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BUILDING SOUTH AFRICA THROUGH BETTER ROADS

THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED

CONTRACT SANRAL N.012-150-2021/1F

FOR

CONSULTING ENGINEERING SERVICES FOR THE INSTALLATION OF STREET LIGHTING ON NATIONAL ROUTE N12 SECTION 15 (KM 71.00 TO KM 76.30)

DRAFT DETAILED DESIGN REPORT

DATE: 04 July 2022 **Volume 1 of 1**

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kV	Kilo-Volt
SLK	Street Lighting Kiosk
MV	Medium Voltage
LV	Low Voltage
LED	Light Emitting Diode
ADT	Average Daily Traffic
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
MH	Mounting Height
CoM	City of Matlosana
ECMS	Electronic Central Management System

1 INTRODUCTION

1.1 Terms of reference

DNA Consulting Engineers & Project Managers was appointed by SANRAL SOC Ltd as Electrical Engineers to undertake the Electrical Engineering Services for the provision of professional electrical engineering consulting services for the installation of street lighting on National Route N12 Section 15 (KM 71.00 to KM 76.30). A Preliminary Design Report was issued and approved in June 2022. This report provides details of the Detailed Design for the section of works.

1.2 Project description

The N12 section is a national route that is located in the North-West Province within the Matlosana Municipality in Klerksdorp. On the N12 roadway, the scope of the upgrade works includes the design and installation of new roadway lighting and lighting equipment for a 5.3km section. The electrical scope of works as detailed in the contract document is for the installation of new energy efficient lighting infrastructure for the SANRAL National Route.

The Services required are divided into the following distinct stages:

- Project Assessment
- Investigations for Design Development
- Design Development shall include the following phases:
  - Concept
  - Preliminary
  - Detailed design
- Tender Documentation
- Clarification Meeting, Tender Period and Tender Evaluation
- Administration and Monitoring of the Works Contract
- Additional duties, Special Services and Specialist Advice
- Quality Control: Works Contract
- Close Out

This report provides information described at the “Detailed Design” stage and incorporates the Preliminary Design elements proposed, and site discussions with the SANRAL Project Manager and City of Matlosana Electricity Department officials.

It is envisaged that street lights and its associated infrastructure shall be planned to be installed between N12 section 15 KM 71.00 to N12 section 15 KM 76.30 as noted below:

- The lighting is to be installed for the full 5.3km of N12 section.
- Lighting of the intersections to be incorporated.
- Pedestrian Sidewalk Lighting to be incorporated.

- Lighting of the following areas to be considered:
  - High accident areas,
  - High risk pedestrian and traffic areas,
  - High risk intersections.
- Lighting control to be incorporated.
- Anti-vandal techniques / equipment to be incorporated.
- Security systems for the electrical infrastructure to be considered.

The project assessment investigations of the existing electrical infrastructure along the proposed upgrade of National Route N12 Section 15 from KM 71.00 to KM 76.30 are included in the scope of this report, as depicted in figure 1.

Figure 1: Portion of N12 section 15 from KM 71.00 to KM 76.30

1.3 Scope of Detailed Design

The scope of the detailed design is “To supply & install roadway lighting and its associated infrastructure along National Route N12 Section 15 between KM 71.00 to KM 76.30”. This report will present the detailed design for the roadway lighting, the necessary lighting infrastructure, as well as the lighting management and security systems.

2 EXISTING ELECTRICAL INFRASTRUCTURE

2.1 Electrical Infrastructure

From the site audit conducted and engagement with the current N12 routine road maintenance (RRM) team, it has been established that City of Matlosana Electricity are the supply authority within the scope of works. City of Matlosana Electricity have several distribution lines that run parallel to the road reserve of the proposed upgrade along the N12 section. The distribution of electricity in the

project area is via a few 11 kV & 22 kV overhead line networks distributed along the area of the proposed N12 section upgrade.

2.2 Telecommunications Infrastructure

From the site audit conducted, it was found that there are telecommunications infrastructure located within the proposed upgrade area. One (1) telecommunication cell tower was recorded. The existing RRM team advised that there is fibre network along the route, but the service provider is unknown at this stage.

2.3 Road Markers

The section of road between N12 (KM 71.00) to N12 (KM 76.30) was inspected for road markers to confirm the correct area where lighting infrastructure and lighting is to be installed. It was found that the N12 route has missing road markers, and only has a few road markers that are in a fair condition on the N12 section.

2.4 N12 Roadway lanes

The section of road between N12 (KM 71.00) to N12 (KM 76.30) is situated between Wolmaransstad and Klerksdorp. The roadway is predominantly a single carriageway, with 2 lanes and 2 x 0.6m shoulder lanes on the outer edges of the road. However, on some sections of the roadway, the road extends to:

- a single carriageway with 4 lanes and 2 x 0.6m shoulder lanes,
- a dual carriageway with 2 lanes with 2 x 0.6m outer shoulder lanes separated by a 13m wide median that spans approximately 250m long.

The vast majority of the roadway does not have any kerbs. The roadway has a speed limit of 100km/hr, which drops to 80km/hr and then 60km/hr as you approach the intersections, tee-junction or traffic circle. The road was upgraded in 2019 and appears to be in good condition.

3 REGULATORY AND STATUTORY REQUIREMENTS

In order to meet the regulatory and statutory requirements, the following codes and standards were applied when developing the detailed design solutions presented in this report:

- SANS 10142-1: The wiring of premises – Low-voltage installations
- SANS 10098-1: Public Lighting – The lighting of public thoroughfares
- SANS 10098-2: Public Lighting – The lighting of certain specific areas of streets and highways
- Occupational Health and Safety Act 85 of 1993

4 REFERENCE DOCUMENTS & DRAWINGS

For the purpose of this detailed design report, the following reference documents, drawings and information was used:

- N12 section 15 KM 71.00 to KM 76.30 edge of road setting out drawings
- 2019 traffic data received from SANRAL for the N12 roadway section
- SANRAL electrical specifications and minimum standards
- Preliminary Design Report, and subsequent site discussions with the SANRAL Project Manager

5 DESIGN CRITERIA

In the concept and detailed design stages of this project, a few design criteria have been finalized and was integrated into the detailed design solutions presented in this report. These design criteria are expanded below:

5.1 Main Incoming Power Supply

The selected supply voltage for this project is 400V, 3-phase. Multiple main incoming supply points will be required and supply applications will be made for each required supply point.

5.2 Cabling

Low-voltage aluminium cables will be used for this project due to its lower theft risk and its cost effectiveness when compared to copper cables with the same cross-sectional area.

5.3 Pole type

It was agreed to utilize a combination of scissor masts and high masts for this project due to its lower risk of vandalism and ease of maintenance of light fixtures (post installation).

5.4 Lighting technology

LED lighting technology will be used for this project due to its higher efficiency and longer service life; and to conform with national and international industry trends. Also, light fittings will be specified with LMS control capabilities, i.e. the fittings will have a built-in 7 pin NEMA socket & LED Drivers will be capable of being controlled.

5.5 Intersection Lighting

For intersection lighting, a combination of street lights on 20m scissor masts and 30m high mast lighting will be used for this project.

5.6 Lighting Arrangement

The lighting arrangement that will be predominantly used for this project will be single row as shown in the figure below. This lighting arrangement is suitable due to the width of the roadway lanes and due to the cost effectiveness of this lighting arrangement.

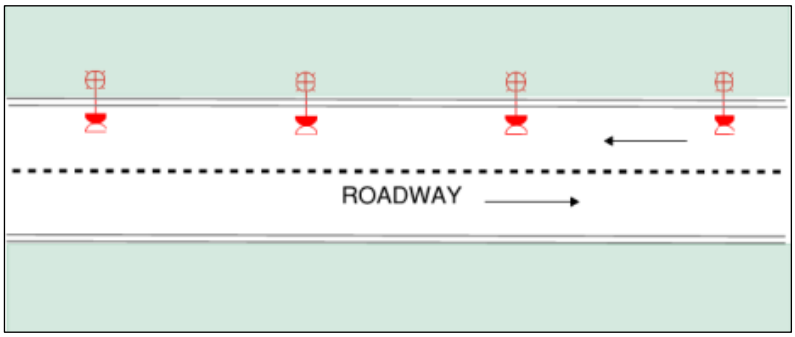


Figure 2: Typical single row lighting arrangement

5.7 Anti-vandal elements

This project will include the installation of anti-vandal lighting infrastructure with electronic mechanisms that will be integrated to SANRAL's Electronic Central Management System (ECMS). Anti-vandal poles and kiosks will be used in this project, as well as anti-theft strategies for the cables.

5.8 Electronic Security and Lighting Management System

The full lighting installation is designed as an anti-vandal system with full electronic security and a Lighting Management System. The electronic security system is a full security system that reports automatically via GSM to the central security system housed at a security company control centre or SANRAL Traffic Control Centre.

In terms of Lighting Management System control, the wireless mesh network method will be used for this project. This is due to the fewer point-to-point failures and success with this type of control on previous similar projects. Equipment such as light fittings & kiosks will be designed to fully utilise this technology.

5.9 Traffic Information and Analysis

The latest traffic data available at the time of compiling this report was the 2019 traffic information for the Wolmaransstad North station. For the data provided, the following information was extracted:

- The average daily traffic (ADT) for the roadway is 2340 vehicles.
- The percentage of night traffic (20h00 – 06h00) is 19.4%. Therefore the average night traffic is calculated to be 454 vehicles.
- The average number of vehicles per hour per lane at night is calculated to be 46 vehicles.

However, the peak number of vehicles per hour per lane at night is unknown. To accommodate this unknown peak traffic volume, the parameters selected are of a group A roadway with a higher traffic volume category to the roadway night traffic volume calculated.

The lighting of the N12 roadway will be over-designed as recommended by the SANRAL project team. Therefore the highest road lighting parameters for a group A1 will be used for the N12 roadway.

5.10 Sleeves at road crossings

For the road crossings, the pipe-jacking method will be the utilized as opposed to cutting of the road. 110mm sleeves will be pipe-jacked for the relevant cables.

6 DETAILED DESIGN

The design components for this project are listed below:

- Electrical Distribution System,
- Lighting Infrastructure,
- Control System,
- Security System.

6.1 Electrical Distribution System

The following components will be discussed further under this section:

- Main Incoming Power Supply
- Kiosks
- Cabling and reticulation
- Manholes, Plinths, Ducts & Sleeves at Road Crossings

6.1.1 Main Incoming Power Supply

The supply voltage is 400V, as per discussions with the Matlosana Electricity Department. The three-phase, 400V supplies are the most convenient and easily attainable supply option for the site. The proposed power supplies are to comply with the City of Matlosana Municipality requirements and specifications. No MV supplies and equipment are required in conjunction with the LV supply proposed.

The size of the power supplies is based on detailed load calculations. From the load schedules developed, three 80A, 400V, 10kA supplies are required and will feed directly to the street lighting kiosks. The locations for the kiosks are detailed in the table below:

Table 1: Details of supply kiosks

Supply	Location Description	KM Marker	Coordinates
SLK-01	Phuduhudu Street Traffic Circle	KM 71.90	-26.880769, 26.565813
SLK-02	Phuthaditshaba Street Intersection	KM 73.70	-26.877445, 26.582814
SLK-03	Near the existing rail bridge	KM 75.50	-26.874011, 26.600517

The following electrical mechanisms will be implemented (at a minimum) in the power supply locations described above:

- 400V Distribution Kiosk
- Metering Unit
- Anti-vandal enclosure (detailed later in report)
- Early detection security system (detailed later in report)

City of Matlosana Electricity Planning Department have been made aware of the proposed upgrades and are willing to assist with the applications for the new supplies required for the upgrade. Officials from the electrical department stated that in order for them to recommend the nearest supply, GPS coordinates for the new supply points must be provided. The cable link between the municipal supply and the Street Lighting Kiosk as well as the associated costs must be accommodated in the project budget. The electricity department officials advised that it would be ideal if the municipal power meters were included in our project budgets and a reimbursement plan will be discussed with SANRAL at a later stage. Applications for the power supplies will be made after detailed designs are approved.

Detailed design drawings will also be submitted to the City of Matlosana Electricity Department for acceptance and to ensure compliance with CoM Municipal specifications and regulations. Figure 3 – 5 below shows the electrical single line diagram (SLD) developed for this project (three supplies).

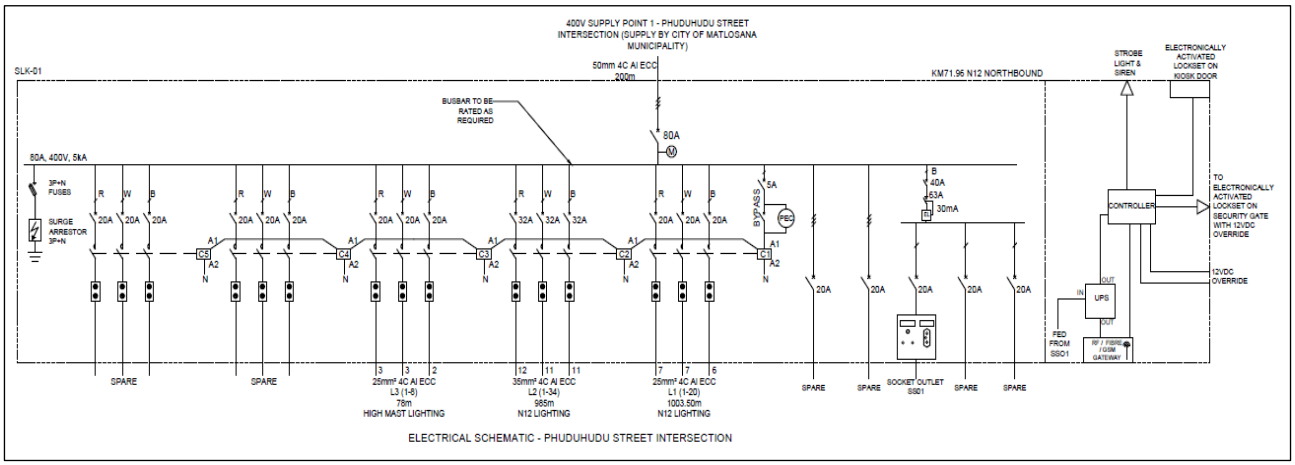


Figure 3: SLK-01 – Phuduhudu Traffic Circle Kiosk

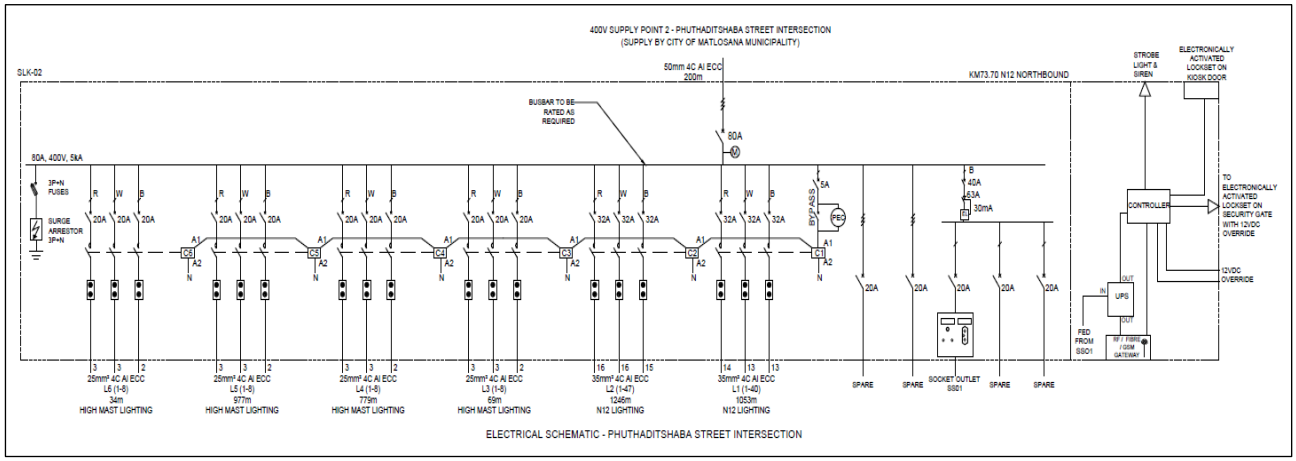


Figure 4: SLK-02 – Phuthaditshaba Street Intersection Kiosk

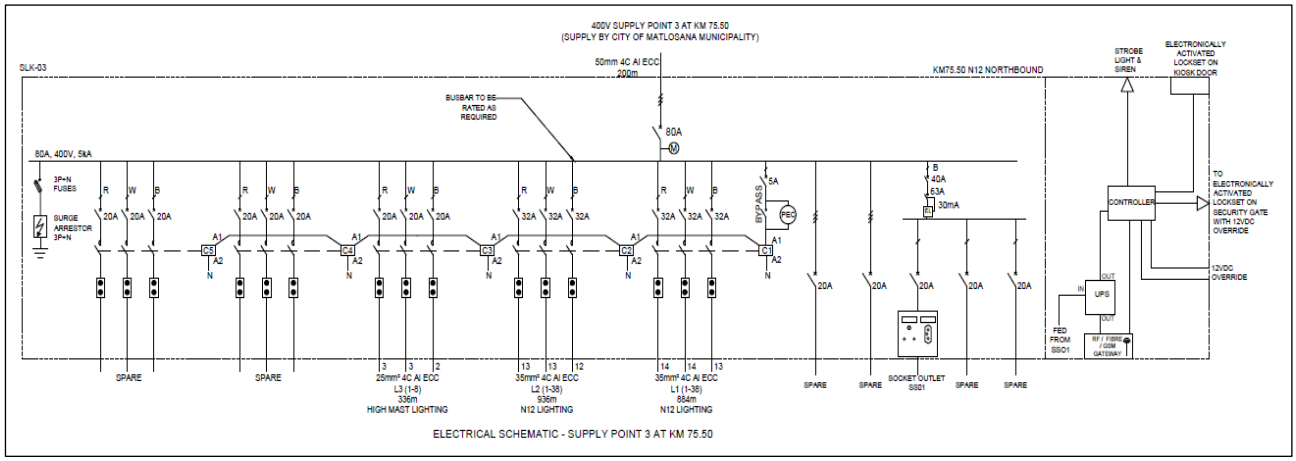


Figure 5: SLK-03 – Street Lighting Kiosk at KM 75.50

6.1.2 Distribution / Street Lighting Kiosks

As described above, Street Lighting Kiosks will be installed along the N12 roadway at the pre-determined locations. These kiosks are intended to be anti-vandal with electronic security and to provide the lighting installation with the necessary distribution nodes. The anti-vandal kiosks are to be constructed from 3CR12 steel. All low voltage kiosks are to comply with SANRAL specifications and requirements.

Each street lighting kiosk will include the following electrical equipment / mechanisms (at a minimum):

- An on-load main circuit breaker,
- Surge arrestors,
- Circuit breaker and contactor for each street lighting circuit,
- Spare street lighting circuit breakers,
- Earthing and bonding equipment,
- Electronic security.

Figures 6 and 7 below show the proposed typical anti-vandal kiosk with electronic security.

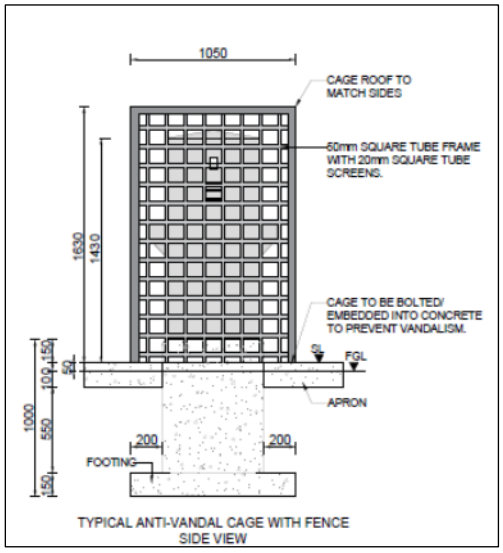


Figure 6: Typical anti-vandal kiosk

Figure 7: Kiosk in security cage

6.1.3 Method of LV Reticulation

The method of power reticulation for the roadway lighting will be by means of 400V PVC/PVC/SWA/PVC Low Voltage (LV) underground aluminium cables. These LV cables will be installed directly in ground along the outer edges as detailed in SANRAL typical drawings. The cables will be installed in a concrete encasement as an anti-theft strategy implemented for this project. The cables will be sheathed in chicken mesh with a 300mm wide x 200mm thick concrete encase ment. The concrete mix must have a minimum tensile strength of 20 MPa. Danger tape will be installed in the trench above the concrete encased cable.

Figure 8 below shows a typical 400V Aluminium Cable. Figure 9 below shows a typical concrete encased cable in a trench.

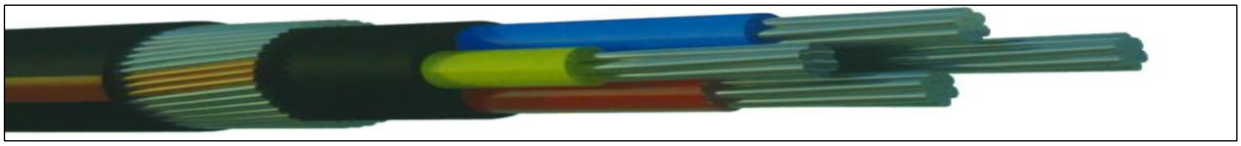


Figure 8: 400V PVC/PVC/SWA/PVC Low Voltage Underground Cable (Aluminium)

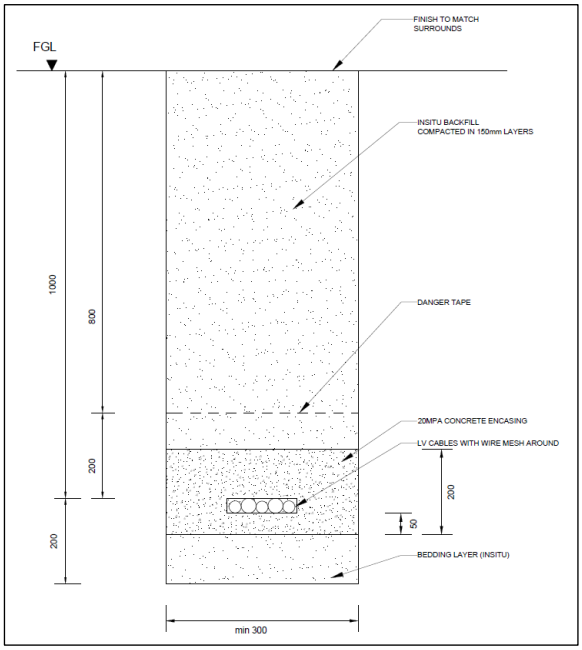


Figure 9: Typical trench detail with concrete encased cables

6.1.4 Poles / Masts

On the N12 roadway, 20m scissor masts will be used for street lighting. Wherever practicable, 30m high masts will be deployed. Double spigot 20m scissor masts will be utilised wherever there is a sidewalk on the side of the road that leads to Johannesburg; and for the section of roadway that requires median lighting. Single spigot scissor masts will be used on the roadway where there are no sidewalk present.

At intersections and at the pedestrian overhead bridge, 30m high mast lighting will be utilised. Each high mast will have eight luminaires. The scissor mast and high mast will be installed on concrete bases and each mast will have an access hatch, 5 Amp circuit breaker, and earthing and lightning protection equipment.

Both the scissor mast and high mast will have anti-vandal and electronic security mechanisms installed on them. These include anti-vandal bolts, latches and tamper-proof elevated access hatches.

Figures 10 and 11 depict a vandal-resistant 20m scissor mast and a 30m high mast, respectively

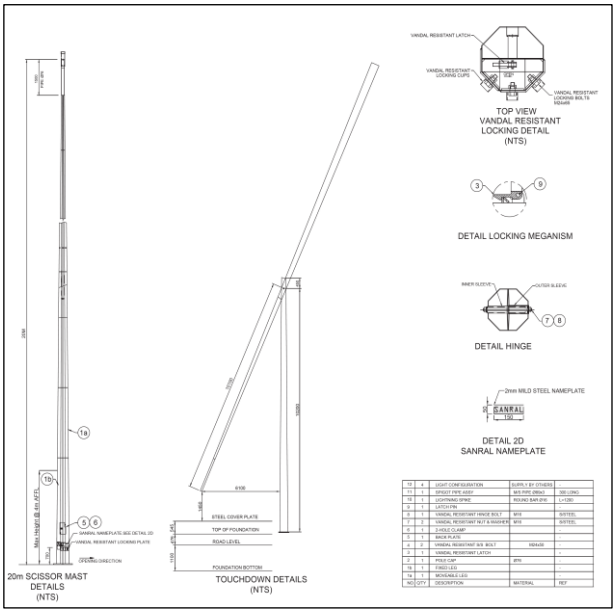


Figure 10: Typical 20m Scissor Mast

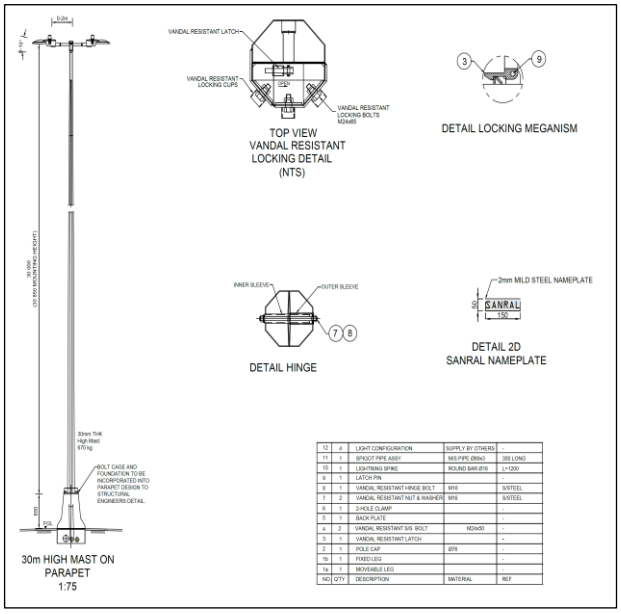


Figure 11: Typical 30m High Mast

6.1.5 Manholes, Plinths, Ducts & Sleeves at Road Crossings

Manholes are not necessary because the entire installation will be low voltage (400V), and the cables will be buried directly in the ground.

All kiosks will be installed on concrete plinths. The plinths will be designed and adequately rated to support the equipment's weight.

110mm High-density Polyethylene (HDPE) corrugated sleeves at road crossings will be installed. Each road cross will have a minimum of 4 x 110mm sleeves installed. The method of installing the sleeves across the roadway will be pipe-jacking. The pipe-jacking procedure will adhere to all relevant COTO standard specifications. Figure 12 below depicts a typical detail of sleeves at road crossings.

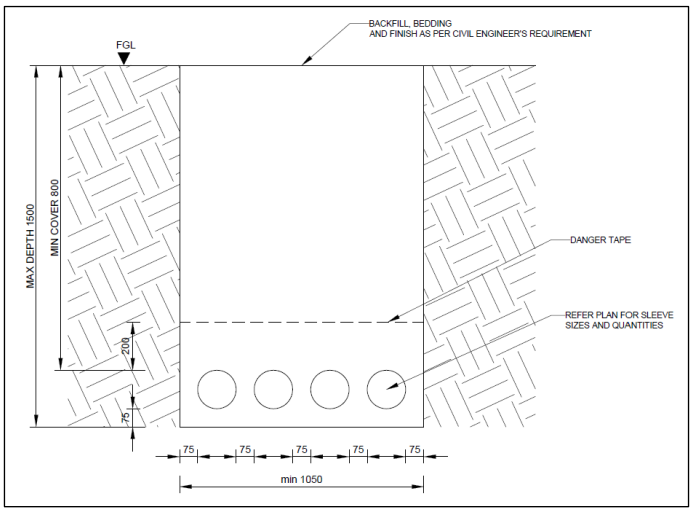


Figure 12: Typical detail of sleeves at road crossing

6.2 Lighting Infrastructure

The following components will be discussed further under this section:

- Roadway lighting on the N12
- Roadway lighting at the intersections, tee-junction, and traffic circle
- Pedestrian sidewalk lighting
- Simulation Study

6.2.1 Roadway lighting on the N12

As mentioned previously, the road classification and the lighting requirements selected for the N12 Roadway is the highest category for a group A1 road. The table below summarises the minimum lighting requirements for the highest group A1 road as extracted from Table 1 in SANS 10098-1.

Table 2: Road Class A1 with maximum traffic volume of >600 vehicles per hour per lane at night

L_n [cd/m²]	U_0	U_L	TI [%]
≥ 2	≥ 0.40	≥ 0.70	≤ 15

Where: **L_n** is the minimum average luminance
U_0 is the overall luminance uniformity
U_L is the longitudinal luminance uniformity
TI is the threshold increment

For the N12 roadway, there are two roadway lane layouts that exist on site. These roadway lane layouts are:

- Single Carriageway with 2 Lanes, and 2 shoulders
- Single Carriageway with 4 Lanes, and 2 shoulders

6.2.2 Lighting of Intersections, Tee-Junction and Traffic Circle without Median

The table below shows the minimum required lighting levels associated with the A3 roadway without median and with speed limits not exceeding 60km/h, with a maximum traffic volume during darkness of 300 vehicles per hour per lane.

Table 3: Road Class A3 with maximum traffic volume of 300 vehicles per hour per lane at night

L_n [cd/m²]	U_0	U_L	TI [%]
≥ 0.60	≥ 0.40	≥ 0.50	≤ 20

Where: **L_n** is the minimum average luminance
U_0 is the overall luminance uniformity
U_L is the longitudinal luminance uniformity
TI is the threshold increment

For the Lighting of Intersections, Tee-Junctions and Traffic Circles without Median, there is one roadway lane layout that exists on site. This roadway lane layout is:

- Single Carriageway with 4 Lanes, and 2 shoulders

6.2.3 Lighting of Intersections, Tee-Junction and Traffic Circle with Median

The table below shows the minimum required lighting levels associated with the A3 roadway with median and with speed limits not exceeding 60km/h, with a maximum traffic volume during darkness of 600 vehicles per hour per lane.

Table 4: Road Class A3 with maximum traffic volume of 600 vehicles per hour per lane at night

L_n [cd/m²]	U_0	U_L	TI [%]
≥ 0.80	≥ 0.40	≥ 0.50	≤ 20

Where: **L_n** is the minimum average luminance
U_0 is the overall luminance uniformity
U_L is the longitudinal luminance uniformity
TI is the threshold increment

For the Lighting of Intersections, Tee-Junctions and Traffic Circles with Median, there is one roadway lane layout that exist on site and will be simulated in the subsections below. This roadway lane layout is:

- Dual Carriageway with 2 Lanes, and 2 shoulders

6.2.4 Pedestrian Sidewalk Lighting along Roadway

There is a pedestrian sidewalk on both sides of the road for a large section of the roadway that is to be upgraded. Therefore, lighting of these sidewalks will be implemented. The utilisation of double spigot light poles will provide lighting for the road as well as the pedestrian sidewalk. The width of the sidewalk is 3.5m.

The recommended illuminance levels are represented for five different classes of pedestrian sidewalks, where the selection of class depends on the level of crime risk, whether facial recognition is required, the difficulty of the navigational task, the volume of traffic flow for pedestrians and the ambient brightness levels. Table 5 below illustrates the selection of classes for pedestrian sidewalks. Table 6 shows the minimum illuminance levels for pedestrian sidewalks for various classes.

Table 5: Selection of classes for pedestrian sidewalks

1	2	3	4	5	6	7	8	9
Crime risk	**Facial recognition**	**Navigational task**	**Traffic flow pedestrians**					
			High			**Normal**		
			Ambient brightness			**Ambient brightness**		
			High	Medium	Low	High	Medium	Low
			Class					
High	Necessary	High	0	0	1	1	1	2
		Normal	1	1	1	2	2	3
		High	1	2	2	2	3	3
		Normal	1	2	2	2	3	4
Normal	Unnecessary	High	2	2	3	3	4	4
		Normal	2	3	3	4	5	5

Table 6: Recommended illuminance levels for pedestrian sidewalks

1	2	3
Class	**Horizontal illuminance** lx	
	E_{ave} (minimum maintained)	**E_{min} (minimum)**
0	50	0,4
1	30	0,4
2	20	0,4
3	15	0,4
4	10	0,4
5	7,5	0,4

From table 5 above, the following parameters were used to determine the illumination class for this project.

Crime Risk: Normal
Facial Recognition: Unnecessary
Navigational Task: Normal
Pedestrian Traffic Flow: Normal
Ambient Brightness: Medium

From the information above, it can be deduced that the illuminance class is 5. From table 6, the minimum illuminance levels for a pedestrian sidewalk are extracted and is shown in table 7 below.

Table 7: Minimum illuminance levels for pedestrian sidewalk of class 5

E_{ave} [lx]	E_{min} [lx]
7.5	0.4

6.2.5 Simulation Study

The simulation data reported in the Preliminary Design Report was revised and further investigated. The roadway design criteria were amended, and some design parameters were fixed. The fixed parameters include pole spacing, mounting height, and light overhang as opposed to specifying fixed luminaire wattages or lumen output.

Table 8 summarizes the updated design criteria developed for the roadway lighting system, along with the roadway descriptions and fixed parameters set for each road carriageway layout.
Table 9 details the requirements and minimum specifications for the luminaires proposed for this project.

Table 8: Schedule of Simulations

DESIGN CRITERIA																
Maintenance factor of 0.9 (maximum) shall be used in all lighting simulations **N12 Roadway:** Road Class A1 (>90km/h), Without Median, Maximum traffic volume of >600 vehicles per hour per lane at night **Intersections, tee-junctions, traffic circles:** Road Class A3 (≤ 60km/h), Without Median, Maximum traffic volume of 300 vehicles per hour per lane at night **Intersections, tee-junctions, traffic circles:** Road Class A3 (≤ 60km/h), With Median, Maximum traffic volume of 600 vehicles per hour per lane at night															
Simulation #	**Luminaire Type**	**Description**	**Carriageway Type**	**Roadway Width [m]**	**Number of Lanes**	**Median Width [m]**	**Shoulder Width [m]**	**Pole Spacing [m]**	**Pole Mounting Height [m]**	**Spigot Length [m]**	**Number of Light fittings per pole**	**Maximum Spigot Rake Angle [°]**	**Lighting Arrangement**	**Distance from Edge of Roadway [m]**	**SANS 10098 min. lighting requirements for roadway**	**SANS 10098 min. lighting requirements for sidewalk**
1	LED	N12 Roadway	Single Carriageway, 2 Lanes, 2 x shoulders	7.4	2	0	2 x 0.6m	45	20	2	2	15	Single Row	3	A1a: Ln ≥ 2 Uo ≥ 0.4 UL ≥ 0.7 TI ≤ 15	Class 5: Eave ≥ 7.5 lx Emin ≥ 0.4 lx
2	LED	N12 Roadway	Single Carriageway, 4 Lanes, 2 x shoulders	14.8	4	0	2 x 0.6m	35	20	2	2	15	Single Row	3	A1a: Ln ≥ 2 Uo ≥ 0.4 UL ≥ 0.7 TI ≤ 15	Class 5: Eave ≥ 7.5 lx Emin ≥ 0.4 lx
3	LED	Approaching intersections, tee-junctions, traffic circle	Single Carriageway, 4 Lanes, 2 x shoulders	14.8	4	0	2 x 0.6m	60	20	2	2	15	Single Row	3	A3b: Ln ≥ 0.6 Uo ≥ 0.4 UL ≥ 0.5 TI ≤ 20	Class 5: Eave ≥ 7.5 lx Emin ≥ 0.4 lx
4	LED	Approaching intersections, tee-junctions, traffic circle	Dual Carriageway, 2 Lanes, 2 x shoulders	14.8	4	13	2 x 0.6m	60	20	2	2	15	On Median	6.5	A3e: Ln ≥ 0.8 Uo ≥ 0.4 UL ≥ 0.5 TI ≤ 20	Class 5: Eave ≥ 7.5 lx Emin ≥ 0.4 lx

Table 9: Table of Luminaire Minimum Specification

No.	Requirements	Minimum requirements
1	Luminaire Type	LED Street light
2	Performance Requirements	• CIE 121, The photometry and goniophotometry of luminaires. • SANS 9227/ISO 9227:2007, Corrosion tests in artificial atmospheres – Salt spray tests. Amdt 2 • SANS 10098-1, Public lighting – Part 1: The lighting of public thoroughfares. • SANS 10098-2, Public lighting – Part 2: The lighting of certain specific areas of streets and highways. • SANS 60529/IEC 60529, Degrees of protection provided by enclosures (IP Code). • SANS 60598-1/IEC 60598-1, Luminaires – Part 1: General requirements and tests. • SANS 60598-2-1/IEC 60598-2-1, Luminaires – Part 2: Particular requirements – Section 1: Fixed general-purpose luminaires. • SANS 60598-2-3/IEC 60598-2-3, Luminaires – Part 2-3: Particular requirements – Luminaires for road and street lighting.
3	Luminaire efficacy	>120 lumens/watt
4	Colour Temperature	CCT maximum 4000K Neutral White CRI≥70
5	LED Engine	Modular
6	LED Driver Current	350mA to 1A (maximum)
7	LMS compatibility	Dimming 1 - 10V (flicker and noise free form 10 - 100%) Luminaires fitted with NEMA/ANSI C136.41 compliant 7-pin socket
8	Operating Voltage	205-255VAC
9	Frequency	50Hz
10	Electrical class	Class I (SANS 62262)
11	Power Factor	>0.9
12	Harmonic Distortion	THD shall not exceed 5% of the supply voltage and no single harmonic shall exceed 3%.
13	Surge Arrestor	Nominal discharge current: 10kA Voltage protection level: 10kV Response time: ≤25nS Luminaire cut-out
14	Lifetime at 25^{o}C	>50 000 hrs (lumen depreciation not more than 30% - L70)
15	Operating Temperature	-10 ^{o}C to +45 ^{o}C No external part of luminaire shall exceed temperature of 70^{o}C during or after operation
16	Thermal Management	Optimal external heat exchange surface Temperature sensor and cut out to prevent overheating

No.	Requirements	Minimum requirements
17	IP Rating: Control gear compartment Optical compartment	IP66 certified (SANS 60598)
18	Housing	Weather and corrosion proof. Marine grade die cast aluminium alloy grade AC-44300 or better in accordance with DIN EN 1706
19	Front Protector	Heat and Impact resistant. High impact clear glass, with sealed joint in housing
20	Impact resistance	Per SANS 62262 >IK 08
21	Screw, bolts and metal parts	Stainless steel S316
22	NEMA Socket	NEMA/ANSI C136.41 compliant 7-pin socket
23	Finish	Unpainted Aluminium

6.3 Control System

The control system is to be compliant to SANRAL's latest requirements and specifications and to comprise of luminaire controllers and/or zone controllers with communicating devices to switch, dim and monitor lighting levels and events remotely. It is to be noted that all wireless communicating devices are to be ICASA approved.

The following components will be discussed further under this section:

- Lighting Management system
- Integration to SANRAL ECMS

6.3.1 Lighting Management System (LMS)

The lighting management system will control the lighting within the project limits. The lighting management system will be compliant to SANRAL requirements. The installed lighting management system will tie-in to the existing SANRAL Electronic Central Management System (ECMS).

The ECMS can perform several overview, monitoring and control functions, *inter alia*:

- Real-time control
- Equipment failure reporting
- Energy consumption monitoring
- Equipment inventory
- Equipment failure analysis
- Event scheduling
- Work Orders generation

A basic topology of the typical LMS system is depicted in figure 13 below. The LMS System will consist of the shown components at a minimum.

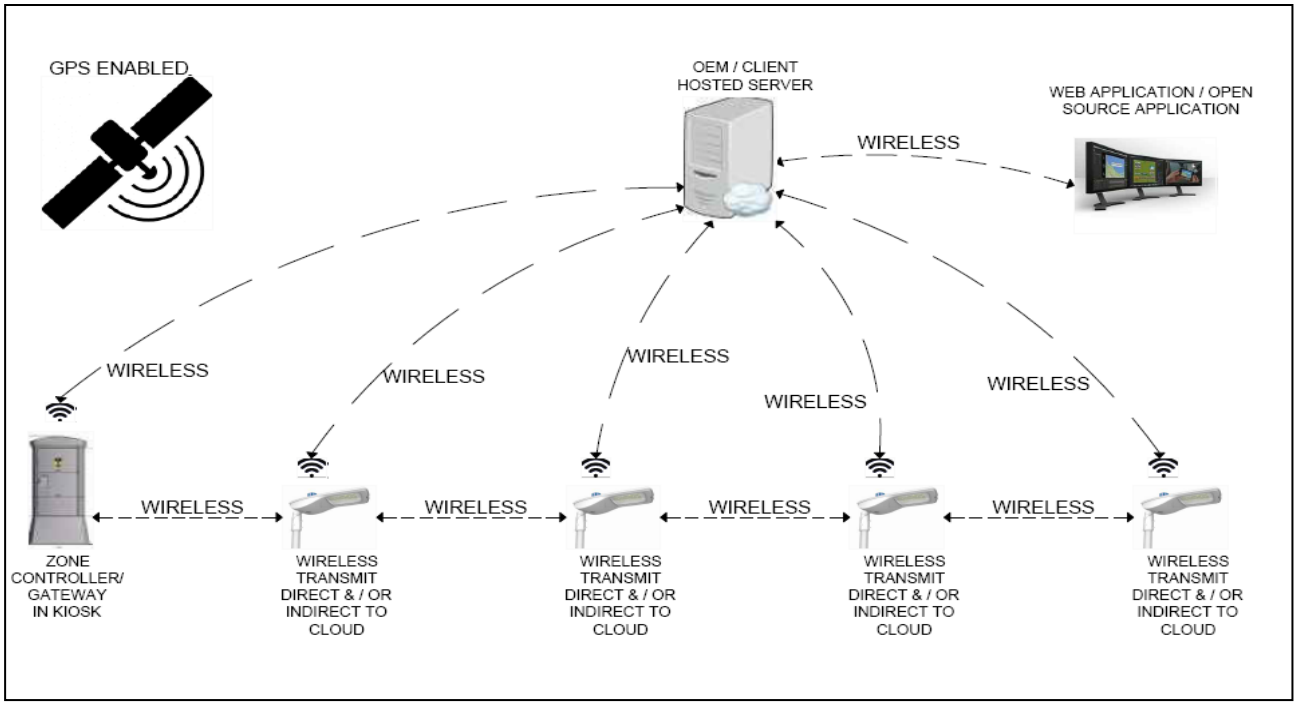


Figure 13: Typical LMS Topology

6.3.1.1 Luminaire Controller (LC)

A luminaire controller is proposed to be installed at each Luminaire point via 7-pin NEMA socket / base on luminaire. Luminaire controllers must communicate with the Zone Controller (ZC) or directly to system server via wireless communications protocols or other approved method.

Luminaire Controllers receive commands (ON, OFF, dimming, set values and parameters) and send data (e.g. lamp and ballast failures, low power factor, voltage, current, power, energy, burning hours, lamp feedback) back to the Zone Controller (ZC) or system server. The luminaire controller needs to be able to be integrated into existing SANRAL ECMS software to be controlled and monitored remotely.

The luminaire controller is to have enhanced security features with the capability of utilizing vibration/tilt sensors to send an alarm to the system server in the event of vandalism or accident. This function can be provided by an internal (built-in) or external vibration/tilt sensor wired back to the luminaire controller. The vibration/tilt sensor will be further discussed under the relevant heading.

6.3.1.2 Zone Controller (ZC) (If required)

The Zone Controller is to be installed in the nearest street light kiosk, pole, or mast if required as part of the proposed lighting management system architecture. The ZC must be able to relay all instructions to and from the luminaire and server.

The zone controller must have its own clock to trigger the lamps as per scenario selected. It must also be able to send commands (ON, OFF, dimming, set values and parameters) to all luminaire controllers. All data (e.g. lamp and ballast failures, low power factor, voltage, current, power, energy,

burning hours, lamp feedback) must be able to be transmitted via wireless methods or fibre optic cables, and managed and monitored by existing SANRAL ECMS software.

6.3.2 Integration to SANRAL ECMS

Authorised personnel must be able to remotely monitor and control all the street lights fitted with luminaire controllers. Communication between luminaire / zone controllers and the Client server, to be via Fibre optic cable or GSM if a fibre link is not available.

6.4 Security System

The security system is will compliant to SANRAL's latest requirements and specifications and to comprise of field sensors, access controllers, electronic actuated locks, and communicating devices. All wireless communicating devices will ICASA approved.

The following components will be discussed further under this section:

- Early detection security system
- Integration to SANRAL ECMS

6.4.1 Early detection security system

The early detection / warning alarm system will be used to provide early warning alarm signals to an existing 24-hour control and monitoring centre which will dispatch a reaction team immediately to the affected area. This pro-active security system shall mainly help in preventing cable damage or theft; pole, and enclosure tampering or intrusion; and protect vital assets and infrastructure.

The early detection system must comprise of the following at a minimum:

- Electronic access locks for enclosures & cages
- Vibration sensors for enclosures, cages and poles
- Open / Close Magnetic door sensor for enclosures & cages
- Strobe & Sirens for enclosures

6.4.2 Integration to SANRAL ECMS

Authorised personnel will be able to monitor alarms and control access to all field enclosures. Communication between luminaire / zone controllers and the Client server, to be via Fibre optic cable or GSM if a fibre link is not available. The security system shall be incorporated into the LMS system whereby the link to client server may be jointly utilized.

7 SIMULATION AND MARKET RESEARCH

Simulation studies were conducted to determine whether there are existing solutions in the market that can adhere to the design criteria developed and shown in table 8. Four major street lighting suppliers were used in the simulation studies. The suppliers investigated are listed below:

- BEKA Schréder [simulation (a)]
- Magnitech Lighting [simulation (b)]
- Genlux Lighting [simulation (c)]
- Philips Lighting [simulation (d)]

Suppliers were provided with the design criteria and were requested to provide luminaires that will meet the lighting design requirements. Suppliers were also requested to provide photometric data which was used to conduct the simulations shown in sections below.

7.1 N12 Roadway – Single Carriageway with 2 Lanes

Figure 14 below illustrates the 3D render for the roadway modelled on DIALux Evo.

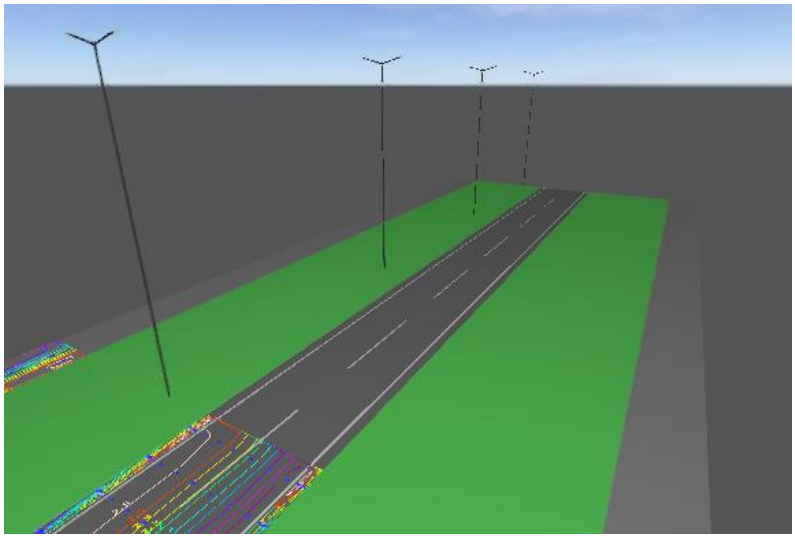


Figure 14: 3D render for the roadway modelled on DIALux Evo

Table 10 shows an extract from table 8 detailing the design criteria for the N12 roadway that are single carriageways with 2 lanes. Table 11 shows the luminaires proposed by the suppliers for the N12 roadway that are single carriageways with 2 lanes.

Table 10: Design criteria for the N12 roadway that are single carriageways with 2 lanes

Simulation #	Description	Carriageway Type	Shoulder Width [m]	Pole Spacing [m]	Pole Mounting Height [m]	Spigot Length [m]	Number of Light fittings per pole	Maximum Spigot Rake Angle [°]	SANS 10098 min. lighting requirements for roadway	SANS 10098 min. lighting requirements for sidewalk
1	N12 Roadway	Single Carriageway, 2 Lanes, 2 x shoulders	2 x 0.6m	45	20	2	2	15	A1a: Ln ≥ 2 Uo ≥ 0.4 UL ≥ 0.7 TI ≤ 15	Class 5: Eave ≥ 7.5 lx Emin ≥ 0.4 lx

Table 11: Luminaires proposed by suppliers for the N12 roadway that are single carriageways with 2 lanes

Sim. No.	Supplier	Luminaire Description	Technical Data
1a	BEKA Schréder	LEDLUME XP 4 & LEDLUME MIDI 5248 64 LED	265.0 W / 43584 lm & 138.0 W / 20345 lm
1b	Magnitech Lighting	JD-1065K & SPECTRALED FP	297.7 W / 46235 lm & 150.9 W / 21429 lm
1c	Genlux Lighting	GEN II HP SL 5 & GEN I SL 3	280.0 W / 43205 lm & 120.0 W / 17520 lm
1d	Philips Lighting	RoadFlair Gen2 BRP494 LED435 & RoadFlair Gen2 BRP492 LED215	300.0 W / 43500 lm & 150.0 W / 21500 lm

7.1.1 Simulation 1a – BEKA Schréder

Figure 15 and 16 below planning data and photometric results for simulation 1a which was the simulation of the N12 roadway that are single carriageways with 2 lanes using the BEKA Schréder luminaire.

Pole distance	45.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	15.0°
(4) Boom length	2.000 m

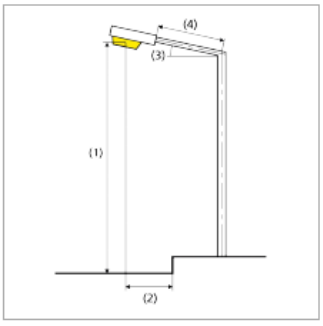


Figure 15: Simulation 1a – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}	12.78 lx	≥ 7.50 lx	✓
	U_o	0.81	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	24.18 lx	≥ 7.50 lx	✓
	U_o	0.78	≥ 0.40	✓
Roadway 1	L_{av}	2.00 cd/m²	≥ 2.00 cd/m²	✓
	U_o	0.80	≥ 0.40	✓
	U_l	0.90	≥ 0.70	✓
	$TI^{(2)}$	6 %	≤ 15 %	✓
	$R_{EI}^{(1)}$	0.79	-	-
Shoulder 2 (C5)	E_{av}	32.03 lx	≥ 7.50 lx	✓
	U_o	0.93	≥ 0.40	✓
Sidewalk 2	E_{av}	12.79 lx	≥ 7.50 lx	✓
	U_o	0.72	≥ 0.40	✓

Figure 16: Simulation 1a – Photometric Results

7.1.2 Simulation 1b – Magnitech Lighting

Figure 17 and 18 below planning data and photometric results for simulation 1b which was the simulation of the N12 roadway that are single carriageways with 2 lanes using the Magnitech Lighting luminaire.

Pole distance	45.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	15.0°
(4) Boom length	2.000 m

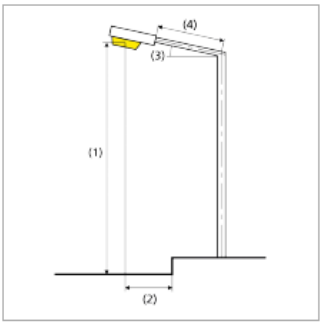


Figure 17: Simulation 1b – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}	13.59 lx	≥ 7.50 lx	✓
	U_o	0.77	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	35.30 lx	≥ 7.50 lx	✓
	U_o	0.74	≥ 0.40	✓
Roadway 1	L_{av}	2.04 cd/m²	≥ 2.00 cd/m²	✓
	U_o	0.68	≥ 0.40	✓
	U_l	0.85	≥ 0.70	✓
	TI[2]	5 %	≤ 15 %	✓
	R_{EI}[1]	0.86	-	-
Shoulder 2 (C5)	E_{av}	29.58 lx	≥ 7.50 lx	✓
	U_o	0.76	≥ 0.40	✓
Sidewalk 2	E_{av}	16.27 lx	≥ 7.50 lx	✓
	U_o	0.86	≥ 0.40	✓

Figure 18: Simulation 1b – Photometric Results

7.1.3 Simulation 1c – Genlux Lighting

Figure 19 and 20 below planning data and photometric results for simulation 1c which was the simulation of the N12 roadway that are single carriageways with 2 lanes using the Genlux Lighting luminaire.

Pole distance	45.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	5.0°
(4) Boom length	2.000 m

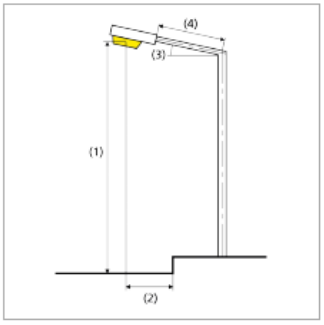


Figure 19: Simulation 1c – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}	10.00 lx	≥ 7.50 lx	✓
	U_o	0.72	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	17.95 lx	≥ 7.50 lx	✓
	U_o	0.92	≥ 0.40	✓
Roadway 1	L_{av}	2.06 cd/m²	≥ 2.00 cd/m²	✓
	U_o	0.79	≥ 0.40	✓
	U_l	0.87	≥ 0.70	✓
	TI[2]	6 %	≤ 15 %	✓
	R_{EI}[1]	0.58	-	-
Shoulder 2 (C5)	E_{av}	29.93 lx	≥ 7.50 lx	✓
	U_o	0.85	≥ 0.40	✓
Sidewalk 2	E_{av}	12.47 lx	≥ 7.50 lx	✓
	U_o	0.73	≥ 0.40	✓

Figure 20: Simulation 1c – Photometric Results

7.1.4 Simulation 1d – Philips Lighting

Figure 21 and 22 below planning data and photometric results for simulation 1d which was the simulation of the N12 roadway that are single carriageways with 2 lanes using the Philips Lighting luminaire.

Pole distance	45.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	15.0°
(4) Boom length	2.000 m

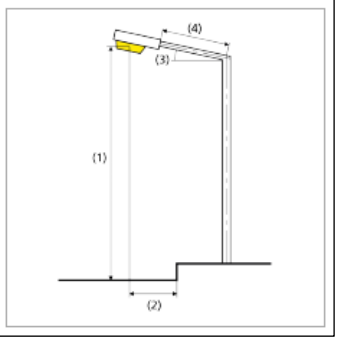


Figure 21: Simulation 1d – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}	13.84 lx	≥ 7.50 lx	✓
	U_o	0.83	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	32.41 lx	≥ 7.50 lx	✓
	U_o	0.83	≥ 0.40	✓
Roadway 1	L_{av}	2.00 cd/m²	≥ 2.00 cd/m²	✓
	U_o	0.72	≥ 0.40	✓
	U_l	0.93	≥ 0.70	✓
	TI[2]	5 %	≤ 15 %	✓
	R_{EI}[1]	0.91	-	-
Shoulder 2 (C5)	E_{av}	27.28 lx	≥ 7.50 lx	✓
	U_o	0.84	≥ 0.40	✓
Sidewalk 2	E_{av}	16.37 lx	≥ 7.50 lx	✓
	U_o	0.91	≥ 0.40	✓

Figure 22: Simulation 1d – Photometric Results

7.1.5 Simulation 1 summary

The table below summarises the planning and photometric results calculated for the N12 roadway that are single carriageways with 2 lanes when simulating the luminaires proposed by the four lighting brands.

Table 12: N12 roadway that are single carriageways with 2 lanes – Simulation 1 Summary

Sim. No.	Supplier	Luminaire Wattage / pole	Pole Distance [m]	Boom Angle [°]	Road & Sidewalk Lighting Criteria Met	Power consumption / km
1a	BEKA Schréder	1 x 265.0 W & 1 x 138.0 W	45	15	Yes	8.87 kW
1b	Magnitech Lighting	1 x 297.7 W & 1 x 150.9 W	45	15	Yes	9.87 kW
1c	Genlux Lighting	1 x 280.0 W & 1 x 120.0 W	45	5	Yes	8.80 kW
1d	Philips Lighting	1 x 300.0 W & 1 x 150.0 W	45	15	Yes	9.90 kW

7.2 N12 Roadway – Single Carriageway with 4 Lanes

Figure 23 below illustrates the 3D render for the roadway modelled on DIALux Evo.

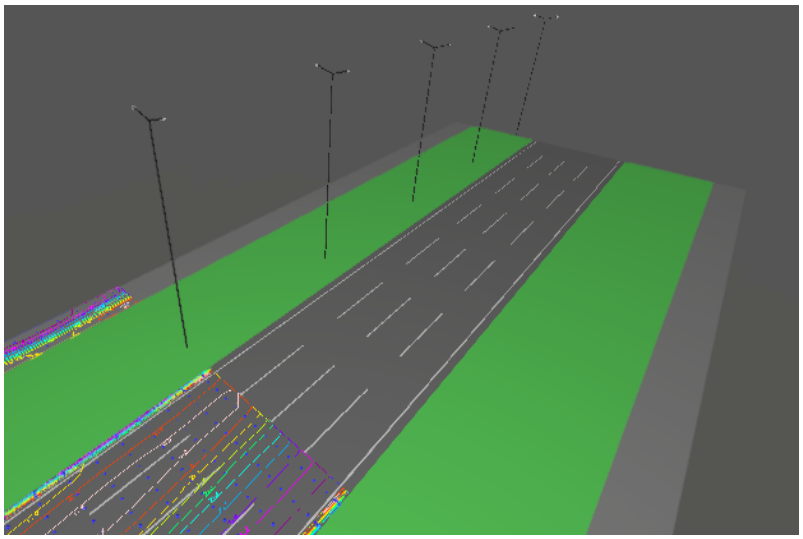


Figure 23: 3D render for the roadway modelled on DIALux Evo

Table 13 shows an extract from table 8 detailing the design criteria for the N12 roadway that are single carriageways with 4 lanes. Table 14 shows the luminaires proposed by the suppliers for the N12 roadway that are single carriageways with 4 lanes.

Table 13: Design criteria for the N12 roadway that are single carriageways with 4 lanes

Simulation #	Description	Carriageway Type	Shoulder Width [m]	Pole Spacing [m]	Pole Mounting Height [m]	Spigot Length [m]	Number of Light fittings per pole	Maximum Spigot Rake Angle [°]	SANS 10098 min. lighting requirements for roadway	SANS 10098 min. lighting requirements for sidewalk
2	N12 Roadway	Single Carriageway, 4 Lanes, 2 x shoulders	2 x 0.6m	35	20	2	2	15	A1a: Ln ≥ 2 Uo ≥ 0.4 UL ≥ 0.7 TI ≤ 15	Class 5: Eave ≥ 7.5 lx Emin ≥ 0.4 lx

Table 14: Luminaires proposed by suppliers for the N12 roadway that are single carriageways with 4 lanes

Sim. No.	Supplier	Luminaire Description	Technical Data
2a	BEKA Schréder	LEDLUME XP 4 & LEDLUME MIDI 5248 64 LED	265.0 W / 43584 lm & 138.0 W / 20345 lm
2b	Magnitech Lighting	JD-1065K & SPECTRALED FP	297.7 W / 46235 lm & 150.9 W / 21429 lm
2c	Genlux Lighting	GEN II HP SL 5 & GEN I SL 3	280.0 W / 43205 lm & 120.0 W / 17520 lm
2d	Philips Lighting	RoadFlair Gen2 BRP494 LED435 & RoadFlair Gen2 BRP492 LED215	300.0 W / 43500 lm & 150.0 W / 21500 lm

7.2.1 Simulation 2a – BEKA Schréder

Figure 24 and 25 below planning data and photometric results for simulation 2a which was the simulation of the N12 roadway that are single carriageways with 4 lanes using the BEKA Schréder luminaire.

Pole distance	35.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	15.0°
(4) Boom length	2.000 m

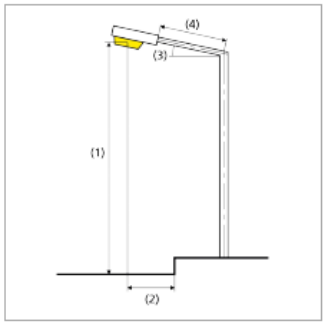


Figure 24: Simulation 2a – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}	15.72 lx	≥ 7.50 lx	✓
	U_o	0.89	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	26.95 lx	≥ 7.50 lx	✓
	U_o	0.88	≥ 0.40	✓
Roadway 1	L_{av}	2.07 cd/m²	≥ 2.00 cd/m²	✓
	U_o	0.56	≥ 0.40	✓
	U_l	0.86	≥ 0.70	✓
	$TI^{(2)}$	7 %	≤ 15 %	✓
	$R_{EI}^{(1)}$	0.72	-	-
Shoulder 2 (C5)	E_{av}	26.90 lx	≥ 7.50 lx	✓
	U_o	0.98	≥ 0.40	✓
Sidewalk 2	E_{av}	9.55 lx	≥ 7.50 lx	✓
	U_o	0.84	≥ 0.40	✓

Figure 25: Simulation 2a – Photometric Results

7.2.2 Simulation 2b – Magnitech Lighting

Figure 26 and 27 below planning data and photometric results for simulation 2b which was the simulation of the N12 roadway that are single carriageways with 4 lanes using the Magnitech Lighting luminaire.

Pole distance	35.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	10.0°
(4) Boom length	2.000 m

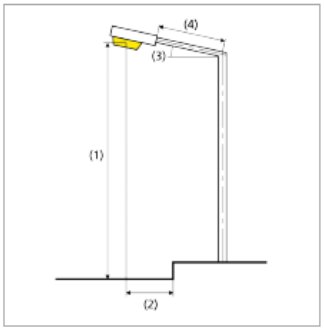


Figure 26: Simulation 2b – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}	17.88 lx	≥ 7.50 lx	✓
	U_o	0.85	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	45.39 lx	≥ 7.50 lx	✓
	U_o	0.89	≥ 0.40	✓
Roadway 1	L_{av}	2.02 cd/m²	≥ 2.00 cd/m²	✓
	U_o	0.53	≥ 0.40	✓
	U_l	0.93	≥ 0.70	✓
	$TI^{(2)}$	5 %	≤ 15 %	✓
	$R_{EI}^{(1)}$	0.83	-	-
Shoulder 2 (C5)	E_{av}	27.36 lx	≥ 7.50 lx	✓
	U_o	0.97	≥ 0.40	✓
Sidewalk 2	E_{av}	10.53 lx	≥ 7.50 lx	✓
	U_o	0.83	≥ 0.40	✓

Figure 27: Simulation 2b – Photometric Results

7.2.3 Simulation 2c – Genlux Lighting

Figure 28 and 29 below planning data and photometric results for simulation 2c which was the simulation of the N12 roadway that are single carriageways with 4 lanes using the Genlux Lighting luminaire.

Pole distance	35.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	0.0°
(4) Boom length	2.000 m

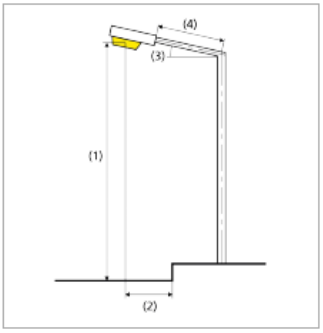


Figure 28: Simulation 2c – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}	13.18 lx	≥ 7.50 lx	✓
	U_o	0.79	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	17.10 lx	≥ 7.50 lx	✓
	U_o	0.92	≥ 0.40	✓
Roadway 1	L_{av}	2.00 cd/m²	≥ 2.00 cd/m²	✓
	U_o	0.61	≥ 0.40	✓
	U_l	0.90	≥ 0.70	✓
	$TI^{(2)}$	7 %	≤ 15 %	✓
	$R_{EI}^{(1)}$	0.70	-	-
Shoulder 2 (C5)	E_{av}	28.22 lx	≥ 7.50 lx	✓
	U_o	0.95	≥ 0.40	✓
Sidewalk 2	E_{av}	7.50 lx	≥ 7.50 lx	✓
	U_o	0.81	≥ 0.40	✓

Figure 29: Simulation 2c – Photometric Results

7.2.4 Simulation 2d – Philips Lighting

Figure 30 and 31 below planning data and photometric results for simulation 2d which was the simulation of the N12 roadway that are single carriageways with 4 lanes using the Philips Lighting luminaire.

Pole distance	35.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	15.0°
(4) Boom length	2.000 m

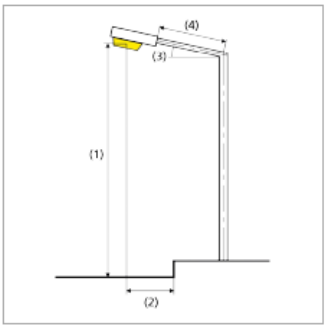


Figure 30: Simulation 2d – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}	17.79 lx	≥ 7.50 lx	✓
	U_o	0.91	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	41.68 lx	≥ 7.50 lx	✓
	U_o	0.93	≥ 0.40	✓
Roadway 1	L_{av}	2.01 cd/m²	≥ 2.00 cd/m²	✓
	U_o	0.55	≥ 0.40	✓
	U_l	0.95	≥ 0.70	✓
	$TI^{(2)}$	5 %	≤ 15 %	✓
	$R_{EI}^{(1)}$	0.85	-	-
Shoulder 2 (C5)	E_{av}	26.70 lx	≥ 7.50 lx	✓
	U_o	0.97	≥ 0.40	✓
Sidewalk 2	E_{av}	12.50 lx	≥ 7.50 lx	✓
	U_o	0.91	≥ 0.40	✓

Figure 31: Simulation 2d – Photometric Results

7.2.5 Simulation 2 summary

The table below summarises the planning and photometric results calculated for the N12 roadway that are single carriageways with 4 lanes when simulating the luminaires proposed by the four lighting brands.

Table 15: N12 Roadway Single Carriageway with 4 Lanes – Simulation 2 Summary

Sim. No.	Supplier	Luminaire Wattage / pole	Pole Distance [m]	Boom Angle [°]	Road & Sidewalk Lighting Criteria Met	Power consumption / km
2a	BEKA Schréder	1 x 265.0 W & 1 x 138.0 W	35	15	Yes	11.28 kW

2b	Magnitech Lighting	1 x 297.7 W & 1 x 150.9 W	35	10	Yes	12.56 kW
2c	Genlux Lighting	1 x 280.0 W & 1 x 120.0 W	35	0	Yes	11.20 kW
2d	Philips Lighting	1 x 300.0 W & 1 x 150.0 W	35	15	Yes	12.60 kW

7.3 Approaching Intersections – Single Carriageway with 4 Lanes

Figure 32 below illustrates the 3D render for the roadway modelled on DIALux Evo.

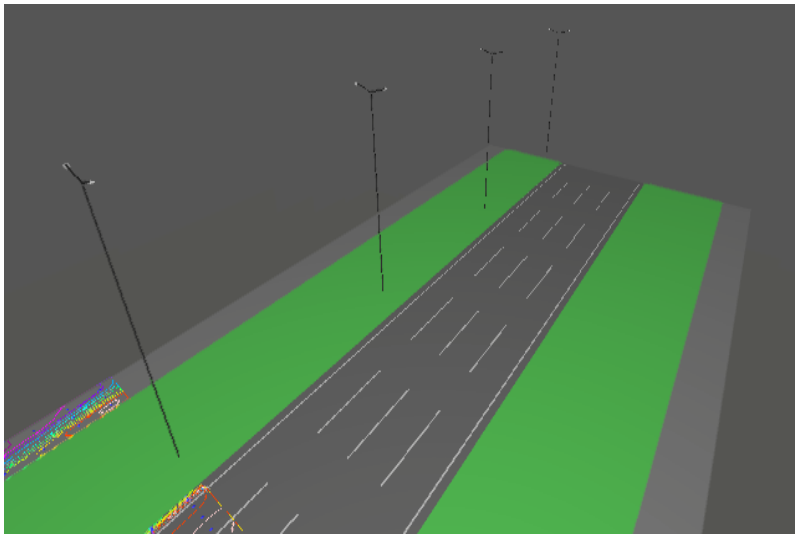


Figure 32: 3D render for the roadway modelled on DIALux Evo

Table 16 shows an extract from table 8 detailing the design criteria for the roadway approaching intersections that are single carriageways with 4 lanes. Table 17 shows the luminaires proposed by the suppliers for the roadway approaching intersections that are single carriageways with 4 lanes.

Table 16: Design criteria for the roadway approaching intersections that are single carriageways with 4 lanes

Simulation #	Description	Carriageway Type	Shoulder Width [m]	Pole Spacing [m]	Pole Mounting Height [m]	Spigot Length [m]	Number of Light fittings per pole	Maximum Spigot Rake Angle [°]	SANS 10098 min. lighting requirements for roadway	SANS 10098 min. lighting requirements for sidewalk
3	Approaching intersections, tee-junctions, traffic circle	Single Carriageway, 4 Lanes, 2 x shoulders	2 x 0.6m	60	20	2	2	15	A3b: Ln ≥ 0.6 Uo ≥ 0.4 UL ≥ 0.5 TI ≤ 20	Class 5: Eave ≥ 7.5 lx Emin ≥ 0.4 lx

Table 17: Luminaires proposed by suppliers for the roadway approaching intersections that are single carriageways with 4 lanes

Sim. No.	Supplier	Luminaire Description	Technical Data
3a	BEKA Schréder	LEDLUME XP 4 & LEDLUME MIDI 5248 64 LED	265.0 W / 43584 lm & 138.0 W / 20345 lm
3b	Magnitech Lighting	JD-1065K & SPECTRALED FP	297.7 W / 46235 lm & 150.9 W / 21429 lm
3c	Genlux Lighting	GEN II HP SL 5 & GEN I SL 3	280.0 W / 43205 lm & 120.0 W / 17520 lm
3d	Philips Lighting	RoadFlair Gen2 BRP494 LED435 & RoadFlair Gen2 BRP492 LED215	300.0 W / 43500 lm & 150.0 W / 21500 lm

7.3.1 Simulation 3a – BEKA Schréder

Figure 33 and 34 below planning data and photometric results for simulation 3a which was the simulation of the roadway approaching intersections that are single carriageways with 4 lanes using the BEKA Schréder luminaire.

Pole distance	60.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	15.0°
(4) Boom length	2.000 m

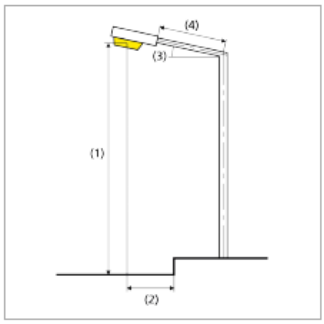


Figure 33: Simulation 3a – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	$E_{av}^{(2)}$	9.78 lx	≥ 7.50 lx	✓
	U_o	0.65	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	13.46 lx	≥ 7.50 lx	✓
	U_o	0.60	≥ 0.40	✓
Roadway 1	$L_{av}^{(2)}$	0.86 cd/m²	≥ 0.60 cd/m²	✓
	$U_o^{(2)}$	0.60	≥ 0.40	✓
	$U_l^{(2)}$	0.85	≥ 0.50	✓
	$TI^{(2)}$	9 %	≤ 20 %	✓
	$R_{EI}^{(1)}$	0.89	-	-
Shoulder 2 (C5)	E_{av}	12.13 lx	≥ 7.50 lx	✓
	U_o	0.87	≥ 0.40	✓
Sidewalk 2	E_{av}	9.54 lx	≥ 7.50 lx	✓
	U_o	0.92	≥ 0.40	✓

Figure 34: Simulation 3a – Photometric Results

7.3.2 Simulation 3b – Magnitech Lighting

Figure 35 and 36 below planning data and photometric results for simulation 3b which was the simulation of the roadway approaching intersections that are single carriageways with 4 lanes using the Magnitech Lighting luminaire.

Pole distance	60.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	15.0°
(4) Boom length	2.000 m

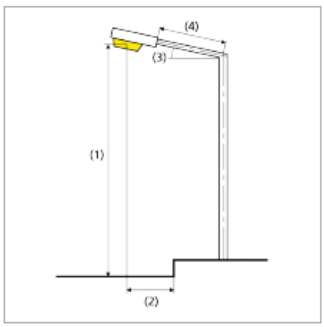


Figure 35: Simulation 3b – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}(2)	10.01 lx	≥ 7.50 lx	✓
	U_o	0.66	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	25.75 lx	≥ 7.50 lx	✓
	U_o	0.56	≥ 0.40	✓
Roadway 1	L_{av}(2)	1.16 cd/m²	≥ 0.60 cd/m²	✓
	U_o(2)	0.52	≥ 0.40	✓
	U_l(2)	0.83	≥ 0.50	✓
	TI(2)	6 %	≤ 20 %	✓
	R_{EI}(1)	0.83	-	-
Shoulder 2 (C5)	E_{av}	15.88 lx	≥ 7.50 lx	✓
	U_o	0.74	≥ 0.40	✓
Sidewalk 2	E_{av}	8.02 lx	≥ 7.50 lx	✓
	U_o	0.83	≥ 0.40	✓

Figure 36: Simulation 3b – Photometric Results

7.3.3 Simulation 3c – Genlux Lighting

Figure 37 and 38 below planning data and photometric results for simulation 3c which was the simulation of the roadway approaching intersections that are single carriageways with 4 lanes using the Genlux Lighting luminaire.

Pole distance	60.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	0.0°
(4) Boom length	2.000 m

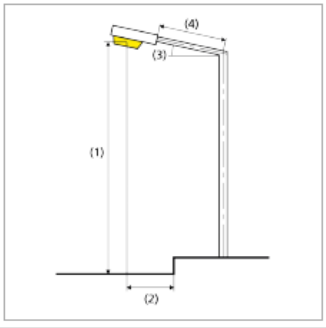


Figure 37: Simulation 3c – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av}(2)	7.80 lx	≥ 7.50 lx	✓
	U_o	0.68	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	8.10 lx	≥ 7.50 lx	✓
	U_o	0.89	≥ 0.40	✓
Roadway 1	L_{av}(2)	1.04 cd/m²	≥ 0.60 cd/m²	✓
	U_o(2)	0.56	≥ 0.40	✓
	U_l(2)	0.66	≥ 0.50	✓
	TI(2)	9 %	≤ 20 %	✓
	R_{EI}(1)	0.86	-	-
Shoulder 2 (C5)	E_{av}	16.69 lx	≥ 7.50 lx	✓
	U_o	0.87	≥ 0.40	✓
Sidewalk 2	E_{av}	8.33 lx	≥ 7.50 lx	✓
	U_o	0.83	≥ 0.40	✓

Figure 38: Simulation 3c – Photometric Results

7.3.4 Simulation 3d – Philips Lighting

Figure 39 and 40 below planning data and photometric results for simulation 3d which was the simulation of the roadway approaching intersections that are single carriageways with 4 lanes using the Philips Lighting luminaire.

Pole distance	60.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-1.000 m
(3) Boom inclination	15.0°
(4) Boom length	2.000 m

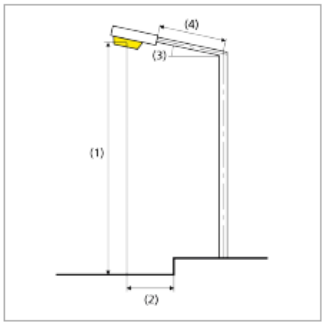


Figure 39: Simulation 3d – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	E_{av} (2)	10.50 lx	≥ 7.50 lx	✓
	U_o	0.70	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	24.31 lx	≥ 7.50 lx	✓
	U_o	0.67	≥ 0.40	✓
Roadway 1	L_{av} (2)	1.18 cd/m²	≥ 0.60 cd/m²	✓
	U_o (2)	0.55	≥ 0.40	✓
	U_l (2)	0.88	≥ 0.50	✓
	TI (2)	7 %	≤ 20 %	✓
	R_{EI} (1)	0.85	-	-
Shoulder 2 (C5)	E_{av}	15.58 lx	≥ 7.50 lx	✓
	U_o	0.81	≥ 0.40	✓
Sidewalk 2	E_{av}	8.84 lx	≥ 7.50 lx	✓
	U_o	0.88	≥ 0.40	✓

Figure 40: Simulation 3d – Photometric Results

7.3.5 Simulation 3 summary

The table below summarises the planning and photometric results calculated for the roadway approaching intersections that are single carriageways with 4 lanes when simulating the luminaires proposed by the four lighting brands.

Table 18: Roadway approaching intersections that are single carriageways with 4 lanes – Simulation 3 Summary

Sim. No.	Supplier	Luminaire Wattage / pole	Pole Distance [m]	Boom Angle [°]	Road & Sidewalk Lighting Criteria Met	Power consumption / km
3a	BEKA Schréder	1 x 265.0 W & 1 x 138.0 W	60	15	Yes	6.45 kW
3b	Magnitech Lighting	1 x 297.7 W & 1 x 150.9 W	60	15	Yes	7.18 kW
3c	Genlux Lighting	1 x 280.0 W & 1 x 120.0 W	60	0	Yes	6.40 kW
3d	Philips Lighting	1 x 300.0 W & 1 x 150.0 W	60	15	Yes	7.20 kW

7.4 Approaching Intersections – Dual Carriageway with 2 Lanes

Figure 41 below illustrates the 3D render for the roadway modelled on DIALux Evo.

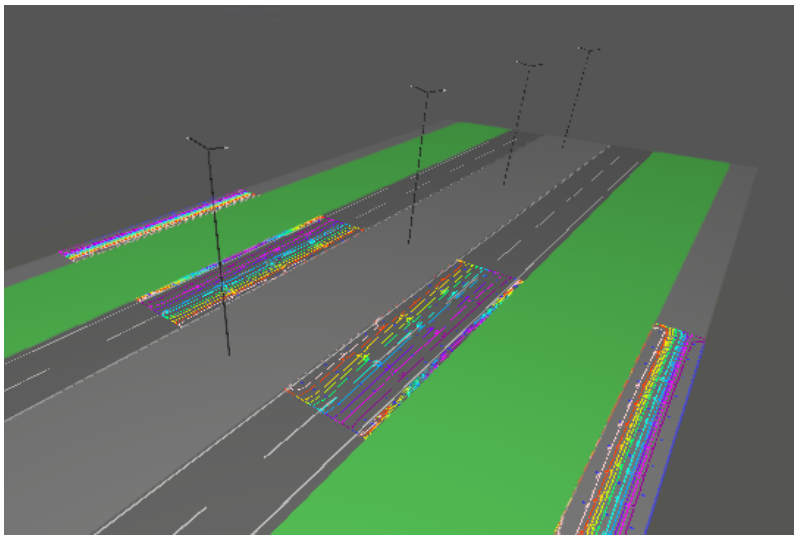


Figure 41: 3D render for the roadway modelled on DIALux Evo

Table 19 shows an extract from table 8 detailing the design criteria for the roadway approaching intersections that are dual carriageways with 2 lanes. Table 20 shows the luminaires proposed by the suppliers for the roadway approaching intersections that are dual carriageways with 2 lanes.

Table 19: Design criteria the roadway approaching intersections that are dual carriageways with 2 lanes

Simulation #	Description	Carriageway Type	Shoulder Width [m]	Pole Spacing [m]	Pole Mounting Height [m]	Spigot Length [m]	Number of Light fittings per pole	Maximum Spigot Rake Angle [°]	SANS 10098 min. lighting requirements for roadway	SANS 10098 min. lighting requirements for sidewalk
4	Approaching intersections, tee-junctions, traffic circle	Dual Carriageway, 2 Lanes, 2 x shoulders	2 x 0.6m	60	20	2	2	15	A3e: Ln ≥ 0.8 Uo ≥ 0.4 UL ≥ 0.5 TI ≤ 20	Class 5: Eave ≥ 7.5 lx Emin ≥ 0.4 lx

Table 20: Luminaires proposed by suppliers for the roadway approaching intersections that are dual carriageways with 2 lanes

Sim. No.	Supplier	Luminaire Description	Technical Data
4a	BEKA Schréder	LEDLUME XP 4	265.0 W / 43584 lm
4b	Magnitech Lighting	JD-1065K SPECTRALED FP	297.7 W / 46235 lm & 202.9 W / 27695 lm
4c	Genlux Lighting	GEN II HP SL 5	244.0 W / 37354 lm
4d	Philips Lighting	RoadFlair Gen2 BRP493 LED362 & RoadFlair Gen2 BRP493 LED285	250.0 W / 36200 lm & 200.0 W / 28500 lm

7.4.1 Simulation 4a – BEKA Schréder

Figure 42 and 43 below planning data and photometric results for simulation 4a which was the simulation of the roadway approaching intersections that are dual carriageways with 2 lanes using the BEKA Schréder luminaire.

Pole distance	60.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-4.542 m
(3) Boom inclination	15.0°
(4) Boom length	1.995 m

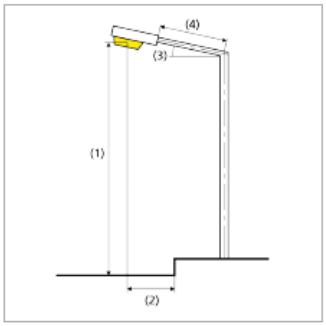


Figure 42: Simulation 4a – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	$E_{av}^{(2)}$	10.03 lx	≥ 7.50 lx	✓
	U_o	0.94	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	14.95 lx	≥ 7.50 lx	✓
	U_o	0.79	≥ 0.40	✓
Roadway 1	$L_{av}^{(2)}$	1.06 cd/m²	≥ 0.80 cd/m²	✓
	$U_o^{(2)}$	0.71	≥ 0.40	✓
	$U_l^{(2)}$	0.88	≥ 0.50	✓
	$TI^{(2)}$	8 %	≤ 20 %	✓
	R_{EI}	1.05	≥ 0.30	✓
Roadway 2	$L_{av}^{(2)}$	1.06 cd/m²	≥ 0.80 cd/m²	✓
	U_o	0.71	≥ 0.40	✓
	$U_l^{(2)}$	0.88	≥ 0.50	✓
	$TI^{(2)}$	8 %	≤ 20 %	✓
	R_{EI}	1.05	≥ 0.30	✓
Shoulder 2 (C5)	E_{av}	14.95 lx	≥ 7.50 lx	✓
	U_o	0.79	≥ 0.40	✓

Figure 43: Simulation 4a – Photometric Results

7.4.2 Simulation 4b – Magnitech Lighting

Figure 44 and 45 below planning data and photometric results for simulation 4b which was the simulation of the roadway approaching intersections that are dual carriageways with 2 lanes using the Magnitech Lighting luminaire.

Pole distance	60.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-4.500 m
(3) Boom inclination	15.0°
(4) Boom length	2.044 m

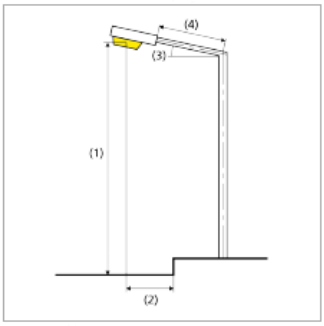


Figure 44: Simulation 4b – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	$E_{av}^{(2)}$	9.10 lx	≥ 7.50 lx	✓
	U_o	0.80	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	19.24 lx	≥ 7.50 lx	✓
	U_o	0.67	≥ 0.40	✓
Roadway 1	$L_{av}^{(2)}$	1.23 cd/m²	≥ 0.80 cd/m²	✓
	$U_o^{(2)}$	0.66	≥ 0.40	✓
	$U_l^{(2)}$	0.84	≥ 0.50	✓
	$TI^{(2)}$	6 %	≤ 20 %	✓
	R_{EI}	1.10	≥ 0.30	✓
Roadway 2	$L_{av}^{(2)}$	0.82 cd/m²	≥ 0.80 cd/m²	✓
	U_o	0.62	≥ 0.40	✓
	$U_l^{(2)}$	0.88	≥ 0.50	✓
	$TI^{(2)}$	7 %	≤ 20 %	✓
	R_{EI}	1.27	≥ 0.30	✓
Shoulder 2 (C5)	E_{av}	10.33 lx	≥ 7.50 lx	✓
	U_o	0.75	≥ 0.40	✓

Figure 45: Simulation 4b – Photometric Results

7.4.3 Simulation 4c – Genlux Lighting

Figure 46 and 47 below planning data and photometric results for simulation 4c which was the simulation of the roadway approaching intersections that are dual carriageways with 2 lanes using the Genlux Lighting luminaire.

Pole distance	60.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-4.542 m
(3) Boom inclination	15.0°
(4) Boom length	1.986 m

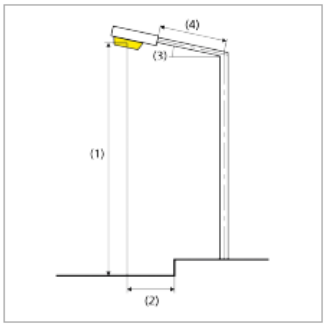


Figure 46: Simulation 4c – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	$E_{av}^{(2)}$	8.38 lx	≥ 7.50 lx	✓
	U_o	0.86	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	17.26 lx	≥ 7.50 lx	✓
	U_o	0.72	≥ 0.40	✓
Roadway 1	$L_{av}^{(2)}$	1.04 cd/m²	≥ 0.80 cd/m²	✓
	$U_o^{(2)}$	0.80	≥ 0.40	✓
	$U_l^{(2)}$	0.87	≥ 0.50	✓
	$TI^{(2)}$	7 %	≤ 20 %	✓
	R_{EI}	0.55	≥ 0.30	✓
Roadway 2	$L_{av}^{(2)}$	1.00 cd/m²	≥ 0.80 cd/m²	✓
	U_o	0.80	≥ 0.40	✓
	$U_l^{(2)}$	0.84	≥ 0.50	✓
	$TI^{(2)}$	7 %	≤ 20 %	✓
	R_{EI}	0.55	≥ 0.30	✓
Shoulder 2 (C5)	E_{av}	17.26 lx	≥ 7.50 lx	✓
	U_o	0.72	≥ 0.40	✓

Figure 47: Simulation 4c – Photometric Results

7.4.4 Simulation 4d – Philips Lighting

Figure 48 and 49 below planning data and photometric results for simulation 4d which was the simulation of the roadway approaching intersections that are dual carriageways with 2 lanes using the Philips Lighting luminaire.

Pole distance	60.000 m
(1) Light spot height	20.000 m
(2) Light point overhang	-4.500 m
(3) Boom inclination	15.0°
(4) Boom length	2.044 m

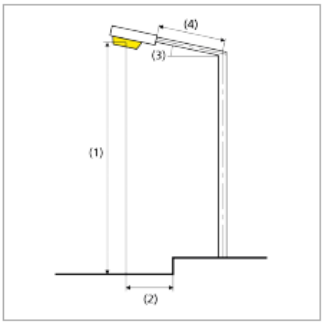


Figure 48: Simulation 4d – Planning Data

	Symbol	Calculated	Target	Check
Sidewalk 1	$E_{av}^{(2)}$	8.08 lx	≥ 7.50 lx	✓
	U_o	0.87	≥ 0.40	✓
Shoulder 1 (C5)	E_{av}	15.41 lx	≥ 7.50 lx	✓
	U_o	0.75	≥ 0.40	✓
Roadway 1	$L_{av}^{(2)}$	1.06 cd/m²	≥ 0.80 cd/m²	✓
	$U_o^{(2)}$	0.69	≥ 0.40	✓
	$U_l^{(2)}$	0.88	≥ 0.50	✓
	$TI^{(2)}$	7 %	≤ 20 %	✓
	R_{EI}	1.14	≥ 0.30	✓
Roadway 2	$L_{av}^{(2)}$	0.86 cd/m²	≥ 0.80 cd/m²	✓
	U_o	0.68	≥ 0.40	✓
	$U_l^{(2)}$	0.89	≥ 0.50	✓
	$TI^{(2)}$	7 %	≤ 20 %	✓
	R_{EI}	1.23	≥ 0.30	✓
Shoulder 2 (C5)	E_{av}	12.40 lx	≥ 7.50 lx	✓
	U_o	0.75	≥ 0.40	✓

Figure 49: Simulation 4d – Photometric Results

7.4.5 Simulation 4 summary

The table below summarises the planning and photometric results calculated for the roadway approaching intersections that are dual carriageways with 2 lanes when simulating the luminaires proposed by the four lighting brands.

Table 21: Roadway approaching intersections that are dual carriageways with 2 lanes – Simulation 4 Summary

Sim. No.	Supplier	Luminaire Wattage / pole	Pole Distance [m]	Boom Angle [°]	Road & Sidewalk Lighting Criteria Met	Power consumption / km
4a	BEKA Schréder	2 x 265.0 W	60	15	Yes	8.48 kW
4b	Magnitech Lighting	1 x 297.7 W & 1 x 202.9 W	60	15	Yes	8.01 kW
4c	Genlux Lighting	2 x 244.0 W	60	15	Yes	7.81 kW
4d	Philips Lighting	1 x 250.0 W & 1 x 200.0 W	60	15	Yes	7.20 kW

7.5 Summary of Simulation Results

The four street lighting suppliers' simulation results for the various roadways are summarized in the table below.

Table 22: Summary of Simulation Results obtained for all the roadways

Sim. No.	Supplier	Luminaire Wattage / pole	Pole Distance [m]	Boom Angle [°]	Road & Sidewalk Lighting Criteria Met	Power consumption / km
1a	BEKA Schréder	1 x 265.0 W & 1 x 138.0 W	45	15	Yes	8.87 kW
1b	Magnitech Lighting	1 x 297.7 W & 1 x 150.9 W	45	15	Yes	9.87 kW
1c	Genlux Lighting	1 x 280.0 W & 1 x 120.0 W	45	5	Yes	8.80 kW
1d	Philips Lighting	1 x 300.0 W & 1 x 150.0 W	45	15	Yes	9.90 kW
2a	BEKA Schréder	1 x 265.0 W & 1 x 138.0 W	35	15	Yes	11.28 kW
2b	Magnitech Lighting	1 x 297.7 W & 1 x 150.9 W	35	10	Yes	12.56 kW
2c	Genlux Lighting	1 x 280.0 W & 1 x 120.0 W	35	0	Yes	11.20 kW
2d	Philips Lighting	1 x 300.0 W & 1 x 150.0 W	35	15	Yes	12.60 kW
3a	BEKA Schréder	1 x 265.0 W & 1 x 138.0 W	60	15	Yes	6.45 kW

3b	Magnitech Lighting	1 x 297.7 W & 1 x 150.9 W	60	15	Yes	7.18 kW
3c	Genlux Lighting	1 x 280.0 W & 1 x 120.0 W	60	0	Yes	6.40 kW
3d	Philips Lighting	1 x 300.0 W & 1 x 150.0 W	60	15	Yes	7.20 kW
4a	BEKA Schréder	2 x 265.0 W	60	15	Yes	8.48 kW
4b	Magnitech Lighting	1 x 297.7 W & 1 x 202.9 W	60	15	Yes	8.01 kW
4c	Genlux Lighting	2 x 244.0 W	60	15	Yes	7.81 kW
4d	Philips Lighting	1 x 250.0 W & 1 x 200.0 W	60	15	Yes	7.20 kW

8 LIFE CYCLE COSTS

The life cycle costs were calculated for various street lighting suppliers for each roadway layout simulation. The sections below summarise the life cycle cost calculated.

8.1 N12 Roadway – Single Carriageway with 2 Lanes

8.1.1 Simulation 1a – BEKA Schréder (Life Cycle Cost)

Table 23: Maintenance Cost

Yr (1)	Luminaire Type (2)	Qty of luminaires per mast (3)	Qty of luminaires (1 km) (4)	Burning Hrs / Annum (5)	Luminaire Life Hrs (6)	Luminaire Replacement: Material + Labour (7)	Labour cost to clean 1 x luminaire glass (Fixed) (8)	Total Maintenance Cost / Annum Col (7+8) x (4) (9)
1	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	46000	R -	R 100.00	R 4 400.00
2	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	42000	R -	R 110.00	R 4 840.00
3	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	38000	R -	R 121.00	R 5 324.00
4	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	34000	R -	R 133.10	R 5 856.40
5	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	30000	R -	R 146.41	R 6 442.04
6	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	26000	R -	R 161.05	R 7 086.24
7	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	22000	R -	R 177.16	R 7 794.87
8	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	18000	R -	R 194.87	R 8 574.36
9	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	14000	R -	R 214.36	R 9 431.79
10	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	10000	R -	R 235.79	R 10 374.97
11	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	6000	R -	R 259.37	R 11 412.47
12	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	2000	R -	R 285.31	R 12 553.71
13	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	46000	R12 474.80	R 313.84	R 562 700.28
14	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	42000	R -	R 345.23	R 15 189.99
15	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	44	4000	38000	R -	R 379.75	R 16 708.99
	TOTAL (a) Maintenance Cost: R							R 688 690.12

Table 24: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	403
[2]	Pole spacing	m	45
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	9 596.00
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 820 544.44
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	8.96
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R132 900.44
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R3 814 051.11

Table 25: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 688 690.12
2	TOTAL COST OF OWNERSHIP	R	R 3 814 051.11
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 4 502 741.23**

8.1.2 Simulation 1b – Magnitech Lighting (Life Cycle Cost)

Table 26: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	46000	R -	R 100.00	R 4 400.00
2	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	42000	R -	R 110.00	R 4 840.00
3	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	38000	R -	R 121.00	R 5 324.00
4	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	34000	R -	R 133.10	R 5 856.40
5	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	30000	R -	R 146.41	R 6 442.04
6	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	26000	R -	R 161.05	R 7 086.24
7	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	22000	R -	R 177.16	R 7 794.87
8	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	18000	R -	R 194.87	R 8 574.36
9	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	14000	R -	R 214.36	R 9 431.79
10	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	10000	R -	R 235.79	R 10 374.97
11	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	6000	R -	R 259.37	R 11 412.47
12	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	2000	R -	R 285.31	R 12 553.71
13	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	46000	R17 420.00	R 313.84	R 780 289.08
14	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	42000	R -	R 345.23	R 15 189.99
15	1 x 300W LED + 1 x 150W SPECTRALED FP	2	44	4000	38000	R -	R 379.75	R 16 708.99
	TOTAL (a) Maintenance Cost: R							R 906 278.92

Table 27: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	450
[2]	Pole spacing	m	45
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	13 400.00
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 905 077.78
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	10.00
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R148 400.00
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R4 131 077.78

Table 28: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 906 278.92
2	TOTAL COST OF OWNERSHIP	R	R 4 131 077.78
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 5 037 356.70**

8.1.3 Simulation 1c – Genlux Lighting (Life Cycle Cost)

Table 29: Maintenance Cost

Yr (1)	Luminaire Type (2)	Qty of luminaires per mast (3)	Qty of luminaires (1 km) (4)	Burning Hrs / Annum (5)	Luminaire Life Hrs (6)	Luminaire Replacement: Material + Labour (7)	Labour cost to clean 1 x luminaire glass (Fixed) (8)	Total Maintenance Cost / Annum Col (7+8) x (4) (9)
1	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	46000	R -	R 100.00	R 4 400.00
2	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	42000	R -	R 110.00	R 4 840.00
3	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	38000	R -	R 121.00	R 5 324.00
4	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	34000	R -	R 133.10	R 5 856.40
5	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	30000	R -	R 146.41	R 6 442.04
6	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	26000	R -	R 161.05	R 7 086.24
7	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	22000	R -	R 177.16	R 7 794.87
8	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	18000	R -	R 194.87	R 8 574.36
9	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	14000	R -	R 214.36	R 9 431.79
10	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	10000	R -	R 235.79	R 10 374.97
11	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	6000	R -	R 259.37	R 11 412.47
12	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	2000	R -	R 285.31	R 12 553.71
13	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	46000	R14 317.86	R 313.84	R 643 795.01
14	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	42000	R -	R 345.23	R 15 189.99
15	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	44	4000	38000	R -	R 379.75	R 16 708.99
	TOTAL (a) Maintenance Cost: R							R 769 784.85

Table 30: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	400
[2]	Pole spacing	m	45
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	11 013.74
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 852 049.78
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	8.89
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R131 911.11
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R3 830 716.44

Table 31: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 769 784.85
2	TOTAL COST OF OWNERSHIP	R	R 3 830 716.44
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 4 600 501.29**

8.1.4 Simulation 1d – Philips Lighting (Life Cycle Cost)

Table 32: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	46000	R -	R 100.00	R 4 400.00
2	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	42000	R -	R 110.00	R 4 840.00
3	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	38000	R -	R 121.00	R 5 324.00
4	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	34000	R -	R 133.10	R 5 856.40
5	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	30000	R -	R 146.41	R 6 442.04
6	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	26000	R -	R 161.05	R 7 086.24
7	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	22000	R -	R 177.16	R 7 794.87
8	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	18000	R -	R 194.87	R 8 574.36
9	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	14000	R -	R 214.36	R 9 431.79
10	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	10000	R -	R 235.79	R 10 374.97
11	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	6000	R -	R 259.37	R 11 412.47
12	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	2000	R -	R 285.31	R 12 553.71
13	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	46000	R12 976.77	R 313.84	R 584 786.92
14	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	42000	R -	R 345.23	R 15 189.99
15	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	44	4000	38000	R -	R 379.75	R 16 708.99
	TOTAL (a) Maintenance Cost: R							R 710 776.76

Table 33: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	450
[2]	Pole spacing	m	45
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	9 982.13
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 829 125.11
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	10.00
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R148 400.00
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R4 055 125.11

Table 34: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 710 776.76
2	TOTAL COST OF OWNERSHIP	R	R 4 055 125.11
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 4 765 901.87**

8.2 N12 Roadway – Single Carriageway with 4 Lanes

8.2.1 Simulation 2a – BEKA Schréder (Life Cycle Cost)

Table 35: Maintenance Cost

Yr (1)	Luminaire Type (2)	Qty of luminaires per mast (3)	Qty of luminaires (1 km) (4)	Burning Hrs / Annum (5)	Luminaire Life Hrs (6)	Luminaire Replacement: Material + Labour (7)	Labour cost to clean 1 x luminaire glass (Fixed) (8)	Total Maintenance Cost / Annum Col (7+8) x (4) (9)
1	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	46000	R -	R 100.00	R 5 600.00
2	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	42000	R -	R 110.00	R 6 160.00
3	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	38000	R -	R 121.00	R 6 776.00
4	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	34000	R -	R 133.10	R 7 453.60
5	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	30000	R -	R 146.41	R 8 198.96
6	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	26000	R -	R 161.05	R 9 018.86
7	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	22000	R -	R 177.16	R 9 920.74
8	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	18000	R -	R 194.87	R 10 912.82
9	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	14000	R -	R 214.36	R 12 004.10
10	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	10000	R -	R 235.79	R 13 204.51
11	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	6000	R -	R 259.37	R 14 524.96
12	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	2000	R -	R 285.31	R 15 977.45
13	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	46000	R12 474.80	R 313.84	R 716 164.00
14	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	42000	R -	R 345.23	R 19 332.72
15	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	56	4000	38000	R -	R 379.75	R 21 265.99
	TOTAL (a) Maintenance Cost: R							R 876 514.70

Table 36: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	403
[2]	Pole spacing	m	35
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	9 596.00
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	2 340 700.00
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	11.51
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R170 872.00
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R4 903 780.00

Table 37: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 876 514.70
2	TOTAL COST OF OWNERSHIP	R	R 4 903 780.00
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 5 780 294.70**

8.2.2 Simulation 2b – Magnitech Lighting (Life Cycle Cost)

Table 38: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	46000	R -	R 100.00	R 5 600.00
2	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	42000	R -	R 110.00	R 6 160.00
3	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	38000	R -	R 121.00	R 6 776.00
4	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	34000	R -	R 133.10	R 7 453.60
5	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	30000	R -	R 146.41	R 8 198.96
6	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	26000	R -	R 161.05	R 9 018.86
7	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	22000	R -	R 177.16	R 9 920.74
8	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	18000	R -	R 194.87	R 10 912.82
9	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	14000	R -	R 214.36	R 12 004.10
10	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	10000	R -	R 235.79	R 13 204.51
11	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	6000	R -	R 259.37	R 14 524.96
12	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	2000	R -	R 285.31	R 15 977.45
13	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	46000	R17 420.00	R 313.84	R 993 095.20
14	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	42000	R -	R 345.23	R 19 332.72
15	1 x 300W LED + 1 x 150W SPECTRALED FP	2	56	4000	38000	R -	R 379.75	R 21 265.99
	TOTAL (a) Maintenance Cost: R							R 1 153 445.90

Table 39: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	450
[2]	Pole spacing	m	35
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	13 400.00
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	2 449 385.71
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	12.86
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R190 800.00
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R5 311 385.71

Table 40: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 1 153 445.90
2	TOTAL COST OF OWNERSHIP	R	R 5 311 385.71
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 6 464 831.61**

8.2.3 Simulation 2c – Genlux Lighting (Life Cycle Cost)

Table 41: Maintenance Cost

Yr (1)	Luminaire Type (2)	Qty of luminaires per mast (3)	Qty of luminaires (1 km) (4)	Burning Hrs / Annum (5)	Luminaire Life Hrs (6)	Luminaire Replacement: Material + Labour (7)	Labour cost to clean 1 x luminaire glass (Fixed) (8)	Total Maintenance Cost / Annum Col (7+8) x (4) (9)
1	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	46000	R -	R 100.00	R 5 600.00
2	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	42000	R -	R 110.00	R 6 160.00
3	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	38000	R -	R 121.00	R 6 776.00
4	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	34000	R -	R 133.10	R 7 453.60
5	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	30000	R -	R 146.41	R 8 198.96
6	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	26000	R -	R 161.05	R 9 018.86
7	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	22000	R -	R 177.16	R 9 920.74
8	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	18000	R -	R 194.87	R 10 912.82
9	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	14000	R -	R 214.36	R 12 004.10
10	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	10000	R -	R 235.79	R 13 204.51
11	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	6000	R -	R 259.37	R 14 524.96
12	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	2000	R -	R 285.31	R 15 977.45
13	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	46000	R14 317.86	R 313.84	R 819 375.47
14	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	42000	R -	R 345.23	R 19 332.72
15	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	56	4000	38000	R -	R 379.75	R 21 265.99
	TOTAL (a) Maintenance Cost: R							R 979 726.17

Table 42: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	400
[2]	Pole spacing	m	35
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	11 013.74
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	2 381 206.86
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	11.43
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R169 600.00
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R4 925 206.86

Table 43: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 979 726.17
2	TOTAL COST OF OWNERSHIP	R	R 4 925 206.86
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 5 904 933.03**

8.2.4 Simulation 2d – Philips Lighting (Life Cycle Cost)

Table 44: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	46000	R -	R 100.00	R 5 600.00
2	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	42000	R -	R 110.00	R 6 160.00
3	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	38000	R -	R 121.00	R 6 776.00
4	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	34000	R -	R 133.10	R 7 453.60
5	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	30000	R -	R 146.41	R 8 198.96
6	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	26000	R -	R 161.05	R 9 018.86
7	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	22000	R -	R 177.16	R 9 920.74
8	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	18000	R -	R 194.87	R 10 912.82
9	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	14000	R -	R 214.36	R 12 004.10
10	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	10000	R -	R 235.79	R 13 204.51
11	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	6000	R -	R 259.37	R 14 524.96
12	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	2000	R -	R 285.31	R 15 977.45
13	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	46000	R12 976.77	R 313.84	R 744 274.26
14	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	42000	R -	R 345.23	R 19 332.72
15	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	56	4000	38000	R -	R 379.75	R 21 265.99
	TOTAL (a) Maintenance Cost: R							R 904 624.96

Table 45: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	450
[2]	Pole spacing	m	35
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	9 982.13
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	2 351 732.29
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	12.86
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R190 800.00
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R5 213 732.29

Table 46: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 904 624.96
2	TOTAL COST OF OWNERSHIP	R	R 5 213 732.29
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 6 118 357.25**

8.3 Approaching Intersections – Single Carriageway with 4 Lanes

8.3.1 Simulation 3a – BEKA Schréder (Life Cycle Cost)

Table 47: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	46000	R -	R 100.00	R 3 200.00
2	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	42000	R -	R 110.00	R 3 520.00
3	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	38000	R -	R 121.00	R 3 872.00
4	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	34000	R -	R 133.10	R 4 259.20
5	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	30000	R -	R 146.41	R 4 685.12
6	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	26000	R -	R 161.05	R 5 153.63
7	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	22000	R -	R 177.16	R 5 669.00
8	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	18000	R -	R 194.87	R 6 235.89
9	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	14000	R -	R 214.36	R 6 859.48
10	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	10000	R -	R 235.79	R 7 545.43
11	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	6000	R -	R 259.37	R 8 299.98
12	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	2000	R -	R 285.31	R 9 129.97
13	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	46000	R12 474.80	R 313.84	R 409 236.57
14	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	42000	R -	R 345.23	R 11 047.27
15	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	2	32	4000	38000	R -	R 379.75	R 12 151.99
	TOTAL (a) Maintenance Cost: R							R 500 865.54

Table 48: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	403
[2]	Pole spacing	m	60
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	9 596.00
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 365 408.33
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	6.72
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R99 675.33
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R2 860 538.33

Table 49: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 500 865.54
2	TOTAL COST OF OWNERSHIP	R	R 2 860 538.33
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 3 361 403.87**

8.3.2 Simulation 3b – Magnitech Lighting (Life Cycle Cost)

Table 50: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	46000	R -	R 100.00	R 3 200.00
2	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	42000	R -	R 110.00	R 3 520.00
3	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	38000	R -	R 121.00	R 3 872.00
4	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	34000	R -	R 133.10	R 4 259.20
5	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	30000	R -	R 146.41	R 4 685.12
6	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	26000	R -	R 161.05	R 5 153.63
7	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	22000	R -	R 177.16	R 5 669.00
8	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	18000	R -	R 194.87	R 6 235.89
9	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	14000	R -	R 214.36	R 6 859.48
10	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	10000	R -	R 235.79	R 7 545.43
11	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	6000	R -	R 259.37	R 8 299.98
12	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	2000	R -	R 285.31	R 9 129.97
13	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	46000	R17 420.00	R 313.84	R 567 482.97
14	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	42000	R -	R 345.23	R 11 047.27
15	1 x 300W LED + 1 x 150W SPECTRALED FP	2	32	4000	38000	R -	R 379.75	R 12 151.99
	TOTAL (a) Maintenance Cost: R							R 659 111.94

Table 51: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	450
[2]	Pole spacing	m	60
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	13 400.00
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 428 808.33
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	7.50
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R111 300.00
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R3 098 308.33

Table 52: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 659 111.94
2	TOTAL COST OF OWNERSHIP	R	R 3 098 308.33
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 3 757 420.27**

8.3.3 Simulation 3c – Genlux Lighting (Life Cycle Cost)

Table 53: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	46000	R -	R 100.00	R 3 200.00
2	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	42000	R -	R 110.00	R 3 520.00
3	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	38000	R -	R 121.00	R 3 872.00
4	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	34000	R -	R 133.10	R 4 259.20
5	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	30000	R -	R 146.41	R 4 685.12
6	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	26000	R -	R 161.05	R 5 153.63
7	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	22000	R -	R 177.16	R 5 669.00
8	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	18000	R -	R 194.87	R 6 235.89
9	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	14000	R -	R 214.36	R 6 859.48
10	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	10000	R -	R 235.79	R 7 545.43
11	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	6000	R -	R 259.37	R 8 299.98
12	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	2000	R -	R 285.31	R 9 129.97
13	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	46000	R14 317.86	R 313.84	R 468 214.55
14	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	42000	R -	R 345.23	R 11 047.27
15	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	2	32	4000	38000	R -	R 379.75	R 12 151.99
	TOTAL (a) Maintenance Cost: R							R 559 843.53

Table 54: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	400
[2]	Pole spacing	m	60
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	11 013.74
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 389 037.33
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	6.67
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R98 933.33
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R2 873 037.33

Table 55: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 559 843.53
2	TOTAL COST OF OWNERSHIP	R	R 2 873 037.33
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 3 432 880.86**

8.3.4 Simulation 3d – Philips Lighting (Life Cycle Cost)

Table 56: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	46000	R -	R 100.00	R 3 200.00
2	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	42000	R -	R 110.00	R 3 520.00
3	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	38000	R -	R 121.00	R 3 872.00
4	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	34000	R -	R 133.10	R 4 259.20
5	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	30000	R -	R 146.41	R 4 685.12
6	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	26000	R -	R 161.05	R 5 153.63
7	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	22000	R -	R 177.16	R 5 669.00
8	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	18000	R -	R 194.87	R 6 235.89
9	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	14000	R -	R 214.36	R 6 859.48
10	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	10000	R -	R 235.79	R 7 545.43
11	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	6000	R -	R 259.37	R 8 299.98
12	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	2000	R -	R 285.31	R 9 129.97
13	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	46000	R12 976.77	R 313.84	R 425 299.58
14	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	42000	R -	R 345.23	R 11 047.27
15	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	2	32	4000	38000	R -	R 379.75	R 12 151.99
	TOTAL (a) Maintenance Cost: R							R 516 928.55

Table 57: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	450
[2]	Pole spacing	m	60
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	9 982.13
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 371 843.83
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	7.50
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R111 300.00
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R3 041 343.83

Table 58: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 516 928.55
2	TOTAL COST OF OWNERSHIP	R	R 3 041 343.83
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 3 558 272.38**

8.4 Approaching Intersections – Dual Carriageway with 2 Lanes

8.4.1 Simulation 4a – BEKA Schréder (Life Cycle Cost)

Table 59: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	2 x 265W LEDLUME XP 4	2	32	4000	46000	R -	R 100.00	R 3 200.00
2	2 x 265W LEDLUME XP 4	2	32	4000	42000	R -	R 110.00	R 3 520.00
3	2 x 265W LEDLUME XP 4	2	32	4000	38000	R -	R 121.00	R 3 872.00
4	2 x 265W LEDLUME XP 4	2	32	4000	34000	R -	R 133.10	R 4 259.20
5	2 x 265W LEDLUME XP 4	2	32	4000	30000	R -	R 146.41	R 4 685.12
6	2 x 265W LEDLUME XP 4	2	32	4000	26000	R -	R 161.05	R 5 153.63
7	2 x 265W LEDLUME XP 4	2	32	4000	22000	R -	R 177.16	R 5 669.00
8	2 x 265W LEDLUME XP 4	2	32	4000	18000	R -	R 194.87	R 6 235.89
9	2 x 265W LEDLUME XP 4	2	32	4000	14000	R -	R 214.36	R 6 859.48
10	2 x 265W LEDLUME XP 4	2	32	4000	10000	R -	R 235.79	R 7 545.43
11	2 x 265W LEDLUME XP 4	2	32	4000	6000	R -	R 259.37	R 8 299.98
12	2 x 265W LEDLUME XP 4	2	32	4000	2000	R -	R 285.31	R 9 129.97
13	2 x 265W LEDLUME XP 4	2	32	4000	46000	R15 334.80	R 313.84	R 500 756.57
14	2 x 265W LEDLUME XP 4	2	32	4000	42000	R -	R 345.23	R 11 047.27
15	2 x 265W LEDLUME XP 4	2	32	4000	38000	R -	R 379.75	R 12 151.99
	TOTAL (a) Maintenance Cost: R							R 592 385.54

Table 60: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	530
[2]	Pole spacing	m	60
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	11 796.00
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 402 075.00
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	8.83
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R131 086.67
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R3 368 375.00

Table 61: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 592 385.54
2	TOTAL COST OF OWNERSHIP	R	R 3 368 375.00
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 3 960 760.54**

8.4.2 Simulation 4b – Magnitech Lighting (Life Cycle Cost)

Table 62: Maintenance Cost

Yr (1)	Luminaire Type (2)	Qty of luminaires per mast (3)	Qty of luminaires (1 km) (4)	Burning Hrs / Annum (5)	Luminaire Life Hrs (6)	Luminaire Replacement: Material + Labour (7)	Labour cost to clean 1 x luminaire glass (Fixed) (8)	Total Maintenance Cost / Annum Col (7+8) x (4) (9)
1	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	46000	R -	R 100.00	R 3 200.00
2	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	42000	R -	R 110.00	R 3 520.00
3	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	38000	R -	R 121.00	R 3 872.00
4	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	34000	R -	R 133.10	R 4 259.20
5	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	30000	R -	R 146.41	R 4 685.12
6	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	26000	R -	R 161.05	R 5 153.63
7	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	22000	R -	R 177.16	R 5 669.00
8	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	18000	R -	R 194.87	R 6 235.89
9	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	14000	R -	R 214.36	R 6 859.48
10	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	10000	R -	R 235.79	R 7 545.43
11	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	6000	R -	R 259.37	R 8 299.98
12	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	2000	R -	R 285.31	R 9 129.97
13	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	46000	R17 420.00	R 313.84	R 567 482.97
14	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	42000	R -	R 345.23	R 11 047.27
15	1 x 300W LED + 1 x 200W SPECTRALED FP	2	32	4000	38000	R -	R 379.75	R 12 151.99
	TOTAL (a) Maintenance Cost: R							R 659 111.94

Table 63: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	500
[2]	Pole spacing	m	60
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	13 400.00
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 428 808.33
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	8.33
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R123 666.67
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R3 283 808.33

Table 64: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R	659 111.94
2	TOTAL COST OF OWNERSHIP	R	R	3 283 808.33
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R**	**3 942 920.27**

8.4.3 Simulation 4c – Genlux Lighting (Life Cycle Cost)

Table 65: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	2 x 244W GEN II HP SL 5	2	32	4000	46000	R -	R 100.00	R 3 200.00
2	2 x 244W GEN II HP SL 5	2	32	4000	42000	R -	R 110.00	R 3 520.00
3	2 x 244W GEN II HP SL 5	2	32	4000	38000	R -	R 121.00	R 3 872.00
4	2 x 244W GEN II HP SL 5	2	32	4000	34000	R -	R 133.10	R 4 259.20
5	2 x 244W GEN II HP SL 5	2	32	4000	30000	R -	R 146.41	R 4 685.12
6	2 x 244W GEN II HP SL 5	2	32	4000	26000	R -	R 161.05	R 5 153.63
7	2 x 244W GEN II HP SL 5	2	32	4000	22000	R -	R 177.16	R 5 669.00
8	2 x 244W GEN II HP SL 5	2	32	4000	18000	R -	R 194.87	R 6 235.89
9	2 x 244W GEN II HP SL 5	2	32	4000	14000	R -	R 214.36	R 6 859.48
10	2 x 244W GEN II HP SL 5	2	32	4000	10000	R -	R 235.79	R 7 545.43
11	2 x 244W GEN II HP SL 5	2	32	4000	6000	R -	R 259.37	R 8 299.98
12	2 x 244W GEN II HP SL 5	2	32	4000	2000	R -	R 285.31	R 9 129.97
13	2 x 244W GEN II HP SL 5	2	32	4000	46000	R15 753.30	R 313.84	R 514 148.44
14	2 x 244W GEN II HP SL 5	2	32	4000	42000	R -	R 345.23	R 11 047.27
15	2 x 244W GEN II HP SL 5	2	32	4000	38000	R -	R 379.75	R 12 151.99
	TOTAL (a) Maintenance Cost: R							R 605 777.41

Table 66: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	488
[2]	Pole spacing	m	60
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	12 117.92
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 407 440.33
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	8.13
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R120 698.67
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R3 217 920.33

Table 67: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 605 777.41
2	TOTAL COST OF OWNERSHIP	R	R 3 217 920.33
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 3 823 697.75**

8.4.4 Simulation 4d – Philips Lighting (Life Cycle Cost)

Table 68: Maintenance Cost

Yr	Luminaire Type	Qty of luminaires per mast	Qty of luminaires (1 km)	Burning Hrs / Annum	Luminaire Life Hrs	Luminaire Replacement: Material + Labour	Labour cost to clean 1 x luminaire glass (Fixed)	Total Maintenance Cost / Annum Col (7+8) x (4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	46000	R -	R 100.00	R 3 200.00
2	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	42000	R -	R 110.00	R 3 520.00
3	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	38000	R -	R 121.00	R 3 872.00
4	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	34000	R -	R 133.10	R 4 259.20
5	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	30000	R -	R 146.41	R 4 685.12
6	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	26000	R -	R 161.05	R 5 153.63
7	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	22000	R -	R 177.16	R 5 669.00
8	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	18000	R -	R 194.87	R 6 235.89
9	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	14000	R -	R 214.36	R 6 859.48
10	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	10000	R -	R 235.79	R 7 545.43
11	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	6000	R -	R 259.37	R 8 299.98
12	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	2000	R -	R 285.31	R 9 129.97
13	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	46000	R12 859.28	R 313.84	R 421 539.77
14	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	42000	R -	R 345.23	R 11 047.27
15	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	2	32	4000	38000	R -	R 379.75	R 12 151.99
	TOTAL (a) Maintenance Cost: R							R 513 168.74

Table 69: Installation and Energy Costs

1	2	3	4
Item	**Criteria**	**Unit**	**Value**
[1]	Luminaire Wattage, (total wattage if more that 1 luminaires on pole)	W	450
[2]	Pole spacing	m	60
[3]	Number of years to be considered for evaluation	years	15
[4]	Electricity cost per kWh, averaged over the projected period	R	3.71
[5]	Cost of installed pole, inclusive of internal wiring	R	70 828.50
[6]	Price of luminaire, inclusive of light source (Unit x Qty on pole)	R	9 891.75
[7]	Scheme price: (1000/[2]*(1500+[5]+[6])	R	1 370 337.50
[8]	Power consumption per km:(1000/[2]*([1]/1000)	kW	7.50
[9]	Annual Energy cost per km: [4]*4000*[8]	R	R111 300.00
[10]	Cost of Ownership for the evaluation period: [7]+([3]*[9])	R	R3 039 837.50

Table 70: Total Life Cycle Cost for 1km of Lighting

1	TOTAL COST OF MAINTENANCE	R	R 513 168.74
2	TOTAL COST OF OWNERSHIP	R	R 3 039 837.50
3	**TOTAL LIFE CYCLE COST FOR 1KM OF LIGHTING**	**R**	**R 3 553 006.24**

8.5 Summary

8.5.1 BEKA Schréder – Life Cycle Costs Summary

Table 71: BEKA Schréder Luminaires – Total Life Cycle Costs calculated

Sim.	Description	Luminaire Configuration	Total Life Cycle cost / km
1a	N12 Roadway – Single Carriageway with 2 Lanes	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	R 4 502 741.23
2a	N12 Roadway – Single Carriageway with 4 Lanes	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	R 5 780 294.70
3a	Approaching Intersections – Single Carriageway with 4 Lanes	1 x 265W LEDLUME XP 4 + 1 x 138W LEDLUME MIDI	R 3 361 403.87
4a	Approaching Intersections – Dual Carriageway with 2 Lanes	2 x 265W LEDLUME XP 4	R 3 960 760.54
			R 17 605 200.34

8.5.2 Magnitech Lighting – Life Cycle Costs Summary

Table 72: Magnitech Lighting Luminaires – Total Life Cycle Costs calculated

Sim.	Description	Luminaire Configuration	Total Life Cycle cost / km
1b	N12 Roadway – Single Carriageway with 2 Lanes	1 x 300W LED + 1 x 150W SPECTRALED FP	R 5 037 356.70
2b	N12 Roadway – Single Carriageway with 4 Lanes	1 x 300W LED + 1 x 150W SPECTRALED FP	R 6 464 831.61
3b	Approaching Intersections – Single Carriageway with 4 Lanes	1 x 300W LED + 1 x 150W SPECTRALED FP	R 3 757 420.27
4b	Approaching Intersections – Dual Carriageway with 2 Lanes	1 x 300W LED + 1 x 200W SPECTRALED FP	R 3 942 920.27
			R 19 202 528.86

8.5.3 Genlux Lighting – Life Cycle Costs Summary

Table 73: Genlux Lighting Luminaires – Total Life Cycle Costs calculated

Sim.	Description	Luminaire Configuration	Total Life Cycle cost / km
1c	N12 Roadway – Single Carriageway with 2 Lanes	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	R 4 600 501.29
2c	N12 Roadway – Single Carriageway with 4 Lanes	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	R 5 904 933.03
3c	Approaching Intersections – Single Carriageway with 4 Lanes	1 x 280W GEN II HP SL 5 + 1 x 120W GEN I SL 3	R 3 432 880.86
4c	Approaching Intersections – Dual Carriageway with 2 Lanes	2 x 244W GEN II HP SL 5	R 3 823 697.75
			R 17 762 012.92

8.5.4 Philips Lighting – Life Cycle Costs Summary

Table 74: Philips Lighting Luminaires – Total Life Cycle Costs calculated

Sim.	Description	Luminaire Configuration	Total Life Cycle cost / km
1d	N12 Roadway – Single Carriageway with 2 Lanes	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	R 4 765 901.87
2d	N12 Roadway – Single Carriageway with 4 Lanes	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	R 6 118 357.25
3d	Approaching Intersections – Single Carriageway with 4 Lanes	1 x 300W RoadFlair Gen2 + 1 x 150W RoadFlair Gen2	R 3 558 272.38
4d	Approaching Intersections – Dual Carriageway with 2 Lanes	1 x 250W RoadFlair Gen2 + 1 x 200W RoadFlair Gen2	R 3 553 006.24
			R 17 995 537.74

9 DRAWINGS ISSUED

9.1 Detailed Electrical Design Drawings

The following are a list of detailed design drawings developed and are submitted with this Detailed Design report.

DNA-N12-ELE-PL-L01	KM 71.00 to KM 71.38
DNA-N12-ELE-PL-L02	KM 71.38 to KM 71.86
DNA-N12-ELE-PL-L03	KM 71.88 to KM 72.36
DNA-N12-ELE-PL-L04	KM 72.38 to KM 72.86
DNA-N12-ELE-PL-L05	KM 72.86 to KM 73.34
DNA-N12-ELE-PL-L06	KM 73.36 to KM 73.84
DNA-N12-ELE-PL-L07	KM 73.84 to KM 74.32
DNA-N12-ELE-PL-L08	KM 74.34 to KM 74.82
DNA-N12-ELE-PL-L09	KM 74.84 to KM 75.32
DNA-N12-ELE-PL-L10	KM 75.32 to KM 75.80
DNA-N12-ELE-PL-L11	KM 75.82 to KM 76.30

9.2 Civil Drawings

The following are a list of civil drawings developed and are submitted with this Detailed Design report.

DNA-N12-CIV-PL-L01	KM 71.00 to KM 71.38
DNA-N12-CIV-PL-L02	KM 71.88 to KM 72.36
DNA-N12-CIV-PL-L03	KM 73.36 to KM 73.84
DNA-N12-CIV-PL-L04	KM 74.32 to KM 74.82
DNA-N12-CIV-PL-L05	KM 74.82 to KM 75.32
DNA-N12-CIV-PL-L06	KM 75.32 to KM 75.80
DNA-N12-CIV-PL-L07	KM 75.82 to KM 76.30

9.3 Anti-vandal Standard Drawings

The following are a list of standard street lighting and anti-vandal drawings that are submitted with this Detailed Design report for approval.

DNA-TD-ELE-PL-1001-01	Anti-Vandal Kiosk with Electronic Security
DNA-TD-ELE-PL-1003-00	LV Cable Trench
DNA-TD-ELE-PL-1003-02	Sleeve Installation
DNA-TD-ELE-PL-1004-00	NEMA Socket on Luminaire
DNA-TD-ELE-PL-1004-01	NEMA Socket on Junction Box
DNA-TD-ELE-PL-1005-00	Labelling & Tagging Detail

DNA-TD-ELE-PL-1006-01	20m Scissor Mast with Electronic Security
DNA-TD-ELE-PL-1006-03	30m High Mast with Electronic Security
DNA-TD-ELE-PL-1007-00	LMS Topology

10 PROJECT PROGRAMME

The program developed for this project is shown in the table below.

Task Name	Duration	Start	Finish	% Complete
CONTRACT: SANRAL X.012-150-2021_1F	**542 days**	**Tue 22/02/22**	**Wed 20/03/24**	**13%**
Appointment of DNA Consulting Engineers	**10 days**	**Tue 22/02/22**	**Mon 07/03/22**	**100%**
Receipt of Form of Acceptance	1 day	Tue 22/02/22	Tue 22/02/22	100%
Project Handover Meeting	1 day	Mon 07/03/22	Mon 07/03/22	100%
Project Assessment phase	**17 days**	**Wed 09/03/22**	**Thu 31/03/22**	**100%**
Site Audit	2 days	Wed 09/03/22	Thu 10/03/22	100%
Prepare Draft Assessment Report	14 days	Fri 11/03/22	Wed 30/03/22	100%
Issue Draft Assessment Report	1 day	Thu 31/03/22	Thu 31/03/22	100%
Concept Stage	**37 days**	**Fri 01/04/22**	**Mon 23/05/22**	**100%**
Comments from Sanral - Assessment Report	7 days	Fri 01/04/22	Mon 11/04/22	100%
Concept Design	20 days	Fri 01/04/22	Thu 28/04/22	100%
Issue Draft Concept Report	2 days	Fri 29/04/22	Mon 02/05/22	100%
Comments from Sanral - Concept Report	15 days	Mon 02/05/22	Fri 20/05/22	100%
Issue Final Concept Report	1 day	Mon 23/05/22	Mon 23/05/22	100%
Prelim Design Stage	**17 days**	**Mon 23/05/22**	**Tue 14/06/22**	**59%**
Prelim Design	10 days	Mon 23/05/22	Fri 03/06/22	100%
Issue Draft Prelim Design Report	1 day	Mon 06/06/22	Mon 06/06/22	0%
Comments from Sanral - Prelim Design Report	5 days	Tue 07/06/22	Mon 13/06/22	0%
Issue Prelim Design Report	1 day	Tue 14/06/22	Tue 14/06/22	0%
Detailed Design Stage	**20 days**	**Tue 14/06/22**	**Mon 11/07/22**	**0%**
Detailed Design	14 days	Tue 14/06/22	Fri 01/07/22	0%
Issue Draft Design Report	1 day	Mon 04/07/22	Mon 04/07/22	0%
Comments from Sanral - Design Report	5 days	Tue 05/07/22	Mon 11/07/22	0%
Tender Documentation	**33 days**	**Tue 05/07/22**	**Thu 18/08/22**	**0%**
Preparation and submission of Draft tender documents & Detailed Design Report	15 days	Tue 05/07/22	Mon 25/07/22	0%
Comments from SANRAL	5 days	Tue 26/07/22	Mon 01/08/22	0%
Prepare and issue final document for PG3	4 days	Tue 02/08/22	Fri 05/08/22	0%
Client approval of tender documentation - PG3	2 days	Mon 08/08/22	Tue 09/08/22	0%
Update and Final submission for tender	7 days	Wed 10/08/22	Thu 18/08/22	0%
Tender Advertisement	**1 day**	Fri 19/08/22	Fri 19/08/22	0%
Tender period	**30 days**	**Mon 22/08/22**	**Fri 30/09/22**	**0%**
Invitation to bid	1 day	Mon 22/08/22	Mon 22/08/22	0%
Site inspection	1 day	Thu 25/08/22	Thu 25/08/22	0%
Tender clarification and period allowed for contractors to submit bids	21 days	Tue 23/08/22	Tue 20/09/22	0%
Tender closure	1 day	Wed 21/09/22	Wed 21/09/22	0%

Preparation and submission of tender evaluation report	7 days	Thu 22/09/22	Fri 30/09/22	0%
Appointment of Contractor	**14 days**	Mon 03/10/22	Thu 20/10/22	0%
Contractor site handover	**14 days**	Fri 21/10/22	Wed 09/11/22	0%
Contractor Mobilization Period (3 Months)	66 days	Thu 10/11/22	Thu 09/02/23	0%
Construction phase (12 months)	**261 days**	Fri 10/02/23	Fri 09/02/24	0%
Submission of draft Contract Report and as-built data	**14 days**	Mon 12/02/24	Thu 29/02/24	0%
Submission of final Contract Reports and as-built data	**14 days**	Fri 01/03/24	Wed 20/03/24	0%

11 PROJECT RISK ASSESSMENT

A baseline risk assessment is submitted as an attachment to this Detailed Design Report.

12 ENVIRONMENTAL ISSUES AND MANAGEMENT

After further investigations and guidance from the SANRAL project team, it was determined that an Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) will not be required for this project.

13 OPERATIONS AND MAINTENANCE STRATEGY

The maintenance strategies for the major electrical equipment and infrastructure are provided in annexure 16.2. The maintenance items shall be implemented by the routine road maintenance (RRM) team for the section of roadway.

14 PROJECT BUDGET

Table 75 below summarizes the project budget developed for this project.

Table 75: Summary of Project Budget

SECTION	DESCRIPTION	AMOUNT (R)
A	CONTRACTOR'S ESTABLISHMENT ON SITE AND GENERAL OBLIGATIONS	R 1 490 000.00
B	ACCOMODATION OF TRAFFIC	R 1 830 000.00
C	CIVIL WORKS	R 12 069 709.43
D1013	STAKEHOLDER AND COMMUNITY LIASON AND TARGETED ENTERPRISES UTILISATION AND DEVELOPMENT	R 2 401 000.00
E	ELECTRICAL WORKS	R 20 325 937.07

	SUB TOTAL (EXCL. VAT)	**R 38 116 646.50**

15 CONCLUSION

The roadway lighting criteria was amended and developed for the four roadway carriageways and was used to simulate the luminaires from four lighting suppliers i.e. BEKA Schréder, Magnitech Lighting, Genlux Lighting, and Philips Lighting. All suppliers were able to provide luminaires that were able to meet the roadway criteria set.

The simulation results obtained for the various suppliers was also used to develop the life cycle costs for each of the relevant supplier. Table 76 below summarizes the life cycle costs for the various suppliers.

Table 76: Summary of Life Cycle Costs for the four suppliers

	Supplier	**Total Life Cycle cost / km**
1	BEKA Schréder Life Cycle Costs	R 17 605 200.34
2	Magnitech Lighting Life Cycle Costs	R 19 202 528.86
3	Genlux Lighting Life Cycle Costs	R 17 762 012.92
4	Philips Lighting Life Cycle Costs	R 17 995 537.74

As observed in the above table, there is no more than a 10% difference between the life cycle costs for the four suppliers. This is a reliable indication that the project's suggested design solutions are easily implementable and widely accessible in the marketplace.

16 ANNEXURES

16.1 Luminaire Datasheets

16.1.1 BEKA Schréder Luminaire Datasheets

LEDlume

LEDlume-mini

IP 66

Up to IK 10

Up to 20kV

LEDlume-midi

LEDlume-maxi

SA Pat. 2012/07685

A profitable investment

The LEDlume range offers optimised photometrical performance with a minimum total cost of ownership. It provides customers with the ideal tool to generate energy savings, improve lighting levels and reduce maintenance costs. The great variety of high-performance optics optimises the photometric distribution for each specific application to achieve minimum energy consumption.

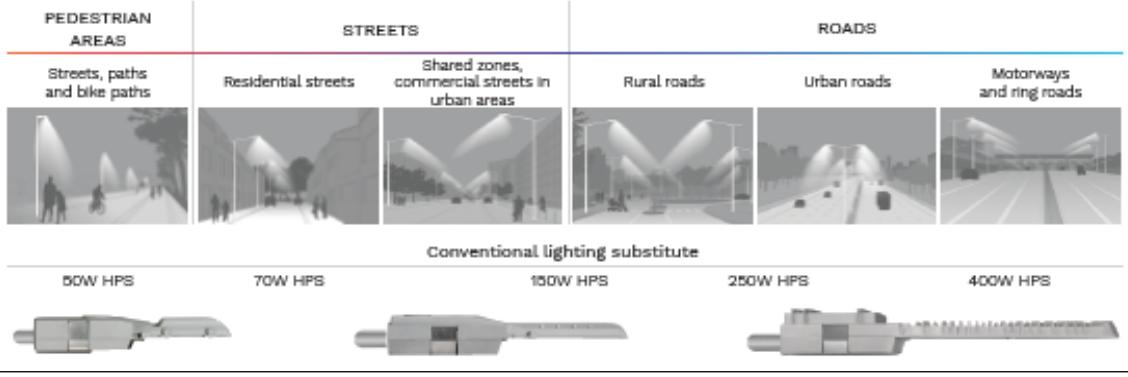
The LEDlume range offers flexible combinations of LED modules, a choice of currents and dimming options to further maximise energy savings and provide the most cost-effective solution.

Key advantages

- Designed and manufactured in South Africa
- Designed to operate LED light sources of up to 276W in an ambient temperature (Tq) environment of up to 25°C, without reducing the useful lifetime of 100 000 hours, at a lumen depreciation of not more than 10% (L90)
- Possible energy savings of more than 70% (*)
- Designed for easy technology upgrade (FutureProof)
- Easy to install
- Unsurpassed light uniformity
- 5 year warranty (**)

(*) Combined with controls

(**) Terms and conditions apply



LEDLUME XP

IP 66

Up to IK 10

Up to 20kV

LEDLUME XP 1

LEDLUME XP 2

LEDLUME XP 3

LEDLUME XP 4

SA Pat. 2012/07685

A profitable investment

The LEDLUME XP offers optimised photometrical performance with a minimum total cost of ownership. It provides customers with the ideal tool to generate energy savings, improve lighting levels and reduce maintenance costs. The great variety of high-performance optics optimises the photometric distribution for each specific application to achieve minimum energy consumption.

The LEDLUME XP range takes advantage of the latest photometric innovations. It uses the new LensoFlex®4 photometric engine, which has been developed around the ideas of performance, compactness, versatility and standardisation.

The LEDLUME XP offers flexible combinations of LED modules, a choice of currents and dimming options to further maximise energy savings and provide the most cost-effective solution.

INTERCHANGE | ROADS & MOTORWAYS | URBAN & RESIDENTIAL STREETS | CAR PARKS | BIKE & PEDESTRIAN PATHS

HIGHMAST LIGHTING | SECURITY LIGHTING | INDUSTRIAL HARBOUR | LOADING BAY | SQUARES & PEDESTRIAN AREAS

Key advantages

- Designed and manufactured in South Africa (SADC Class 5 > 87% local manufacture)
- Designed to operate LED light sources of up to 265W in an ambient temperature (Tq) environment of up to 25°C, without reducing the useful lifetime of 100 000 hours, at a lumen depreciation of not more than 5% (L95B10)
- New generation of LensoFlex®4 photometric engine, providing maximum spacings for compliance with SANS 10098 road lighting classification, while maintaining comfort and safety
- Marine grade, high-pressure die-cast aluminium housing
- Maximised savings in energy (more than 70% possible) and maintenance costs
- Designed for easy technology upgrade (FutureProof)
- Easy to install
- Unsurpassed light uniformity
- Surge protection 10kV/10kA
- Circular economy 4-star rating
- 5 year warranty (*)

(*) Terms and conditions apply

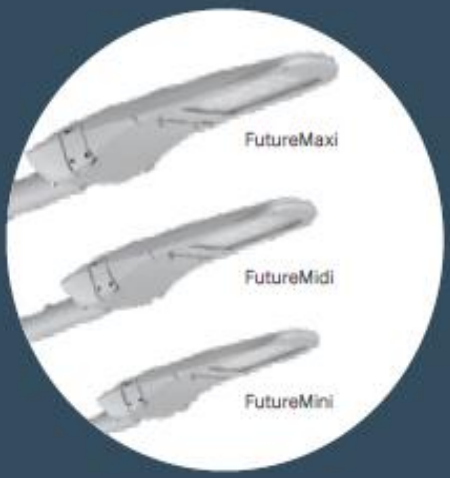
16.1.2 Magnitech Lighting Luminaire Datasheets

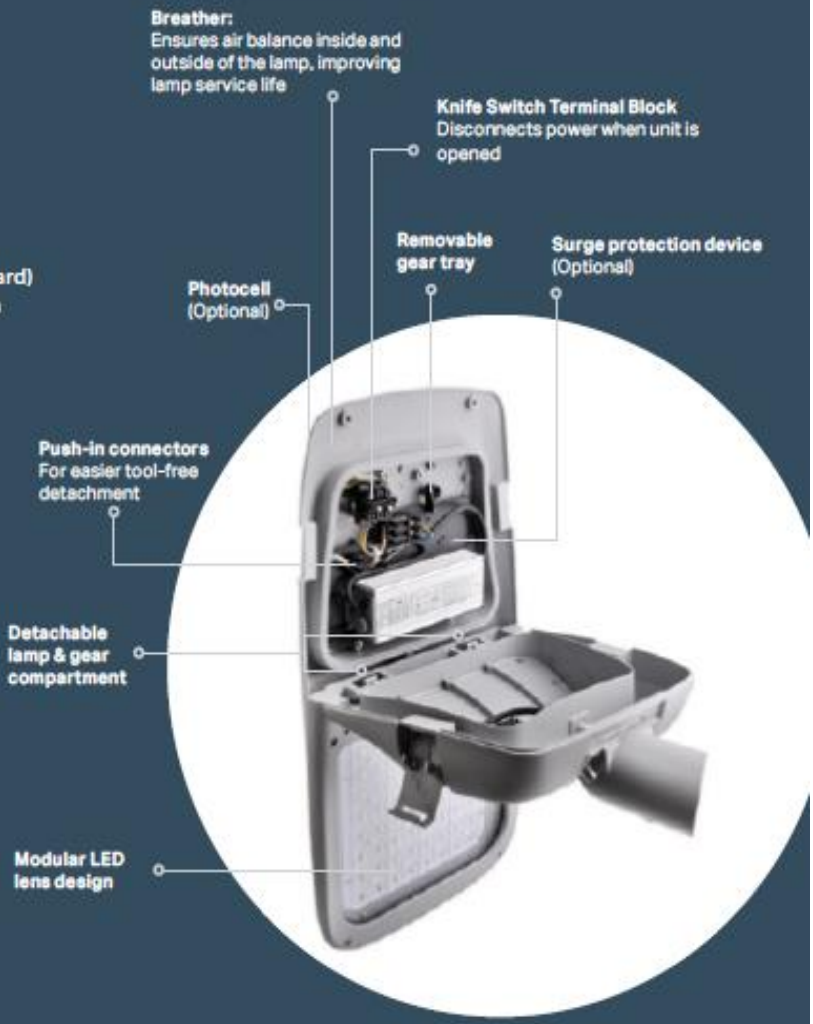
SPECTRALED FP

FUTURE PROOF LED STREETLIGHT AND HIGHMAST RANGE

FEATURES

- **Fully detachable ADC12 IP66 fixture, offering tool-free maintenance, side or bottom entry installation with multiple rake angles as well as various optics for optimal light distribution**
- **IP 66 rated**
- **Body**
  ADC12 Die-cast aluminium, detachable from base
- **Diffuser**
  IK09 impact resistant glass
- **Wiring**
  High Temperature SABS approved wiring with inline push-in connectors
- **Gasket**
  Closed cell silicon gasket for durability and heat resistance
- **Spigot Entry**
  Future Mini: 42mm/60mm ø
  Future Midi: 42mm/60mm ø
  Future Maxi:76mm ø
- **Electrical Class**
  I or II
- **Optics**
  Multiple Optics available
- **Surge Protection:**
  Internal 6kv surge protection (standard)
  External 10kv/20kv surge protection (optional)
- **Windage Area:**
  Future Mini: 0.0345m²
  Future Midi: 0.0503m²
  Future Maxi: 0.0748m²
- **Intelligent Control System**
  Optional





APPLICATIONS

- **Street lighting**
  Class A and B Roadways
- **Highmast and interchanges**
- **Outdoor lighting**
- **Security lighting**
- **General amenity lighting**

STANDARDS

- **SANS / IEC 60598**
- **SANS 475**

16.1.3 Genlux Lighting Luminaire Datasheets

Doc Ref: TD01 Rev: 10

GENLUX LIGHTING
a lighting technology company

GEN I LED STREETLIGHT

GENERAL TECHNICAL DATA & WARRANTY INFORMATION

Typical applications:		• Class A Roadway lighting • Class B Roadway lighting • Parking areas • Commercial areas • Residential areas
Light source:		High powered LED Modules
Colour temperature:		• 3000K* • 4000K • 5000K*
Operating temperature range:		-30°C to 45°C
Relative humidity:	Operational:	5% to 95%
	Storage:	10% to 90%
Design life:		100 000 hours
Typical Lumen maintenance:		Up to L90 @ 100 000 hours
IP Rating:		IP66 (Lamp and gear compartment)
Luminaire housing:		High-pressure die-cast LM6 aluminum finished with a durable dark grey* polyester epoxy powder coating. [*Grey is the standard colour, unpainted or other colours available on request]
Luminaire clips and fasteners:		• 304 Grade stainless steel • 316 Grade stainless steel*
Diffuser:		• 4mm Clear tempered glass diffuser • High impact PC diffuser*
Optics:		Optical grade acrylic (PMMA) Zhaga book 15 compliant lenses
Impact protection grade:		IK08
Mounting options:		• Rear / Side spigot entry tapering from 45mm Ø to 42mm Ø • Spigot mounting depth 125mm
Windage area:		0.095m^2
Dimmable:		1-10V* DALI* D4i*
Surge protection:		10+10KV / 10+10kA
Power supply:		220V to 240V AC 50/60 Hz
Power factor:		0.98
Insulation classification:		Class 1
Compliance standard/s:		• SANS / IEC 60598-2-3 • SANS 475

[*Available on request]

Doc Ref: TD04 Rev: 10

GENLUX LIGHTING
a lighting technology company

GEN II HP LED STREETLIGHT

GENERAL TECHNICAL DATA & WARRANTY INFORMATION

Typical applications:		• Class A Roadway lighting • Class B Roadway lighting • Parking areas • Commercial areas • Residential areas
Light source:		High powered LED Modules
Colour temperature:		• 3000K* • 4000K • 5000K* [*Available on request]
Operating temperature range:		-30°C to 45°C
Relative humidity:	Operational:	5% to 95%
	Storage:	10% to 90%
Design life:		100 000 hours
Typical Lumen maintenance:		Up to L90 @ 100 000 hours
IP Rating:		IP66 (Lamp and gear compartment)
Luminaire housing:		High-pressure die-cast LM6 aluminum finished with a durable dark grey* polyester epoxy powder coating. [*Grey is the standard colour, unpainted or other colours available on request]
Luminaire clips and fasteners:		• 304 Grade* stainless steel [*316 Grade available on request]
Diffuser:		• 4mm Clear tempered glass diffuser [High impact PC diffuser available on request]
Optics:		Optical grade acrylic (PMMA) Zhaga book 15 compliant lenses
Impact protection grade:		IK08
Mounting options:		• Rear / Side spigot entry tapering from 45mm Ø to 42mm Ø • Spigot mounting depth 125mm
Windage area:		0.12m²
Dimmable:		1-10V or DALI* [*Available on request]
Surge protection:		10+10kV / 10+10kA
Power supply:		220V to 240V AC 50/60 Hz
Power factor:		0.98
Insulation classification:		Class 1
Weight:		15.2kg - 16.5 kg
Compliance standard/s:		• SANS / IEC 60598-2-3 • SANS 475

[*Available on request]

16.1.4 Philips Lighting Luminaire Datasheets

PHILIPS

Lighting

RoadFlair Gen2

BRP492 LED215/NW 150W 220-240V DM GM

RoadFlair Gen2 - 21500 lm - 150 W - 4000 K

RoadFlair Gen2 is brand new design road lighting product family, set to meet customers' all-round requirements, including high lumen efficacy for energy saving and sustainability, aesthetic design for nice shape and appearance, quality material and components for product reliability and long lifetime, professional optics for various applications fulfillment, dimming and system control interface for improving municipal operations and offering future-proof features. RoadFlair Gen2 competitive price would help on the acceleration of road lighting LED transformation, to a more sustainable society and smarter city.

Product data

General information	
Light source color	740 neutral white
Driver included	Yes
Optical cover/lens type	Polycarbonate micro lens optic
Control interface	Analog
Connection	Screw connection block 3-pole
Cable	-
Protection class IEC	Safety class I
CE mark	CE mark

Operating and electrical	
Input Voltage	220 to 240 V
Input Frequency	50 or 60 Hz
Power Factor (Min)	0.95

Controls and dimming	
Dimmable	Yes

Mechanical and housing	
Housing Material	Aluminium pressure die cast
Optical cover/lens material	Polycarbonate
Overall length	404 mm
Overall width	230 mm
Overall height	136 mm
Color	Aluminum and gray

Approval and application	
Ingress protection code	IP66 [Dust penetration-protected, jet-proof]
Mech. impact protection code	IK08 [5 J vandal-protected]

Initial performance (IEC compliant)	
Initial luminous flux (system flux)	21500 lm

PHILIPS

Lighting

RoadFlair Gen2

BRP493 LED285/NW 200W 220-240V DM GM

RoadFlair Gen2 - 28500 lm - 200 W - 4000 K

RoadFlair Gen2 is brand new design road lighting product family, set to meet customers' all-round requirements, including high lumen efficacy for energy saving and sustainability, aesthetic design for nice shape and appearance, quality material and components for product reliability and long lifetime, professional optics for various applications fulfillment, dimming and system control interface for improving municipal operations and offering future-proof features. RoadFlair Gen2 competitive price would help on the acceleration of road lighting LED transformation, to a more sustainable society and smarter city.

Product data

General information	
Light source color	740 neutral white
Driver included	Yes
Optical cover/lens type	Polycarbonate micro lens optic
Control interface	Analog
Connection	Screw connection block 3-pole
Cable	-
Protection class IEC	Safety class I
CE mark	CE mark

Operating and electrical	
Input Voltage	220 to 240 V
Input Frequency	50 or 60 Hz
Power Factor (Min)	0.95

Controls and dimming	
Dimmable	Yes

Mechanical and housing	
Housing Material	Aluminium pressure die cast
Optical cover/lens material	Polycarbonate
Overall length	510 mm
Overall width	297 mm
Overall height	136 mm
Color	Aluminum and gray

Approval and application	
Ingress protection code	IP66 [Dust penetration-protected, jet-proof]
Mech. impact protection code	IK08 [5 J vandal-protected]

Initial performance (IEC compliant)	
Initial luminous flux (system flux)	28500 lm

PHILIPS

Lighting

RoadFlair Gen2

BRP493 LED362/NW 250W 220-240V DM GM

36200 lm - 250 W - 4000 K

The RoadFlair Gen2 is brand new design road lighting product family, set to meet customers' all-round requirements, including high lumen efficacy for energy saving and sustainability, an aesthetic design with nice shapes and appearance, quality materials and components for product reliability and long lifetime, professional optics for various applications, a dimming and system control interface for improving municipal operations and offering future-proof features. The RoadFlair Gen2 competitive price will help with the acceleration of road lighting LED transformation, to a more sustainable society and smarter city.

Product data

General Information	
Lamp colour code	740 neutral white
Driver included	Yes
Optical cover/lens type	PC-MLO [Polycarbonate micro lens optic]
Control interface	Analog
Connection	SI [Screw connection block]
Cable	-
Protection class IEC	Safety class I (I)
CE mark	CE mark

Operating and Electrical	
Input Voltage	220 to 240 V
Input frequency	50 or 60 Hz
Power factor (min.)	0.95

Controls and Dimming	
Dimmable	Yes

Mechanical and Housing	
Housing material	Aluminium pressure die cast
Optical cover/lens material	Polycarbonate
Overall length	519 mm
Overall width	297 mm
Overall height	136 mm
Colour	Aluminium and Grey

Approval and Application	
Ingress protection code	IP66 [Dust penetration-protected, jet-proof]
Mech. impact protection code	IK08 [5 J vandal-protected]

Initial Performance (IEC Compliant)	
Initial luminous flux (system flux)	36200 lm

PHILIPS
Lighting

RoadFlair Gen2

BRP494 LED435/NW 300W 220-240V DM GM

RoadFlair Gen2 - 43500 lm - 300 W - 4000 K

RoadFlair Gen2 is brand new design road lighting product family, set to meet customers' all-round requirements, including high lumen efficacy for energy saving and sustainability, aesthetic design for nice shape and appearance, quality material and components for product reliability and long lifetime, professional optics for various applications fulfillment, dimming and system control interface for improving municipal operations and offering future-proof features. RoadFlair Gen2 competitive price would help on the acceleration of road lighting LED transformation, to a more sustainable society and smarter city.

Product data

General information	
Light source color	740 neutral white
Driver included	Yes
Optical cover/lens type	Polycarbonate micro lens optic
Control interface	Analog
Connection	Screw connection block 3-pole
Cable	-
Protection class IEC	Safety class I
CE mark	CE mark

Operating and electrical	
Input Voltage	220 to 240 V
Input Frequency	50 or 60 Hz
Power Factor (Min)	0.95

Controls and dimming	
Dimmable	Yes

Mechanical and housing	
Housing Material	Aluminium pressure die cast
Optical cover/lens material	Polycarbonate
Overall length	702 mm
Overall width	229 mm
Overall height	149 mm
Color	Aluminum and gray

Approval and application	
Ingress protection code	IP66 [Dust penetration-protected, jet-proof]
Mech. impact protection code	IK08 [5 J vandal-protected]

Initial performance (IEC compliant)	
Initial luminous flux (system flux)	43500 lm

16.2 Maintenance Plans

16.2.1 Maintenance Plan for Poles and Masts

Maintenance Items	Items to be checked	Action Required if inspection shows unsatisfactory conditions	Frequency
Inspect the mast or pole	General check for rust, damage, foreign objects, bird nests, etc	Replace or repair	Quarterly
Photocell	Test operation	Clean, Replace if faulty	Quarterly
Pole / Mast label or tag	Review against as-built drawing	Replace if damaged or not clearly visible.	Quarterly
Hoisting Rope *S	Check anchorage points at both ends of rope (thimbles & ferrules)	Replace or repair	Annual
Hoisting Rope *S	Inspect rope for fraying or other damage	Replace or repair	Annual
Maintenance Anchor *S	Check terminations at both ends of rope (thimbles & ferrules)	Replace or repair	Annual
Maintenance Anchor *S	Inspect rope for fraying, kinking or other damage	Replace or repair	Annual
Mast Base *S	Check correct functioning of latching device.	Clean latching area. Replace or repair.	Annual
Mast / Pole	Inspect for corrosion	Remove all traces of rust with steel brush and emery paper. Touch up all clear surfaces with zinc rich primer.	Annual
Mast Base *S	Check that counterweights are securely mounted.	Tighten bolts and nuts on weight retainer bracket.	Annual
Mast Base *S	Inspect all electrical connections	Tighten where necessary.	Annual
Mast Base *S	Check foundation bolts	Tighten where necessary. Holding down nuts and support nuts.	Annual
Mast Base *S	Inspect safety chain for corrosion.	Clean. Seek manufacturer advice. Replace if necessary.	Annual
Mast Base *S	Lowering and raising of mast	Manufacturer's operation method to be followed.	Annual
Luminaire mounting ring	Check all nuts and bolts	Tighten	Annual
Electrical system	Inspect cables, termination boxes, splitter boxes.	Replace all damaged units. Secure cables.	Annual
Earth Resistance	Examine & test earthing and bonding	Take suitable action if earth resistance is high	Annually
Counterweights	Remove and inspect all counterweights and inside mast	Clean and re-paint if required. Seek manufacturer advice. Replace if necessary.	Every 2 years

*S Applicable to Scissor masts

16.2.2 Maintenance Plan for Lighting & Distribution Kiosks

Maintenance Items	Items to be checked	Action Required if inspection shows unsatisfactory conditions	Frequency
Inspect the equipment	General check for rust, damage, foreign objects, bird nests, painting etc	Remove and repair	Quarterly
Clean the exterior surfaces	Any dust build-up, foreign objects	Clean with dry cloth. No water to be used.	Quarterly
Indicator lights	Examine & test indicator lights are indicating and reading correctly.	Clean the components. Replace components and fuse if necessary	Quarterly
Meters	Examine & test meters are indicating and reading correctly.	Clean the components. Re-calibrate and Replace components if necessary	Quarterly
Clean the interior *	Any dust build-up, foreign objects	Clean with blower and dry cloth. No water to be used.	Quarterly
Check terminations*	Examine for loose connects and hot spots	Tighten and replace as required	Quarterly
Protection Systems*	Examine & test relay and alarm contacts, their operation fuse etc. check relay accuracy.	Clean the components. Replace contacts and fuse if necessary	Quarterly
Equipment functions*	Examine & test all circuit breakers and UPS functions and interlocks	Take suitable action if not operating	Quarterly
Circuit Diagrams and Labels	Check and verify that all circuit diagrams and labels and up to date and correct	All equipment to be operated and verified	Quarterly
Safety Compliance Labels	Check and verify that all safety compliance labels and notification signage are up to date and correct	All safety compliance labels and notification signage to be installed and damaged labels and signs to be replaced.	Quarterly
Ingress Protection	Check and verify that all seals and gaskets are in place and not damaged. Ensure IP rating is maintained.	Repair / Replace gaskets and seals to maintain IP rating.	Quarterly
Earth Resistance	Examine & test earthing and bonding	Take suitable action if earth resistance is high	Annually

*Shutdown of equipment necessary. All work to be done under permit and lock out procedures.

16.2.3 Maintenance Plan for Transformers

Maintenance Items	Items to be checked	Action Required if inspection shows unsatisfactory conditions	Frequency
Inspect the transformer	General check for rust, damage, leaks, foreign objects, bird nests, painting etc	Remove and repair	Quarterly
Oil leaks	Check all areas of transformer	Identify leak and repair.	Quarterly
Oil level in conservator	Check oil level above minimum level mark on site glass.	If low, top up. Check for oil leaks	Quarterly
Meters	Examine & test meters are indicating and reading correctly.	Clean the components. Re-calibrate and Replace components if necessary	Quarterly
Circuit Diagrams and Labels	Check and verify that all circuit diagrams and labels and up to date and correct	All equipment to be operated and verified	Quarterly
Clean the exterior surfaces	Any dust build-up, foreign objects	Clean with soapy water and spray	Quarterly
Check terminations*	Examine for loose connects and hot spots	Tighten and replace as required	Annually
Check Bushings*	Examine for cracks and dirt deposit	Clean the dirt. If cracked or broken replace the bushing.	Annually
Protection Systems*	Examine & test relay and alarm contacts, their operation fuses etc. check relay accuracy.	Clean the components. Replace contacts and fuse if necessary	Annually
Earth Resistance	Examine & test earthing and bonding	Take suitable action if earth resistance is high	Annually
Oil Sampling	Take oil sample and submit for lab analysis. (KV, Water, Acid, PCB)	Take suitable action on abnormal conditions	Every 2 years

*Shutdown of equipment necessary. All work to be done under permit and lock out procedures.

16.2.4 Maintenance Plan for Luminaires

Maintenance Items	Items to be checked	Action Required if inspection shows unsatisfactory conditions	Frequency
Inspect the Pole	General check for rust, damage, foreign objects, bird nests, painting etc	Remove and repair	Quarterly
Inspect the Luminaire	General check for rust, damage, foreign objects, bird nests, painting, etc.	Remove and repair	Quarterly
Clean the exterior surfaces of street lights	Any dust build-up, foreign objects	Clean with water.	Quarterly
Local and main street light controllers	Examine & test controllers are indicating and working correctly. (local and on-line review of control system where applicable)	Clean the components. Re-calibrate and Replace components if necessary	Quarterly
Clean the interior of poles and luminaires	Any dust build-up, foreign objects	Clean with blower and dry cloth. No water to be used.	Quarterly
Clean the interior of kiosks and other equipment	Any dust build-up, foreign objects	Clean with blower and dry cloth. No water to be used.	Quarterly
Check terminations*	Examine for loose connects and hot spots. Infrared Checks	Tighten and replace as required	Quarterly
Equipment functions*	Examine & test all circuit breaker functions and controller switching.	Take suitable action if not operating	Quarterly
Circuit Diagrams and Labels	Check and verify that all circuit diagrams and labels and up to date and correct	All equipment to be operated and verified	Quarterly
Luminaire alignment	Check that the luminaire has not moved from alignment.	Align and re-adjust the aiming.	Quarterly
Earth Resistance	Examine & test earthing and bonding	Take suitable action if earth resistance is high	Annually

*Shutdown of equipment necessary. All work to be done under permit and lock out procedures.