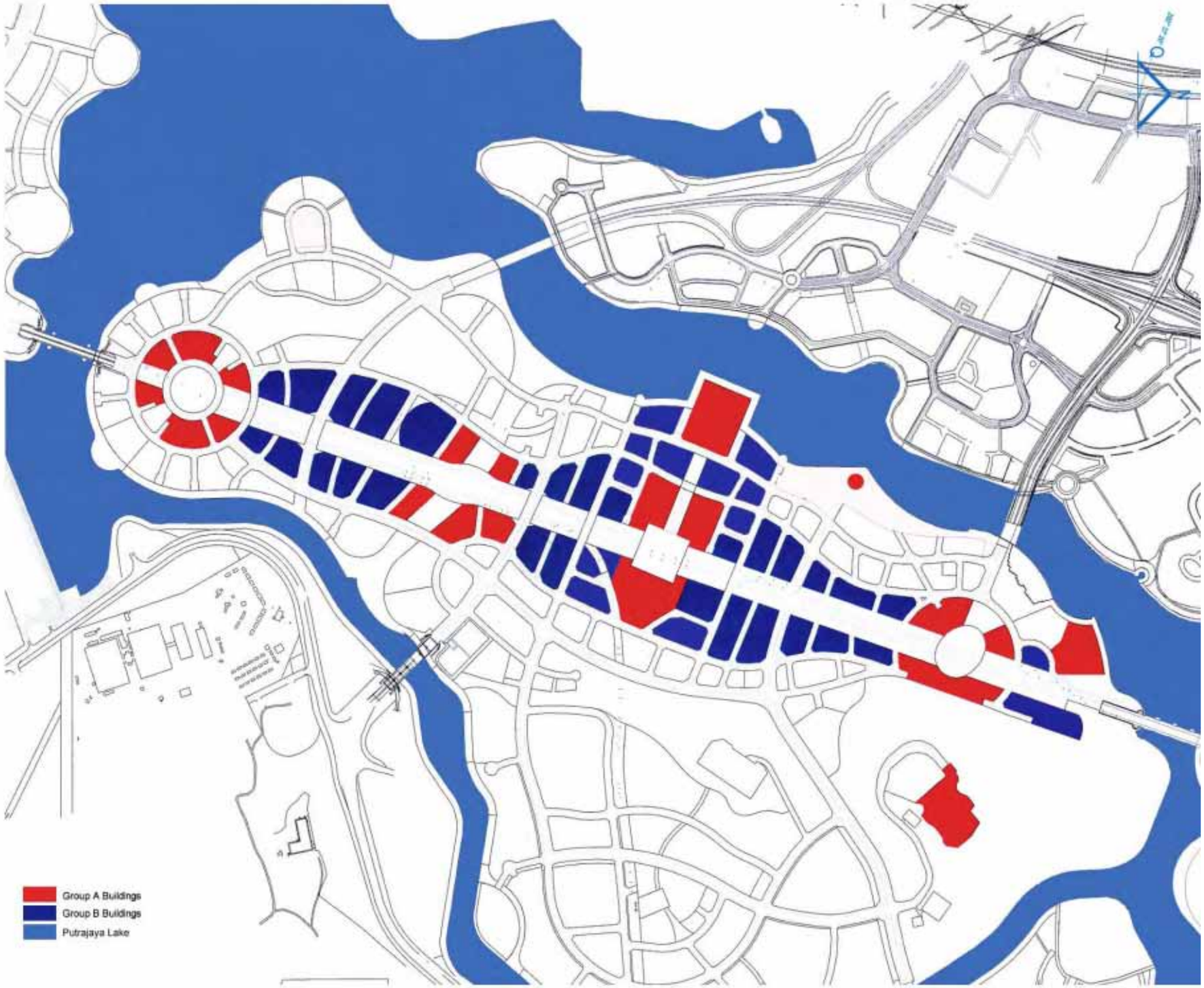
Group C – All remaining buildings, structures and elements that justify lighting for civic, architectural or commercial reasons.

Lit to average luminance of 5-10 cd/m^2 with a maximum of 60 cd/m^2 (refer to Figure 3.2.3)

Figure 3.2.4, 3.2.5, 3.2.6, 3.2.7 and 3.2.8 illustrate some examples of good lighting practice.

Recommendations:

1. ***Categorise buildings into 3 lighting 'brightness' groups to signify status and function within urban plan.***
2. ***Plan lighting installations on the basis of using predicted luminance (cd/m²) values rather than illuminance (lux) values***



Hierarchy of Building in Luminance/' Brightness'

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Figure 2.1.8

Precinct 5 Building Category

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Figure 2.1.8

Precinct 7 & 8 Building Category

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Figure 2.1.8

Group A Buildings

Buildings or groups of buildings that form landmarks when viewed from a major distance, vista terminations, nodal points or buildings which are categorised as landmark buildings in the DUD document, to be lit to an average luminance of 20 – 50 cd/m2 with a maximum of 200 cd/m2

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Figure 2.1.8

Group B Buildings

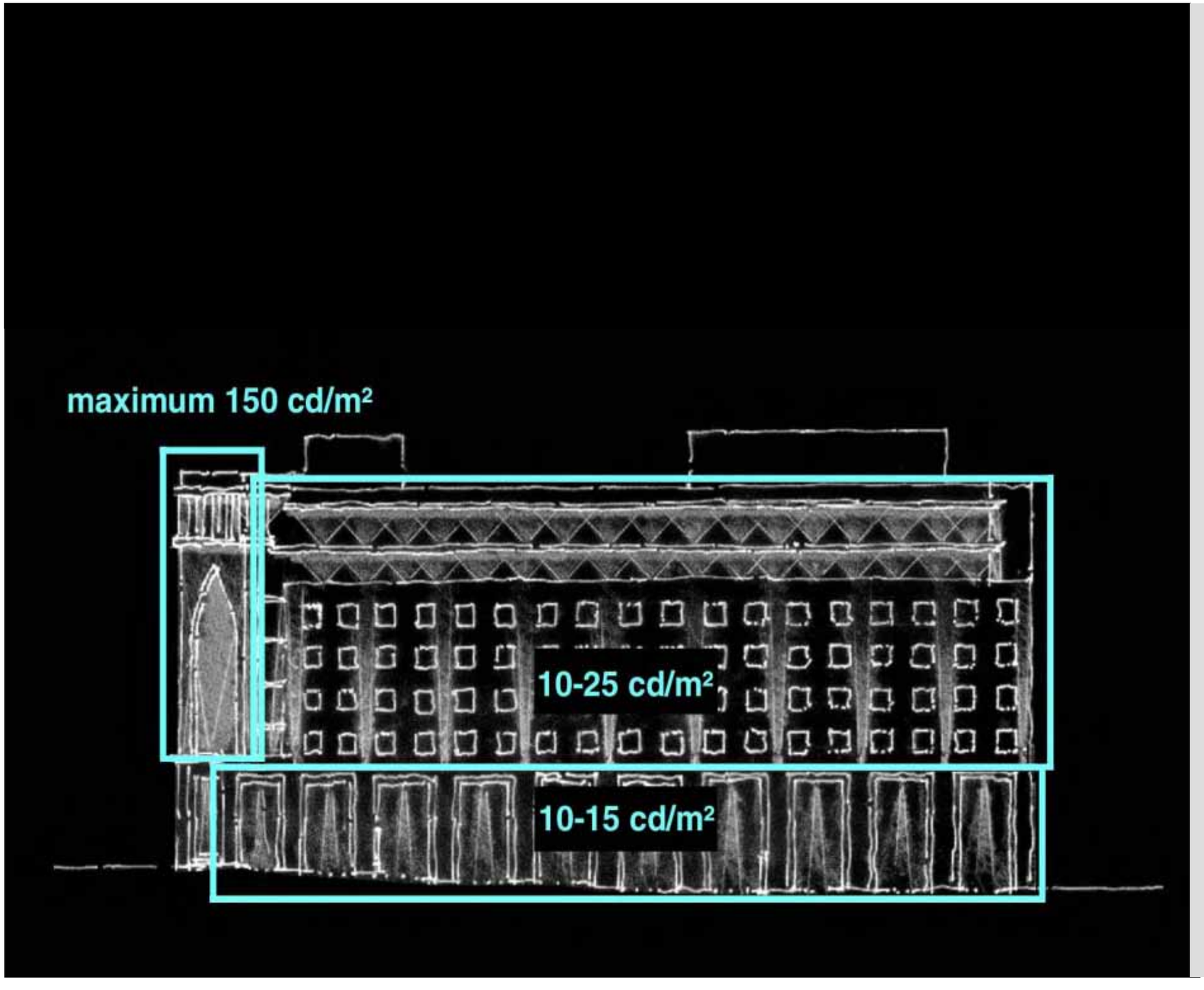

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Figure 2.1.8

Group C Buildings

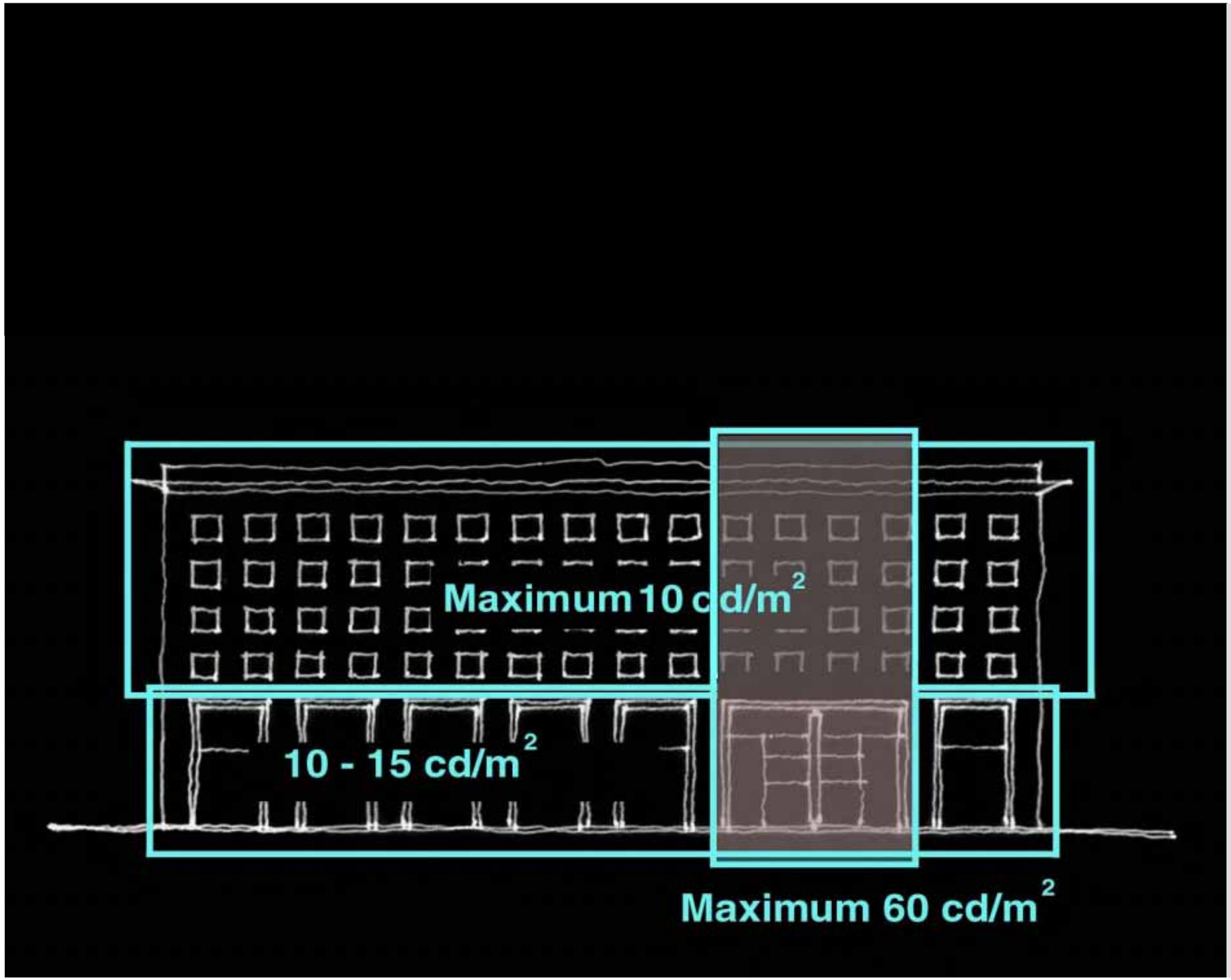

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Figure 2.1.8

Group A Buildings
Good Lighting Practice

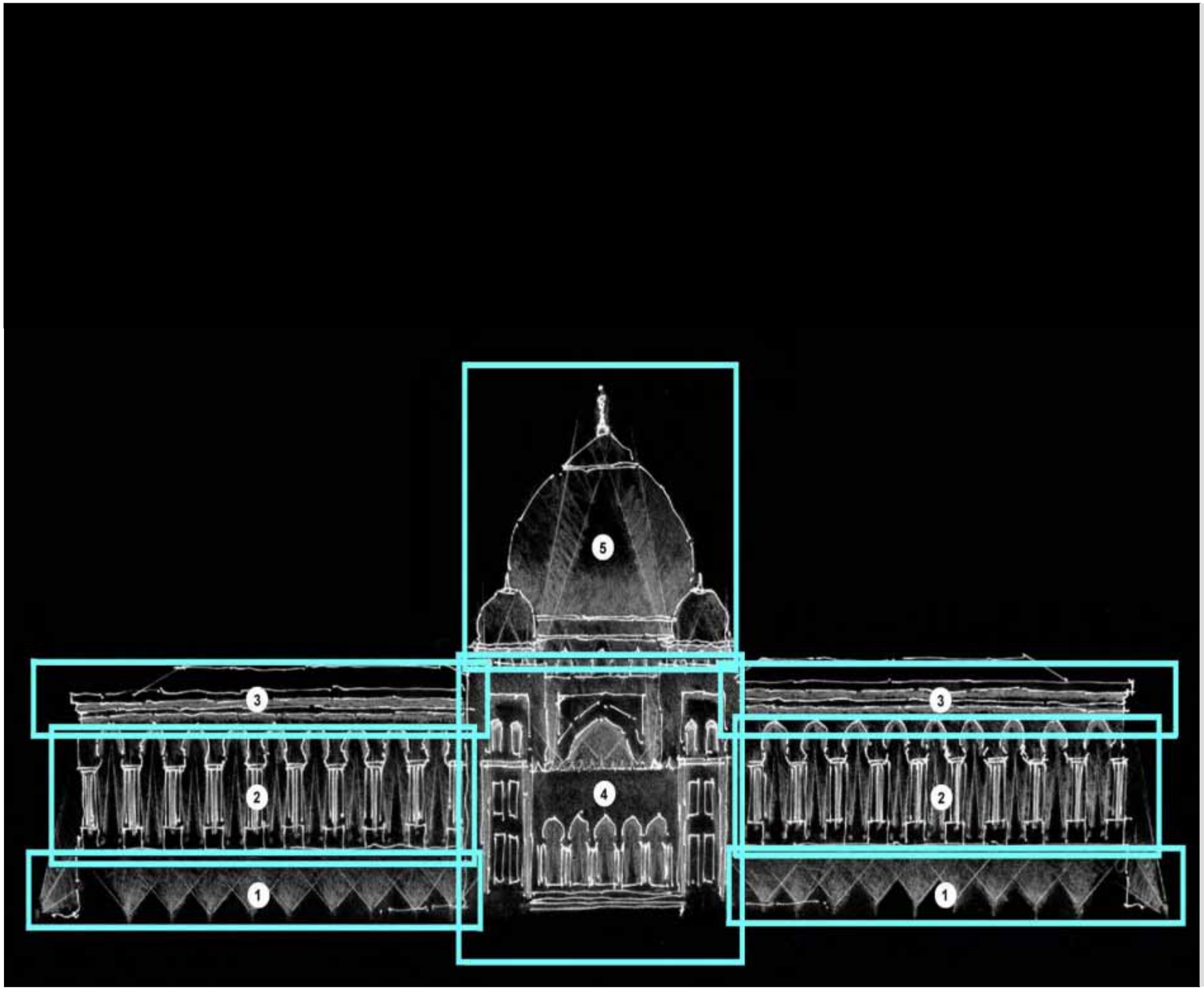

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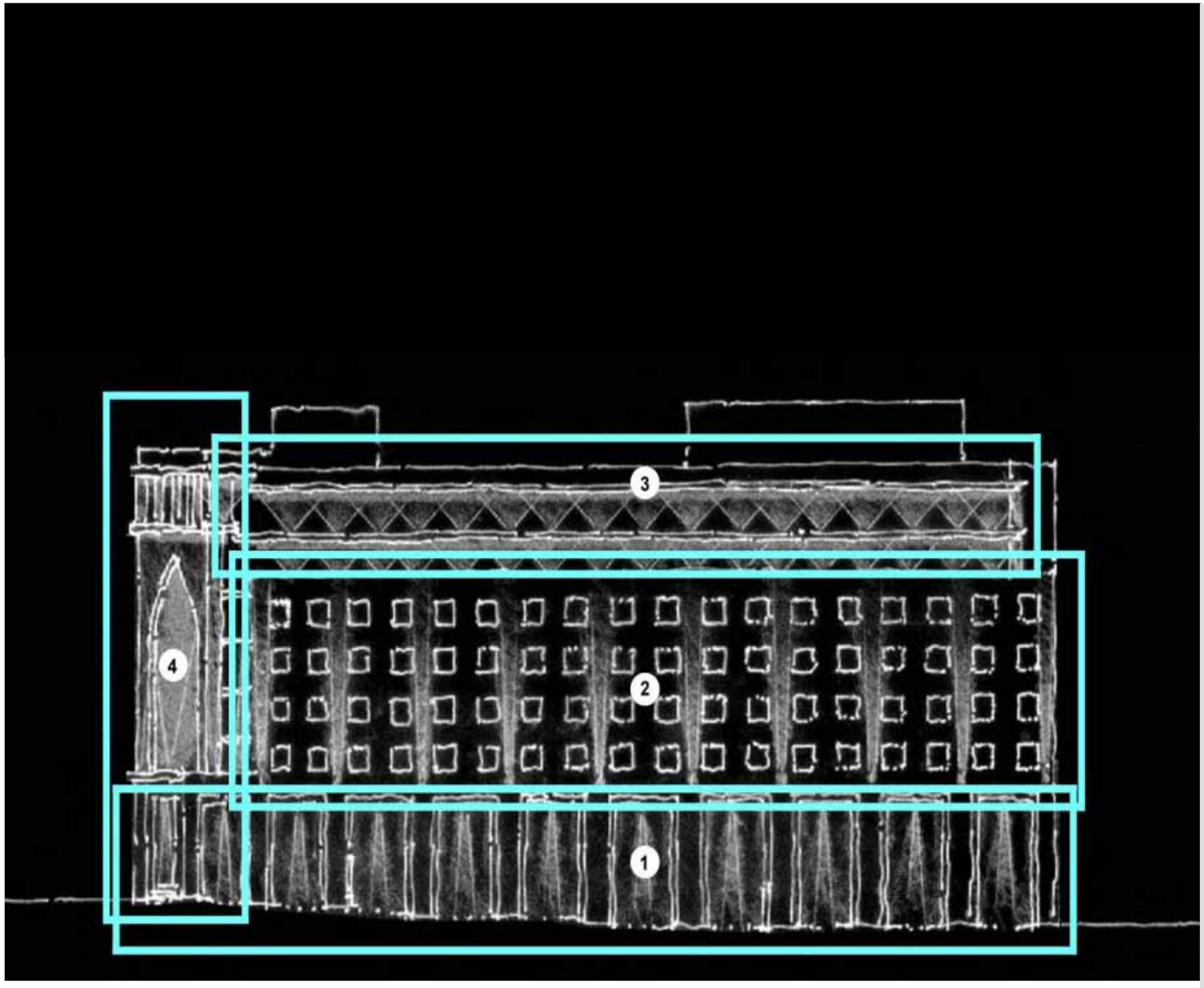
Figure 2.1.8



Group B and C Buildings
Good Lighting Practice

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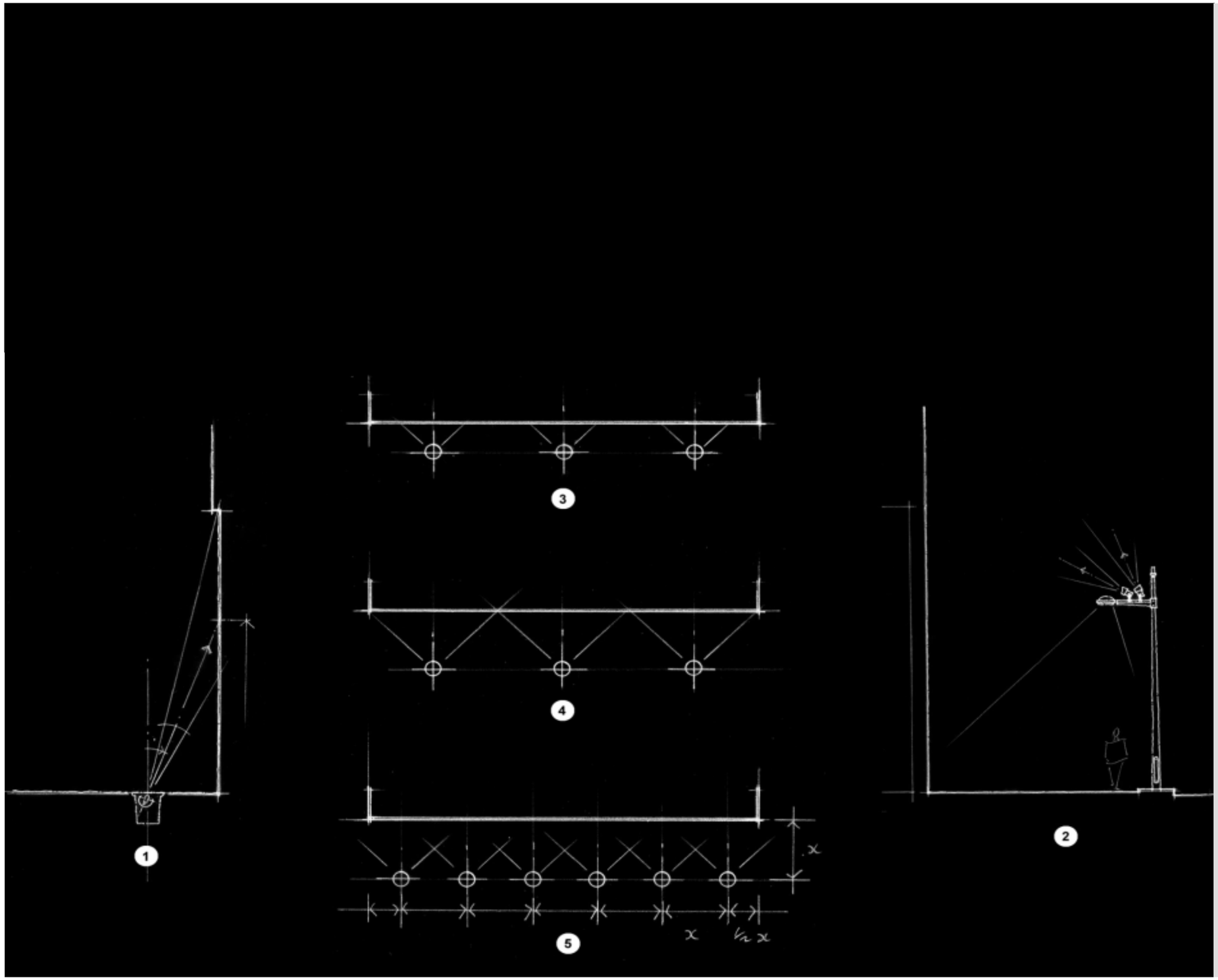
Figure 2.1.8



Good Lighting Practice
Building Lighting

1. **Inground uplights to have either wallwash reflector or a djustbale lamp position to ensure all light emitted from fitting hits the building /wall and does not cause stray light.**

2. **Fittings illuminating streetwalls should be located in concealed locations on building or mounted on streetlight columns to ensure fittings are not seen. Fittings on buildings should be painted in RAL colour to match building materiality. Wiring and conduit to fittings should be concealed as far as is practicable.**

3. **Inground recessed uplights positioned close to walls create dramatic scalloping effect.**

4. **Inground recessed upligts positioned at greater distance from wall create a more uniform wallwash effect.**

5. **Inground recessed uplights positioned at optimum distance from wall create very uniform wallwash effect.**

6. **Ensure additional lighting on buildings or structures have been allowed for structurally.**

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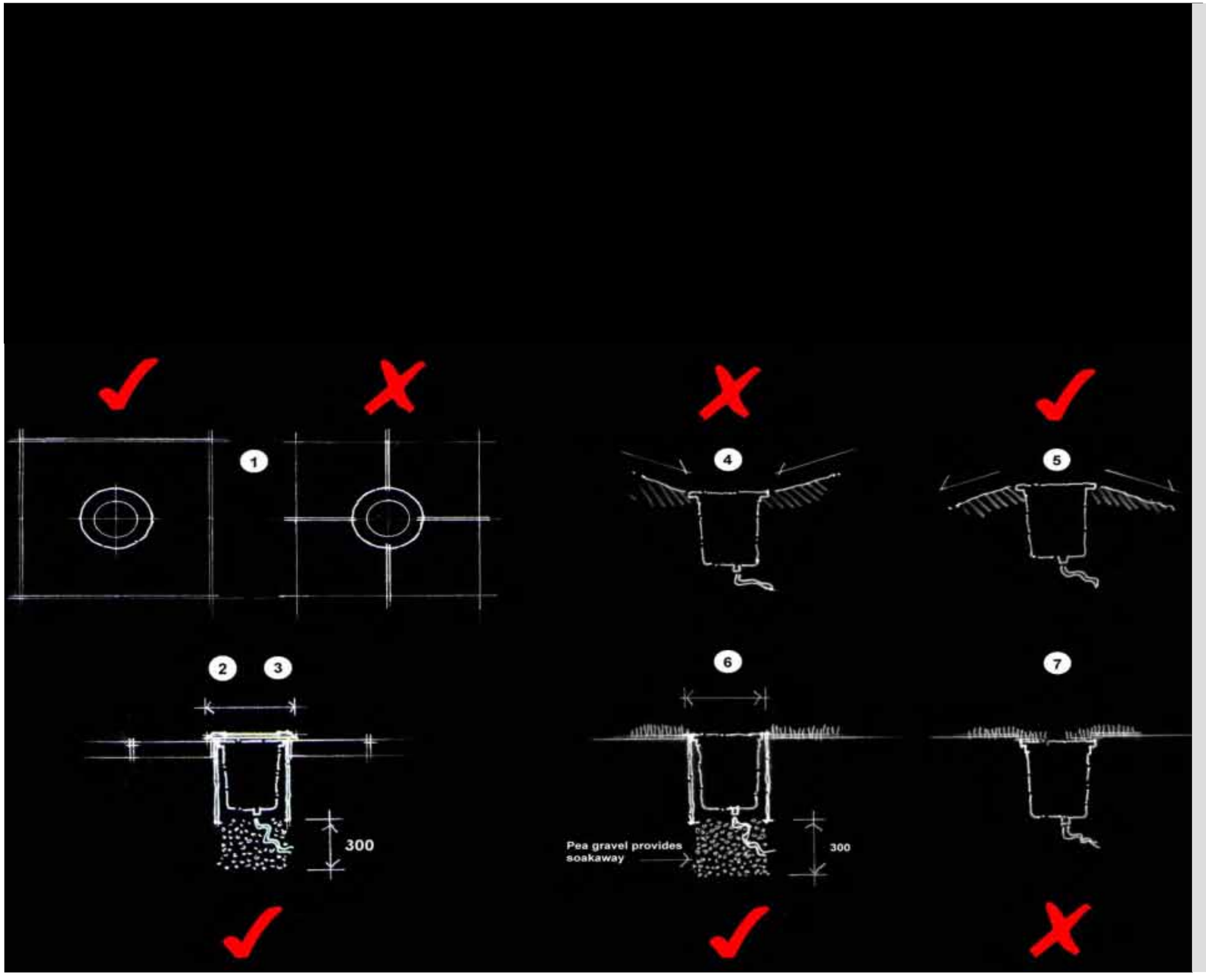
Figure 2.1.8



Good Lighting Practice
Inground Recessed Uplights

1. **Inground uplights should be centered on paving slabs to ensure levels beneath fitting are the same, avoiding differential compression of gasket seals.**
2. **Bevelled top plates can be used to cover discrepancies in slab core cutting.**
3. **Top plates used which extend above ground level should be bevelled to minimised the potential of trip hazards.**
4. **Ground levels to perimeter of inground recessed fittings should fall away from fittings to ensure ponding does not occur on fitting, encouraging seepage into fitting.**
5. **Ground levels fall away from fitting.**
6. **When appropriate e.g. when inground fittings are recessed into concrete slabs, recessing sleeves should be utilised with pea gravel to ensure free draining below fitting.**
7. **Maintenance should be carried out on a regular basis to ensure top plate glass is clean, and free from debris.**

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Figure 2.1.8

3.3 LIGHTING OPPORTUNITIES FOR INDIVIDUAL DESIGN ELEMENTS

3.3.1 Waterfront Promenades

At night the visual relationship between the Lake and its surrounding land should be clarified in certain areas through the use of waterside marker lights that delineate the edge of the Lake and the Core Island. It is proposed that the Lakeside walkway which extends down the western side of the Core Island be marked, at the shoreline, with coloured (possibly blue) LED powered marker lights. It is recommended that a similar treatment be applied to the Lake edge in Precincts 5 and 6 and other locations where a high volume of pedestrian use is anticipated. It is not suggested that this treatment be applied to areas where wildlife conservation is being encouraged or where night time pedestrian traffic is to be discouraged.

3.3.2 Water

The Lake system divides into a number of areas of differing character that can be emphasised at night (refer to Figure 3.3.1 for water hierarchy):

- The water recreation in the southwest area of the Lake –zone for possible floating light sculptures, water jets, fountains and submerged lighting features. These features might be permanent or temporary (refer to Figure 3.3.4)

- The general navigation zone to the west and north of the Core Island– zone for feature lighting 'buoys' (refer to Figure 3.3.3)

- Canal to east of Core Island– zone for shore located marker and way finding lights (refer to Figure 3.3.2)

- Weir at extreme north end of Lake – submerged uplighting to 'catch' water as it falls into light.

- No lighting in wetlands areas

- No lighting in ecologically sensitive areas.

3.3.3 Parks

Parkland lighting is provided for amenity, security and delight. The range of lighting technique is wide but certain fundamentals should be observed:

- Avoid all forms of glare. In an otherwise well balanced lightscape it only requires one badly directed or overly bright light source to create a visual magnet that draws the eye from the remainder of the scene. Additionally, glare sources, through the processes of contrast, make areas that are lit to a relatively low level appear dark.

- Ensure that footpath lighting columns are maintained at centre to centre spacing that avoid glare being created by the use of luminaires that are designed to spread light over a considerable area at low mounting heights.

- Avoid the use of high-pressure sodium light sources. These will render, as a brown colour, the green and blue/green colours of foliage, grass and other forms of planting.

Recommendations:

1. ***Delineate the Lake shoreline with way-finding marker lights in selected areas on the Core Island and elsewhere***
2. ***Maximise the value of the relationship between light, water and reflections***
3. ***Do not light ecologically and environmentally sensitive areas***
4. ***Use reduced height street lighting columns in future low-rise residential areas.***
5. ***Avoid direct 'floodlighting' to residential buildings***
6. ***Consider the identification of high rise residential buildings through a roof top 'cap' lighting feature***
7. ***Characterise night time regional 'centres' through street lighting of a differing quality to that of surrounding roads.***
8. ***Light bridge decks with the same light source as used to light approach ways***
9. ***Light bridge superstructures with white light except during festive periods when colour can be introduced***

- Use saturated colour with care. Converting the natural colours of soft landscape foliage and planting is frequently inadvisable because it distorts the range of subtle colour variation that occurs in a landscape with multiple species of planting. Temporary use of saturated colour is advocated.

- Take advantage of the possibility of shadow play. Whilst uplighting into the crowns of trees and to lower level foliage is a well-established technique, thought should be given to lighting downwards through tree foliage to create interesting shadows at ground level. Projection of foliage shadow work on vertical surfaces is also an attractive technique.

- Use vertical surfaces such as walls and areas of dense vertical foliage to reflect light and to create a sense of boundary. This technique also provides for a sense of enhanced security by placing in silhouette any person between the observer and the vertical surface.

3.3.4 Residential Areas

- In the residential areas the use of high-pressure sodium light sources for road and street lighting is likely to continue for the foreseeable future.

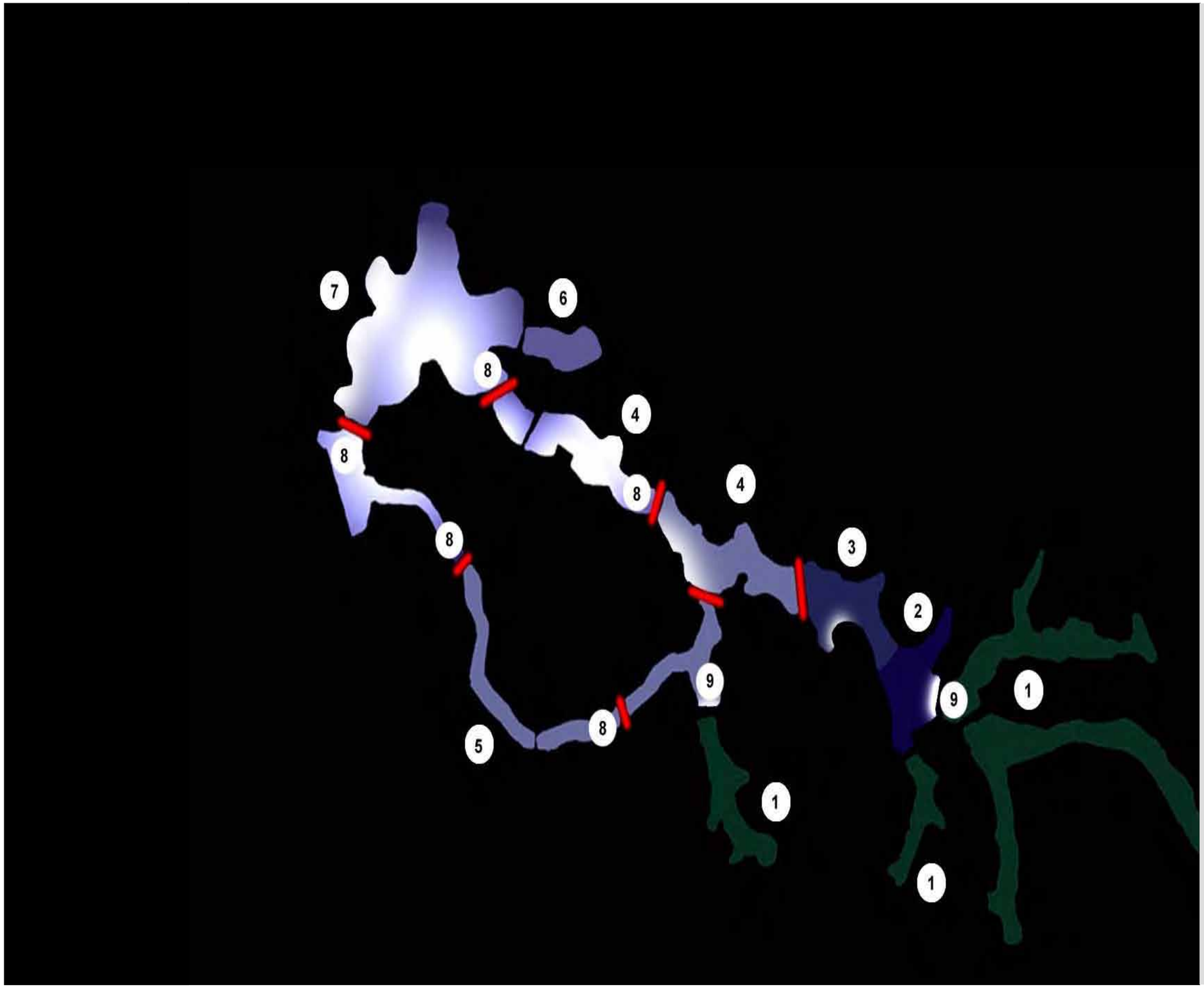
- Height of columns in existing lighting schemes (at April 2002) is 12 metres (Figure 3.3.7). This is acceptable for areas of high-rise residential building but, in future, consideration should be given to the use of 6 – 9 metre columns and increased centre-to-centre spacing in low-rise residential areas. Lighting mounting heights for luminaires located to the rear of low rise residential buildings should be lower yet, at some 4.5 metres.

- Residential building elevations should not be directly floodlit. However, consideration can be given to the creation of roof top ‘cap’ lighting features on high-rise residential buildings.

- Consideration should be given to identifying and characterising the regional ‘centres ‘ in Precincts 7, 8 and 11 through the use of a higher colour temperature and better colour rendering light source for the street lighting within the immediate area that defines the communal centre of the region. Typically such a light source will have colour-rendering index of not less than R^a 85 and a colour temperature range of 4500K to 5300K.

Recommendations:

1. ***Future residential areas to lower height of poles to 6 – 9 metres.***
2. ***Residential building elevation should not be directly floodlit.***
3. ***Regional centres should use higher colour temperature and better colour rendering light source to define communal centre.***



Water Hierarchy

1. **Sensitive Ecological Area- no lighting opportunity.**
2. **Environmental Wetlands Reserve- no lighting opportunity.**
3. **Critical Security and Privacy Area- low levels of ligting opportunity.**
4. **General Navigation Zone- medium to high levels of lighting opportunity.**
5. **General Navigation Zone- (canal area)**
   Medium levels of lighting opportunity.
6. **Passive Recreation Zone – low medium levels of lighting opportunity.**
7. **Active Recreation Zone and General Navigation Zone- high levels of lighting opportunity.**
8. **Bridges illuminated as gateways to Core Island**
9. **Weirs illuminated.**

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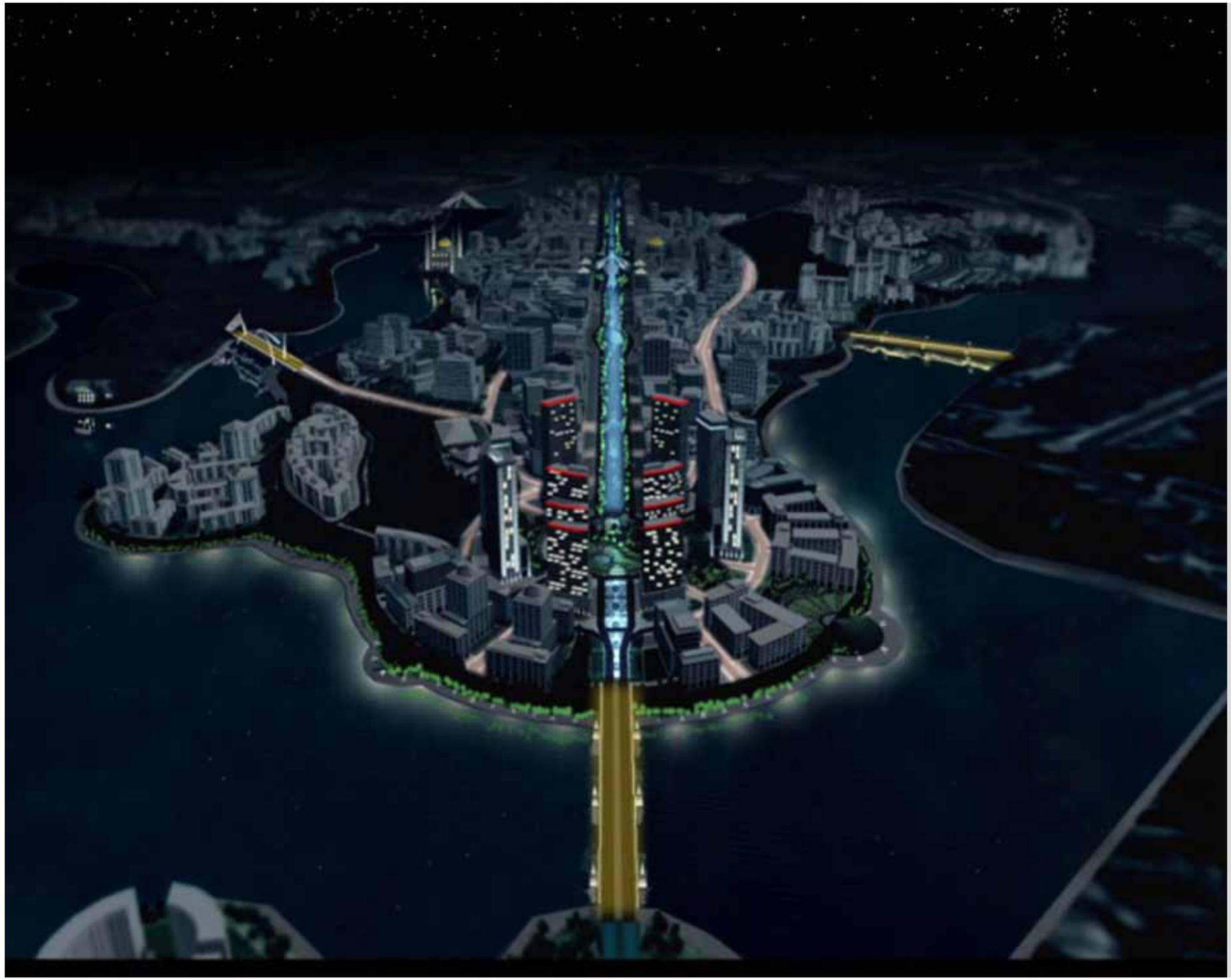
Figure 2.1.8



Aerial View of Core Island Looking North

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Figure 2.1.8

Rowing / Sailing Festival

Illuminated buoys and light strings define rowing and sailing courses for competition opening ceremonies.

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Figure 2.1.8

Water High Days / Holidays Lighting

1. Sound and light shows encouraged at waterfront areas for bigger audience visibility.
2. Bridges can introduce colour during festive periods.
3. Navigational buoys during festive periods introduce laser or beam lights.

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Figure 2.1.8

Parks Hierarchy

1 Taman Wetlands – Sensitive Ecological area. Little/ no lighting opportunity.

2. Taman Putra Perdana
Medium to high levels of illumination

3. Taman Botani
Little / No lighting opportunity

4. Core Island Central Boulevard
High levels of lighting

5. Core Island East – West Axis
Medium to high
Levels of lighting

6. Peripheral Waterfront Promenande
Medim to high levels of lighting

7. Core Island Waterfront Promenade areas
Low to Medium levels of lighting.

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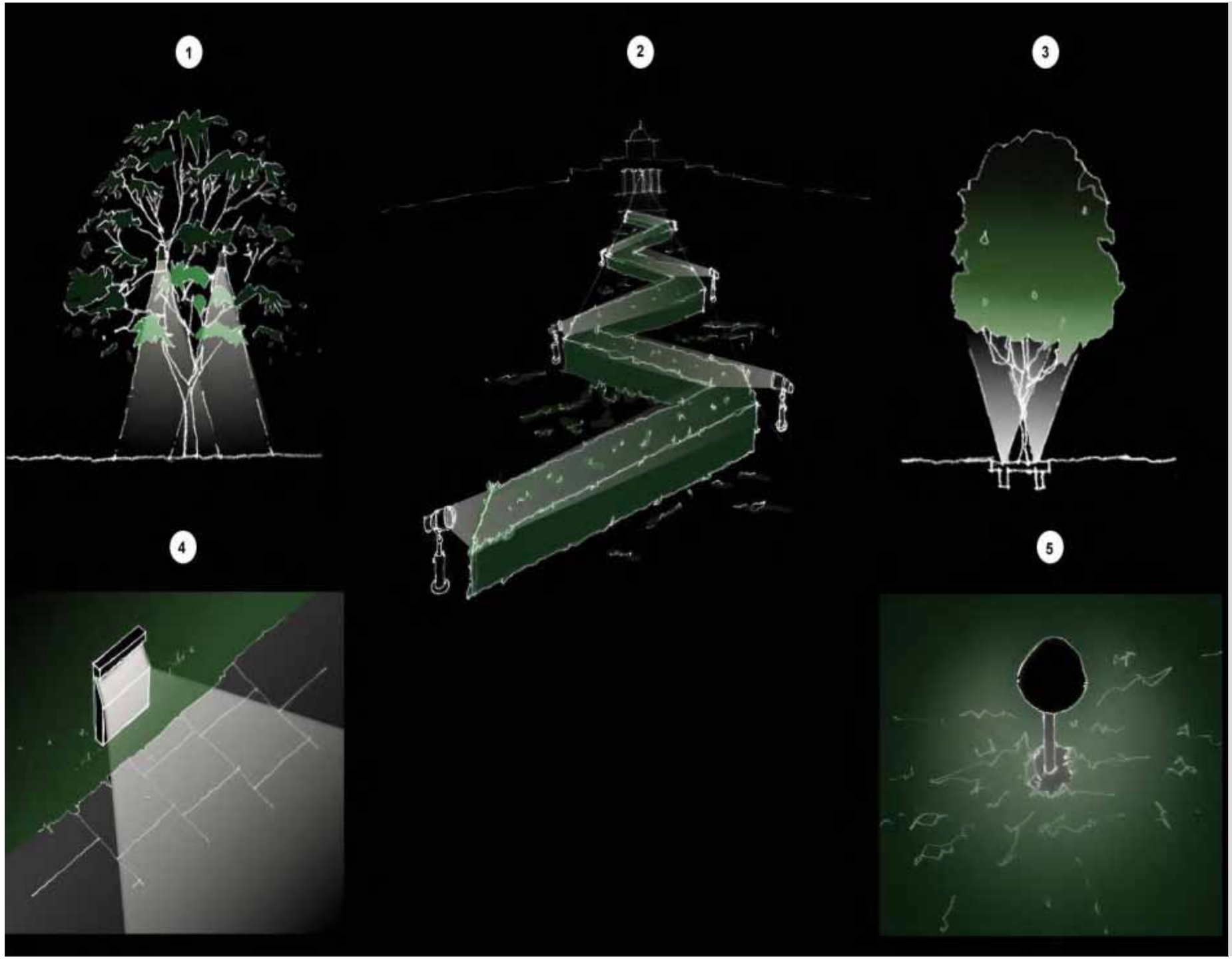
Figure 2.1.8



Parks - Soft Landscaping

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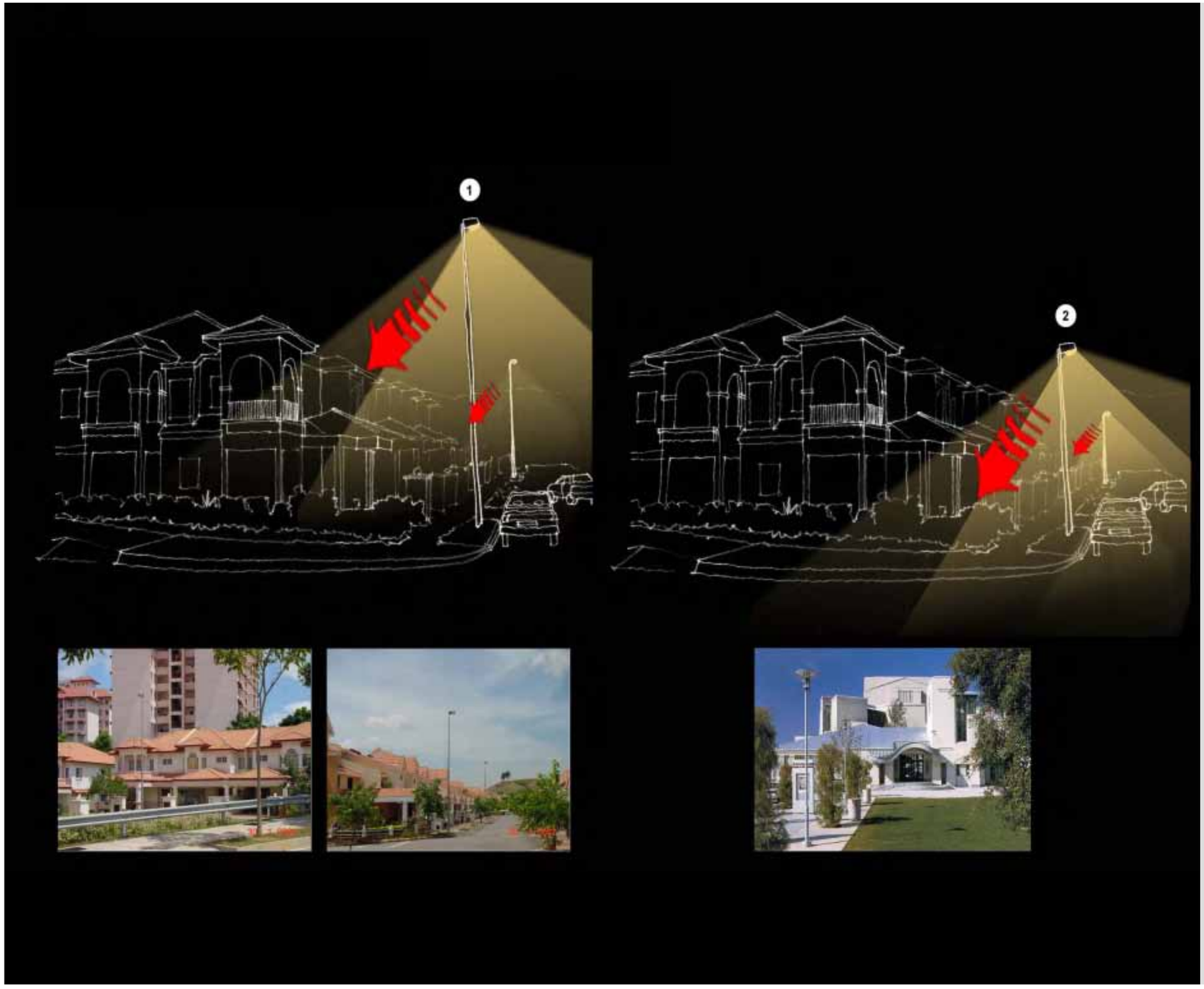
Figure 2.1.8



Residential Lighting

1. Existing Situation
   Column height 12m – stray light enters windows of low scale residential buildings. Columns out of proportion with housing, and can be seen from a distance projecting above roof line.

2. Proposed Situation
   Column height reduced between 6.0m and 9.0m. Light prevented from straying into residential buildings. Column in propotion with buildings and do not project above roof line.

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Figure 2.1.8

3.3.5 Bridges

- The bridges are considered as the gateways to the inner city. The high-pressure sodium light sources that are used to illuminate the roadways that lead to bridges from the outer city should continue to be the light source used to illuminate the vehicle deck of the bridges. Major and Minor gateways are discussed in Policy 3.

- The superstructures of the bridges should be lit with white light during normal use.

- Where possible and appropriate, coloured light should be introduced to the lighting of the superstructures to mark festive periods.

3.3.6 Diplomatic Enclave

Objectives

Security is the primary most important factor relevant to lighting Embassies. Illumination for security purposes will take priority over all other lighting issues. A second factor relates to the qualitative aspect associated with the concept of traditionalism created for this Diplomatic enclave.

Both carriageway and associated pedestrian areas that are bounded by Embassies and Residences should be lit by high colour temperature light sources with high colour rendering characteristics. Typically, such sources will increase the sense of brightness and provide better lighting conditions for visual recognition and perception of distances. Such a source is also particularly suitable for CCTV coverage that will be utilised throughout all external areas of both Embassies and Residences.

The lighting of the village area of the Diplomatic Enclave should be contrasted with the 'business' area represented by the Chanceries and Embassy buildings through the use of lighting with a lower colour temperature of 2800K to 3500K with a colour- rendering index of not less than Ra 85.

Common areas of landscaping and tree planting should be illuminated to minimise shadowing and pockets of darkness thereby further aiding the question of security.

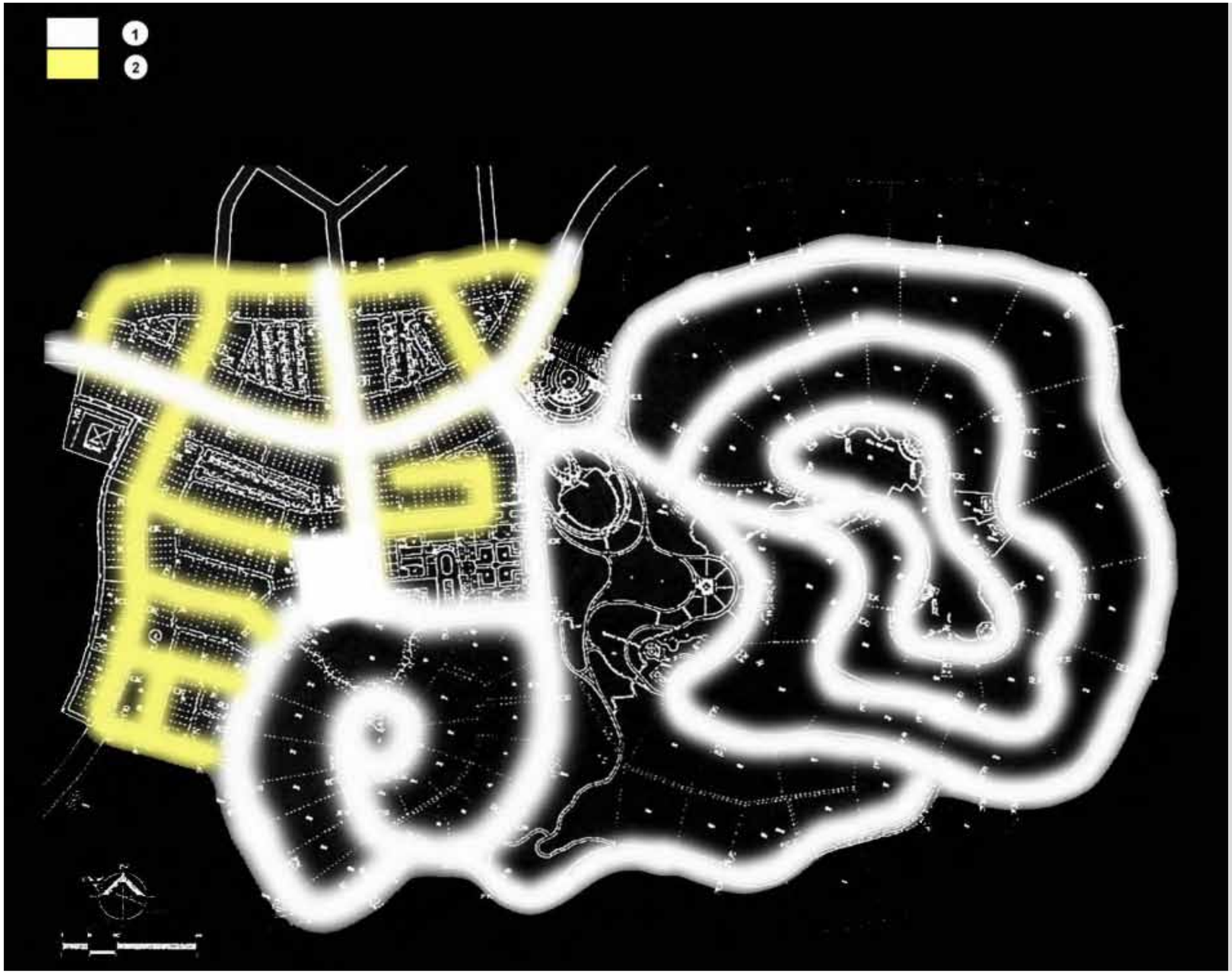
It should be presumed that it is likely that all Embassies and Residences will wish to illuminate their buildings and probably their grounds as well. It should also be presumed that such illumination will include all elevations, entrances, driveways etc. (Figure 3.3.8). High levels of illumination will be sought at areas where cars will be alighted and disembarked. It should also be assumed that there will be a requirement for functional illumination to large areas including the parking of numerous vehicles. During the planning approvals process particular attentions should be given to the avoidance of the levels of glare that indiscriminately located security and amenity lighting can frequently create.

Architectural and landscape Illumination of the both the buildings and associated grounds should be encouraged to have schemes designed which include the security and functional illumination. Such schemes should be designed to include security illumination as part of a co-ordinated lighting design approach and not as an ad hoc feature to be further added as a separate element. Appropriate design and usage of circuitry can easily accommodate this.

Recommendations:

- ***High pressure sodium maintained on the vehicle deck to Bridges***
- ***Superstructures of bridges to be lit with white light***
- ***Security is the primary most important factor relevant to the lighting of Embassies***
- ***Qualitative aspect associated with the concept of traditionalism created for the Diplomatic Enclave should be respected***
- ***Low pressure sodium light sources should not be allowed for security illumination***
- ***The town area of Diplomatic Enclave should be lit with lower colour temperature of 2800k to 3500k , <R^a85***

The use of low-pressure sodium light sources should not be allowed for security illumination. The lighting concept for the Diplomatic Enclave divides the area into two distinct sub-areas. The first is dedicated exclusively to the diplomatic enclave and the chancelleries, the other to a mixed-use centre that includes some diplomatic uses. The two street axes and the main street including the focus on the Town. Square and Visitors Centre are characterised through the use of warm metal halide light sources thereby contrasting these areas with the cooler visual quality of the Chancellery areas.



Diplomatic Enclave Streetlighting Colour Temperature Diagram

1. Good quality high colour temperature lamps within range 4500 – 5300 K with CRI Ra > 85
2. Good quality high colour temperature lamps within range 2800 – 3500 K with CRI Ra > 85

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Septamber 2002
Figure 2.1.8

3.3.7 Monorail

- The Monorail system is a unifying element that is a predominant feature within the city. A major opportunity exists to reinforce its presence by night through the use of a colour-coded form of feature lighting. This should be a two-colour system that signals and distinguishes the two lines - possibly blue and red.

- The light signals should take the form of colour LED clusters located on the concrete support pillars for the over-ground sections of the monorail and at platform locations for the underground sections. Consideration should also be given to the possibility of continuing the way-marking within the tunnel sections.

3.3.8 Non-Residential Areas

- In the non-residential areas the use of high-pressure sodium light sources is likely to continue for the foreseeable future.

- In low-rise areas it is recommended that the road and street lighting be provided from columns of 6 to 9 metre height at appropriate centres. In high-rise areas the continued use of 12 metre columns is advocated.

- Small-scale local community buildings such as markets, sports facilities and small retail outlets should be identified by night through the lighting of external elevations and features.

- Small-scale pockets of soft and hard landscape areas should be supported at night through lighting that provides character as well as amenity and security.

3.3.9 Festive Lighting

Festive lighting is the subject of either:

a) Permanently installed lighting that is switched on only during festive periods; and/or

b) Temporarily installed lighting that is specifically designed for a particular occasion.

It is proposed that some permanently installed coloured lighting be included in the design of the lighting to the elevations of the major buildings on the central Boulevard. This should be located at ground level within the colonnades that are a largely consistent feature and at high level where, again, a largely consistent feature comprises the cornices. Lighting these two elements in colour will create a high and low level visual datum that will be significantly different in character from that seen on normal days.

Further permanent additionally installed coloured lighting can be considered for Jambatan Seri Gemilang (Bridge 6) for the festive expression of its superstructure. Additionally, consideration should be given to the possibility of temporary colour filtration of aspects of the lighting to other bridges.

Other festive lighting elements could include:

a) Temporary colouration to the lighting of the roof caps of the major buildings on the central Boulevard and, possibly, to those in Precincts 1 & 5.

b) Large-scale image or pattern projection to the elevations of selected buildings on the central Boulevard.

Recommendations:

- ***The monorail system should introduce a two colour lighting system signaling the two lines using LED light sources.***
- ***In non-residential areas road and street lighting pole heights should be reduced***
- ***Permanently installed coloured lighting to be included in the design of lighting to the elevations of major buildings***

c) White light sources forming a continuous chain of 'sparkle' down the entire length of the central Boulevard through the use of clear festoon lamps hung between the main roadway lighting columns.

d) Laser projections between rooftops forming an overhead web of laser lines.

e) Colouration to the uplighting of trees that line the central Boulevard.

f) Use of the colour element designed as part of the Millennium Monument.

The lighting infrastructure required to enable the foregoing is considerable in view of the 4.2 km length of the central Boulevard. It is proposed that a detailed study be carried out that identifies:

a) The potential locations for permanently installed festive lighting within those buildings already designed and/or constructed.

b) Guidelines to those responsible for the future lighting design for the exterior of buildings for the inclusion of permanent festive lighting elements.

c) Optimum locations for specialist equipment such as laser or image projectors.

d) Costs associated with the provision and installation of festoon lighting throughout the length of the central Boulevard.

The festive lighting design should be based upon the provision of a permanently available, civically funded, base level infrastructure that is supplemented by the creative initiative associated with each major celebratory event. Repetitive festive lighting themes will quickly fade from prominence and Perbadanan Putrajaya should therefore precipitate new design on a regular basis. This could be achieved either by running a design competition (as was the case for the annual Christmas decorative lighting in Regent Street, London) or by commissioning appropriately skilled designers.

3.4 ROADS AND STREET LIGHTINGS

3.4.1 Appraisal of Existing Roads and Street Lights

- **Scope of Survey**

A survey on existing road lighting was carried out in core precincts of Putrajaya. (Appendix A) This survey analyses the quality of roads and street lights by measuring the lighting levels using an illuminance (lux) meter. The scope of survey conducted in October and November 2001 covers the measurements of lighting levels at Protocol roads within core precinct of Putrajaya, and visual inspection to identify problem areas impacting sky glow, light trespass and discomfort glare. The aesthetic impact of lighting (which include issues of colour and visual coordination) is not covered in this survey.

- **Conclusion**

From the survey the following conclusion can be drawn.

a. All existing roads and streetlights are designed to uniform colour standard using high pressure sodium lamps.
b. Most roads and streetlights are provided with lighting levels which exceed the BS and CIE recommendations (Luminance recommended by CIE 2cd/72)
c. In some cases (suburban and core island), lighting levels are high (compared to recommended levels).
d. Despite the abundance of lighting levels, light distribution and uniformity (especially at main Protocol roads) are poor. The degradation in light distribution and uniformity and inconsistency is due to the poor photometric characteristics of the luminaire where aesthetic consideration is given primacy over the technical.
e. Some problem area in discomfort glare (Dataran Putrajaya, decorative highway luminaire) and sky glow (flood lighting of PM's complex and Grand Mosque) is also identified.

Recommendations:

The survey report recommends the following:

- ***A detail comprehensive and survey of lighting level and performance to be executed by a specialist company.***
- ***Remedial work be carried out to correct non-uniform road lighting (non-uniformity of lighting luminance in Protocol Roads identified in the Survey)***
- ***Remedial works to correct quality of lights issues identified in this survey (discomfort glare and sky glow)***

3.5 LIGHTING CONTROL AND MAINTENANCE

3.5.1 Lighting Control and Maintenance

Cognisant of Policy 5, it is recommended that all external lighting to buildings, structures, landscapes, road and street lighting and any other lit elements owned and/or operated by Perbadanan Putrajaya be controlled through a centralised system. This will enable effective co-ordination of the overall lighting settings throughout a substantial number of the elements that comprise the built city. It will also enable the lighting to be programmed to respond to differing presentations of the city at night for conditions such as:

- National Day, religious holidays and other festive days
- Normal day-to-day conditions – dusk to mid evening
- Normal day-to-day conditions – late evening
- Late night to morning conditions

This network of centrally operated lighting could be known as the City Lighting Network (CLN). The owners of private buildings should be required or encouraged to include the operation of their lighting within the CLN. The justification for this proposal lies in the fact that, in the overall visual context, there is little or no distinction in the eye of the beholder of the city as to what is a publicly or privately owned building. Inclusion of all lit elements, whether private or publicly owned will enable a comprehensive and co-ordinated presentation of the city at night.

It is acknowledged that Perbadanan Putrajaya may meet with resistance from private building owners to participate in the CLN on the basis that they do not materially gain from lighting their buildings at night. In the face of such objection, PJC has two choices:

- To publicise the inclusion of external lighting, it's consistent maintenance and its operation through the CLN as a desirable and publicly spirited act that would be welcomed by PJC as a non-mandatory inclusion within a building planning submission.

- To establish a non-mandatory programme that provides financial assistance to private building owners to offset the costs of designing, installing, maintaining and operating the lighting. Such financial assistance could be offered on the basis that the completed installation must comply with the aims of the Lighting Masterplan, be maintained and be operated through the CLN. Appendix F is a brief technical discussion with some policy proposals for consideration in the implementation of the CLN.

The CLN must interface the requirements of Perbadanan's IT Network System (Putra.Net). The connectivity and integration guidelines are as follows:

a. The CLN components must support the TCP/IP transmission protocol for data transmission.
b. The CLN components must support the SN/IP management protocol for managing the components of the CLN.
c. The CLN data structure must support the ORALLE data structure and requirement for database compatibility.

The CLN must be integrated into the City Management Centre and also be integrated into the Disaster Recovery Centre.

Recommendations:

- ***All external lighting of public building, structure & landscape road and street lighting be centrally controlled by Perbadanan Putrajaya***
- ***Encourage private owners to include the operation of their lighting within the CLN***
- ***CLN to interface with Perbadanan's IT Network System Putra.Net and integrated into the City Management Centre and Disaster Recovery Centre***

3.5.2 Maintenance of Street Lights

In formulating a maintenance policy for road street and public lighting main factors complicating the issue include the wide geographical dispersion of street lights (which present logistical problems) and the perception that street lights are an essential service (in maintaining vehicular safety and pedestrian security).

Methodologies in the maintenance of street luminaire include preventive maintenance where regular and scheduled maintenance are carried out (this also include regular cleaning and the monitoring abnormal operating conditions) and non-scheduled maintenance (damage before their scheduled lifetime usually resulting from accident or vandalism). Regular maintenance of street lamps include relamping and/or changing of ancillary equipment (light switches/contactors etc) in accordance with its designed operating life and cleaning of lamp. Table 3.2 of CIE 92 shows recommended lamp cleaning intervals (see Appendix G). As shown in the table cleaning intervals is a function of IP rating, maintenance factor during design and pollution index.

Maintenance by a municipal department may involve one or all of the following method:

- Subletting part or all maintenance procedure to a private company.
- Maintaining a street lights crew, in this case the man-power allocation may be a problem, and
- The installation of a city wide monitoring and automation network for streetlights.

The CLN management system shall provide the following data but not limited to

- Location and time of lamp power failures
- Statistics on lamp lift
- Automatic generated maintenance schedules
- Lamp on and burn times
- Lamp failure
- Open lamp circuit
- Alternative switching of the lamps
- Real time mapping of the lamp layout

3.6 LIGHTING CODES AND STANDARDS

3.6.1 General Overview of Codes and Standards

- **BS and CIE Standards**

In Malaysia the design and practice of roads and streetlights generally follow British Standards (B.S.) and Codes of Practice (C.P.). The current choice for most design professionals (in roads and street lighting) is BS 5489 published in ten parts (see Appendix G for a detail of BS 5489). Standards for roads and street lightings adopted by CENELEC (the European body for harmonisation of standards) are the standards published by the '*Commission Internationale de L'Ėclairage*' (CIE or International Commission on Illumination). With the harmonisation of British Standards to European ('EN') Standards and in light of current trend towards globalisation, and Malaysia's membership and growing active participation in the Internation Standard Organisation (ISO); the ISO/CIE standards will become important. Appendix G has a listing of CIE publication relevant to roads and street lighting.

- **Local Standards**

No Malaysian codes or standards exist as yet in Malaysia. A working group under S.I.R.I.M., ISC-E ("*Industry Standard Committee – designation 'E' for electrotechnical*') is currently drafting a Malaysian Standard for roads and street lighting.

3.6.2 Regulatory Standards

- **Legal Framework**

In Malaysia, the submission of public road and street lights falls under the purview of the '*Local Council Act*' This Act in conjunction with the '*Street, Drainage and Buildings Act (1974)*' and its accompanying by-law the '*Uniform Building By-Laws (1984)*' empowers local city halls, municipal or district councils, and/or authorities having jurisdiction over public roads and street lights to regulate and approve design of roads and street lights. Submission procedures for (public) roads and street lights are usually subsumed under submission for 'Development Order' and 'Planning Approval' of the councils or authorities concerned. Other authorities/agencies having jurisdiction (and significant influence) on the design and definition of standards are the '*Jabatan Kerja Raya*' ('*JKR*' - or Public Works Department) and the '*Malaysian Highway Authority*' (MHA).

- **Submitting Professionals**

Under the purview of the '*Street, Drainage and Buildings Act (1974)*', the '*Uniform Building By-Laws (1984)*', and the relevant Act governing registration of professionals, submission of road and street lighting planning falls under the responsibility of the electrical engineer.

Legality of Standards

In Malaysia, Standards are governed by the '*Standards of Malaysia Act, 1996*'. The regulatory agency for standards is the Department of Standards Malaysia (DSM). DSM in turn has appointed SIRIM as the coordinator of standards development in Malaysia. Thus any standards adopted as a Malaysian Standards will have status as a legal document under Malaysian law. However, given the absence of a substantial body of standards and Malaysia's membership of the ISO, the relevant ISO standards may have some legal standing in lieu of any non-existing Malaysian standards.

Recommendations:

- ***It is recommended that CIE Standards be adopted by Putrajaya***
- ***The Electrical Engineer is the submitting professionals Under Street, Drainage and Building Act.***

3.6.3 Existing Procedures and Submission Standards

- General

Apart from the two agencies listed in 3.6.2 above, most local authorities in Malaysia do not have firm and written guidelines for approvals of (public) road and street lighting beyond a. delegation of professional responsibilities to the submitting person. Some municipal councils and city halls issue simple guidelines (‘*garispanduan*’) for street lighting submission. Where no guidelines are published or issued, conditions for approval are usually imposed (on an ad-hoc basis) by the district engineer responsible for the district, municipal or city roads.

- **Common Guidelines**

Some common requirement listed in the guidelines issued by most local authorities relate to simple installation standards. The last section of Appendix G has more detail description of approving guidelines and Putrajaya’s existing guidelines on approval of streetlights.

3.7 ENVIRONMENTAL AND ECOLOGICAL CONSIDERATIONS

3.7.1 Energy Efficiency Codes

- **MS 5025:2001**
  'Energy Efficiency in Buildings' (a Malaysian Standard) do not deal with street lighting However a section on general lighting in building advocate:
  a. Use of low loss ballast (this recommendation is now a law under the jurisdiction of the '*Jabatan Elektrik, Suruhanjaya Tenaga*' (Electricity Department of the Energy Commission – previously known as the *Jabatan Bekalan Elektrik Dan Gas*).
  b. Use of energy saving lamps, and
  c. Optimal lighting design based on recommended lighting (lux) levels,

- **Electricity Efficiency Regulations**
  Authored by the 'Energy Commission' these are currently in draft stage. Proposal for labelling of energy efficiency is included in these regulations but however as yet no provision is included for the inclusion of 'energy labels' for street lighting equipment.

3.7.2 Night Sky Pollution

- **Sky Glow and The International Dark Sky Association**
  In the international arena there is a growing realisation that outdoor lighting which is not well-designed (and especially over-designed) and properly installed is harmful to the night time environment. The night time skies above cities are increasing being suffused with a glow, which degrade the clarity of the stars. Due to this, observatories have to be sited increasing further from cities and even towns. It is therefore not surprising that astronomical societies are in the forefront for a growing campaign against night sky pollution. In the U.K. this is represented by the B.A.A. (British Astronomical Association) Campaign for Dark Skies and internationally 'The International Dark Sky Association' (IDA) is the forefront of against night sky pollution.

- **Issues**
  In outdoor lighting design include the following:
  – Glare is the result of poorly-designed or installed lighting which can severely hamper the vision of pedestrians, cyclists, and drivers, creating a hazard rather than increasing safety.
  – Light Trespass is the result of outdoor lighting intruding into or shining onto neighbouring properties and into bedroom windows, reducing privacy, hindering sleep, and creating an unattractive look to the area.
  – Energy Waste Over-design and/or poor outdoor lighting wastes energy due to poor light distribution or over lighting without enhancing security, safety or aesthetic consideration.

- **Sky Glow**
  Occurs where a large proportion of poor designed lighting shines directly upwards. Thereby creating the adverse sky glow above cities. Sky glow obscure our view of the dark night sky, taking away an important natural resource (the beauty if the stars). The IDA in their campaign proclaims their aim of 'bringing back the stars to our children'.

- **International Trends in Lighting Codes**
  Recognising the above, cities in the U.K. and the U.S.A. are increasing adopting codes addressing the concerns listed above. In the 'US pattern codes' (a generic code published by the IDA for the guidance of cities wishing to adopt a good Code Practice for outdoor lighting, are increasing being adapted by cities to regulate outdoor lighting.

Recommendations:

1. ***Adopting international code as a guideline.***
2. ***Ecological consideration by establishing efficient lighting.***

3.7.3 Ecological Considerations

Ecological considerations are addressed as follows:

- Efficient design including considerations of light wastage due to sky glow, light trespass etc contributes to lower energy cost, and
- In ecological enclave (e.g. Wetlands) lighting should be absent or kept to a minimum and where required (for security purpose or pedestrian safety) monochromatic lights (especially low pressure sodium) should not be used. It has been found that monochromatic light sources (LPS etc) has adverse effect on insect and avian ecology.

Environmental Mapping for Lighting Zones