APPENDIX 2: LED Lighting Review and Trials

Summary

The purposes of this report are to:

- Provide background information on LED lighting technology and its advantages and disadvantages.
- Provide an overview of the LED lantern review and trials undertaken by the LBHF Street Lighting Department.
- Present the ranking of the lanterns trialled.

1.0 Introduction

LED street lighting has been on the market for over 10 years. There have been large improvements in the technology over this time and further improvements continue to be made. The cost of LED street lighting has reduced considerably since it first came out and is continuing to fall as the technology is more widely adopted. It is only recently that LED street lighting has surpassed the performance of the Cosmopolis lighting currently used in the borough in terms of energy efficiency and cost.

LED street lighting has now developed to the point where substantial cost savings can be achieved by bulk replacing older types of lanterns with LED lanterns. The cost savings result from reduced energy consumption and maintenance requirements. LED lighting also offers a number of other benefits over the standard lighting currently used in the borough. The main advantages and disadvantages of LED lighting are listed below.

Advantages:

- Uses less energy than previous light sources to produce an equivalent amount of useful light. This reduces energy consumption and carbon emissions.
- Based on manufacturers' warranties and laboratory test data LEDs should last around 20 years without needing to be replaced. The lanterns currently used have lamps that need to be replaced every 4-6 years.
- Can achieve more even illumination of the road surface and footways.
- Reduced light pollution as less light falls outside the area that needs to be illuminated.
- Some luminaires are designed so that they can be upgraded to take advantage of future improvements in LED lighting technology.
- Capital cost of some LED lanterns is less than the standard lanterns currently used in the borough.
- There are LED Lanterns available that fit in with the aesthetic of the lighting currently used in the borough. Although these tend not to be cheapest option.

- LED lanterns are compatible with Central Management System (CMS) technology and programmable ballasts. Both of these can be used to decrease energy consumption and carbon emissions further by dimming the output of the light at quieter times during the night when there is less traffic on a given road. If programmable ballasts are used the ballast for each light needs to be individually programmed. If a CMS system is used the lights are controlled remotely using computer software and can be switched on or off, dimmed or brightened remotely at any time.

Disadvantages:

- Some LED lanterns cannot be repaired easily if the LED panel or another component fails, meaning that in the event of a failure the whole lantern may need to be replaced.
- Performance can be reduced if the design of the lantern does not control temperature adequately. Some early LED lanterns did not allow sufficient dissipation of heat. This resulted in the colour of the light emitted by the LEDs changing unfavourable over time. However this is unlikely to be an issue with the lanterns currently on the market.
- Can be difficult to get decent warranties on existing lanterns that are retro-fitted with LEDs due to concerns from manufacturers over the water tightness of older lighting units.

2.0 Overview of LED Lantern Review and Trials

In 2013 the Street Lighting Department undertook a review to identify LED lanterns that would be suitable for use in the borough. The lanterns selected are given in Table 1 below. Photographs of the lanterns are referenced in Table 2.1 below and are provided at the end of this report.

Table 2.1 – Lanterns considered for use in borough

Manufacturer	Lantern Name	Physical Trial	Photographs*
Cree	LEDway Road	Yes	1
CU Phosco	P851	Yes	2 & 3
Gemma Lighting	Majestic	Yes	12 & 13
Low Carbon Lighting	Luxon	Yes	4 & 5
OrangeTEK	AriaLED	Yes	6 & 7
Phillips/WRTL	Arc RetroLED	Yes	8 & 9
Phillips/WRTL	Mini Iridium	Yes	14 & 15
Urbis Schreder	Axia	Yes	10 & 11
DW Windsor	Kirium	No	17
Iguzzini	Wow	No	16

*Photographs attached at end of report

From August 2013 physical trials of the majority of the lanterns selected have been undertaken, as detailed in Table 2.1 above. The trials were done on residential roads around the Hammersmith Town Hall, and in several housing estates where lighting was being upgraded and the Council's Housing Department were keen to use LED lighting. The purpose of the trials was to

observe the relative performance of the lanterns in the field. And also to compare the light produced by the LEDs against that from the Cosmopolis lamps currently used.

The lanterns were assessed based on their: performance against the British Lighting Standard; aesthetics when installed on the standard residential lamp column used in the borough; the colour of light produced; glare; cost, warranty; and ease of installation and maintenance. The assessment criteria for each of these factors is discussed in more detail in Section 3. The lanterns have been ranked against each other based on the above.

A number of other London boroughs have also undertaken trials over the last 3 years. However due to the length of time it was taking for the findings to be published, LBHF Transport and Technical Services decided to undertake their own trials. The locations of the trials have been shared with the lighting departments of other Councils in London, so that they can observe the performance of the luminaires for themselves if they wish to do so.

Roads and housing estates trialled with LED lighting;
Nigel Playfair Avenue,
Riverside Gardens,
Macbeth Street,
Great Church Lane,
Barb Mews,
Bedford Passage,
Goldhawk Road,
Uxbridge Road,
William Church Estate,
Alice Gillart Court,
Fulham Court,

3 Assessment Lanterns Used in LED Lighting Trials

The performance of the lanterns trialled by Transport and Technical Services have been assessed and ranked based on the criteria presented below. The results are presented in Table 3.1 at the end of this section.

3.1 Performance against British Lighting Standard

The performance of each lantern against the British Lighting Standard was assessed by modelling the lighting in the software package Lighting Reality. The average, minimum, and maximum horizontal illuminance and also the uniformity of the lighting on the road surface and footways was calculated for each lantern, using the same road geometry and column arrangement. of the designs were produced such that the chosen lantern met the requirements of the British Standard in terms of the above parameters. The lanterns have therefore been ranked based firstly on the wattage of the lantern needed to meet the illuminance requirements; the lower being favoured, and secondly based on uniformity of the lighting achieved on the road surface, the higher uniformity favoured..

3.2 Appearance

It is considered to be important that any lanterns used in the borough look appropriate when installed on the Council's standard lamp columns and brackets. And also that they are in general keeping with the aesthetic of the areas where they are installed. The lanterns trialled have been ranked from lanterns that are most similar in appearance to the standard lantern currently used in the borough down to least similar.

Heritage and town centre lighting is likely to be retrofitted with LED technology rather than being replaced with new lanterns, to maintain the special character of that lighting.

3.3 Colour

The trial included LED lanterns with different correlated colour temperatures (CCT). The purpose of this was to determine what CCT would provide the best colour rendition in the borough's environment. The neutral white (4,000K) colour was assessed to give the best results. This seems to be the general consensus among other local authorities and also manufacturers. All of the lanterns trialled are available in neutral white (4,000k). Therefore the performance of the lanterns cannot be differentiated based on this parameter.

The correlated colour temperature (CCT) provides a measure of the appearance of the colour emitted by a lamp. A CCT of 2,700K corresponds to warm light (yellow/orange). Warm light sources include candles (2,000k) and High Pressure Sodium lamps (2,200k). Cosmopolis lamps (2,700k) produce warm white light. A CCT of 4,000k corresponds to neutral 'white' light. A CCT of 6,000K corresponds to cool light (blue tinge). Clear blue sky has a CCT of 6,500K. LEDs on the market, mainly produce warm white light (3,000-3,500K), neutral white light (4,000K), or cool white light (5,700K).

The efficiency of LED lighting increases with increasing CCT. However at higher colour temperatures the colour of the light can make the area feel quite stark. The light can also have an unappealing blue tinge. Because of these effects there is a practical limit to the efficiency gains that can be achieved by increasing the CCT of LEDs.

3.4 Glare

A subjective assessment of the levels of obtrusive and disability glare produced by each lantern relative to the other lanterns trialled.

Disability glare as defined in British Standard 5489, as glare that "reduces the contrast between objects and the background"

Discomfort Glare/Obtrusive glare relates to the amount of light emitted that falls outside the area being illuminated. This includes light going into the sky – referred to as skyglow, and light going into windows.

3.5 Cost

The capital cost of each lantern has been ranked against the capital cost of the other lanterns in trial.

Cost is a very important consideration in the selection of LED lanterns because the lower the capital cost is the shorter the payback period on energy and maintenance savings is.

3.6 Warranty

All the lanterns trialled are covered by a Manufacturer's warranty. The warranties provided with the lanterns have been ranked by the length of the warranty period.

The longer the warranty period is the less risk there is of the Council having to carry out unplanned maintenance, or pay to replace the lantern earlier than its design life. A longer warranty gives greater certainty that predicted savings on maintenance costs will be realised.

A minimum warranty of 6 years is the benchmark, as this is what is provided with the lamps that are currently used. There is a statutory requirement to electrically test lamps every 6 years. So in theory routine maintenance of street lights is only required once every 6 years.

3.7 Installation & Maintenance (IM)

The relative ease of installing and maintaining the LED lanterns has been assessed based on feedback from the Council's Lighting Term Contractor who was responsible for this aspect of the trials. The lanterns have been ranked from easiest to hardest to install and maintain.

Table 3.1 – Ranking of LED Lanterns Trialled for Use in Borough

Manufacturer	Lantern Name	Picture	Performance	Appearance	Colour	Glare	Cost	Warranty	Installation & Maintenance	Ranking
OrangeTEK	AriaLED	6&7	1	4	1	1	3	1	2	1
CU Phosco	P851	2&3	4	2	1	1	2	3	3	2
Urbis Schreder	Axia	10&11	2	5	1	2	4	3	3	3
Phillips/WRTL	Arc RetroLED	8&9	6	1	1	1	6	4	1	3
Gemma	Majestic	12&13	7	2	1	1	5	4	2	5
DW Windsor	Kirium	17	3	7	1	2	4	3	5	6
Low Carbon Lighting	Luxon	4&5	8	7	1	1	1	2	6	7
Iguzzini	Wow	16	5	7	1	2	4	3	4	7
Phillips/WRTL	Mini Iridium	14&15	9	3	1	2	7	4	3	9
Cree	LEDway Road	1	10	6	1	2	8	3	3	10

Table 3.2 – Assessed Weighted Ranking of LED Lanterns Trialled for Use in Borough

Manufacturer	Lantern Name	Picture	Performance (30%)	Appearance (5%)	Colour	Glare (10%)	Cost (45%)	Warranty (5%)	Installation & Maintenance (5%)	Ranking
OrangeTEK	AriaLED	6&7	1	4	1	1	3	1	2	1
CU Phosco	P851	2&3	4	2	1	1	2	3	3	2
Urbis Schreder	Axia	10&11	2	5	1	2	4	3	3	3
DW Windsor	Kirium		3	7	1	2	4	3	5	4
Low Carbon Lighting	Luxon	4&5	8	7	1	1	1	2	6	5
Iguzzini	Wow	1617	5	7	1	2	4	3	4	6
Gemma	Majestic	12&13	7	2	1	1	5	4	2	7
Phillips/WRTL	Arc RetroLED	8&9	6	1	1	1	6	4	1	8
Phillips/WRTL	Mini Iridium	14&15	9	3	1	2	7	4	3	9
Cree	LEDway Road	1	10	6	1	2	8	3	3	10

4 Trial findings

The above tables show that the top three lanterns trial come out top in both the ranking tables, which is a good result for both a well performing lantern and competitive price. Therefore it is proposed to use the most appropriate lantern from the top 3, on a road by road basis, for rollout of LED lanterns in the borough.

OrangeTEK AriaLED ranks highest amongst those lanterns trialled. They are a low cost, high warranty product, that work suitably well with the council's existing curved brackets. They are quite a new manufacturer into the UK, but have been widely trialled in London with positive feedback.

The CU Phosco P851 lantern ranked second, again, this works well with the aesthetic of the councils curved bracket, it also has very good glare control due to the internal reflectors the lamp employees, rather than direct LED illumination of the road surface. Has been chosen by TfL as their lantern of choice.

The Urbis Axia lantern ranked third, a well-known manufacturer historically used throughout the borough in the 1990's and 2000's with their older lighting technology. Their LED lantern performs well, a few aesthetic issues, but has been chosen as Ealing's lantern of choice.

Philips/WRTL Arc RetroLED ranked third due to it being the same lantern as currently used with Cosmopolis lamps, but only ranked 8th when undertaken as a weighted assessment, due to its comparatively high cost and lower performance.

5 Conclusions

In is proposed to use the most appropriate lantern for a given road in the borough, chosen from one of the top 3 lanterns reviewed. Each road is designed to current British Standards using specific lighting software, with each design quickly comparing the 3 top lanterns to determine the best whole life cost option for the road.

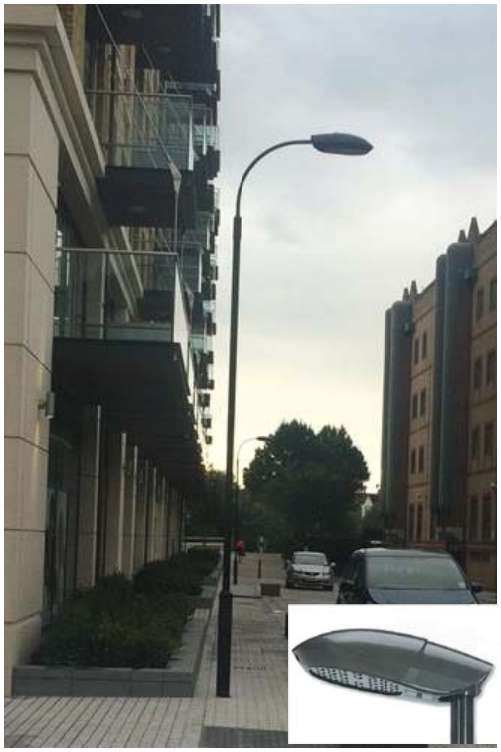
6 Photographs

Photograph 1: Cree – LEDway Road Lantern at Margravine Estate, Field Road

Photographs 2 & 3: C U Phosco – P851 Lantern at Nigel Playfair Avenue

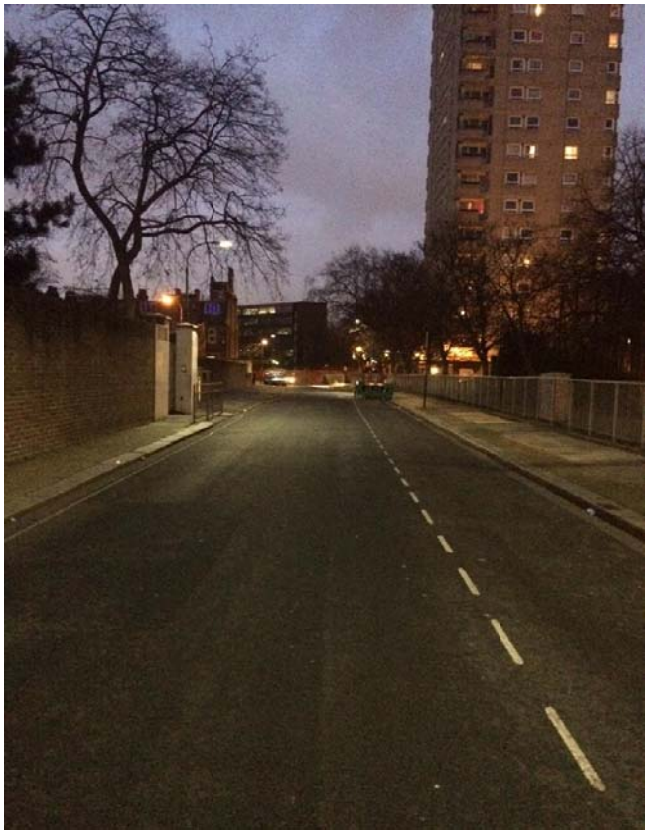
Photographs 4 & 5: Low Carbon Lighting – Luxon Lantern at Holcombe Street

Photographs 6 & 7: OrangeTEK – AriaLED Lantern at Macbeth Street



Photograph 8 & 9: Philips/WRTL – ARC RetroLED Lantern at Fulham Court

Photographs 10 & 11: Urbis – Axia LED Lantern Riverside Gardens



Photographs 12 & 13: Gemma Lighting – Majestic LED lantern Great Church Lane

Photographs 14 & 15: Philips/WRTL – Mini Iridium LED lantern Alice Gillart Court

Photograph 16: Iguzzini – Wow LED lantern, manufacturers picture

Photograph 17: DW Windosr – Kirium LED lantern, manufacturers picture