University of Southern Queensland

Faculty of Engineering and Surveying

Cost Effectiveness of Suburban Street Lighting

A dissertation submitted by

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Abstract

Every municipality throughout Australia provides street lighting. The provision of street lighting is fundamental to vehicle and pedestrian safety alike. Local Government and State/Private energy providers maintain and control streetlighting.

This report focuses on the City of Bunbury (COB) - located two hours south of Perth on the Western Australian south west coastline. The aim of this project is to establish the cost effectiveness of the provision of suburban street lighting within the City by power utility Western Power, compared to the council installing and maintaining its own networks to Australian Standard. The current contract of service between Western Power and the COB for lighting on the majority of its 305km road network expires mid 2006 and COB is now developing a street lighting strategy.

Key findings of the report are:

- The City should continue to adhere to the Western Power Streetlighting 'StreetVision' Agreement.
- The City should through surrounding municipality support and pressure, lobby the monopoly power provider – Western Power, to gain improvements in power supply through reduced provision costs and service improvements.
- The City should attempt to reduce the amount of differing privately owned decorative street lighting being installed.
- The City to commission a report into a Street Light Strategy for the City that will provide a blueprint of streetlighting to be provided throughout the City.

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I further certify that the work is original and has not been previously submitted for assessment in any other course or institution, except where specifically stated.

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Date

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The author would like to extend an eternal gratitude of appreciation towards his wife and two children for their understanding and patience exhibited throughout the preparation of this report.

Jason Fowler

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Glossary of Terms

Illuminance (E) - the luminuous flux arriving at a surface divided by the area of the illuminated surface. Unit: lux (lx); (1 lx = 1 lm/m^2)

Longitudinal Luminance Uniformity (U_L) – the ratio of the minimum luminance to the maximum luminance within the specified section of the carriageway, along the longitudinal line passing through the observer position.

Luminaire - apparatus which distributes, filters or transforms the light transmitted from one of more lamps and which includes, except for the lamp themselves, all the parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply.

Luminance (L) - the physical quantity corresponding to the brightness of a surface (eg a lamp, luminaire, sky or reflecting material) in a specified direction. It is the luminous intensity of an area of the surface divided by that area. Unit: candela per square metre (cd/m^2)

Luminous Flux (Ø) - the measure of the quantity of the light. For a lamp or luminaire it normally refers to the total light emitted irrespective of the directions in which it is distributed. Unit: lumen (lm)

Luminous Intensity (I) - the concentration of luminous flux emitted in a specified direction. Unit: candela (cd)

Maintenance Factor (light loss level) - a factor applied to lighting design calculation, to take account of light losses resulting from the depreciation in lamp lumen output due to aging and the accumulation of dirt on the optical surfaces of the luminaire, during the interval between scheduled maintenance of the lighting system.

Mounting Height (H) - the vertical distance between the centre of a luminaire and the surface which is to illuminated, eg the road surface.

Overall Luminance uniformity (U_O) – the ratio of the minimum luminance to the average carriageway luminance within the specified section of the carriageway, viewed from the specified observer position.

Overhang – the distance, measured horizontally between the centre of a luminaire and the adjacent kerb or carriageway edge. The distance is taken to be positive if the luminaire is in front of the kerb or carriageway edge and negative if it is behind.

Spacing (S) – the distance between successive luminaires in a road lighting installation measured along the centreline of the carriageway. This applies irrespective of whether the carriageway is straight or curved.

Surround Illuminance Ratio (E_S) the ratio of the average illuminance on a 3m wide strip of the verge to the average illuminance on a contiguous 3m wide strip of the adjacent carriageway, calculated for each span of the road lighting installation.

Threshold Increment (TI) – the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with the source of glare present.

Upcast Angle – the angle by which the axis of the fixing spigot entry is tilted above the horizontal when the luminaire is installed.

(Source: AS/NZS 1158.0:1997 Road Lighting Part O: Introduction – Definitions)

1.0 Introduction

1.1 Project Aims

The project "Cost effectiveness of suburban street lighting" will analyse costs associated with the provision of City of Bunbury owned lighting infrastructure and infrastructure maintained by state government utility Western Power. Currently the City of Bunbury owns and maintains a number of lighting networks in areas such as the central business district and tourist precincts. The remainder of the network is owned and maintained by Western Power, under three yearly contracts with the City of Bunbury.

The City of Bunbury (COB) is currently in its last year of the current agreement with Western Power. The City is seeking a street lighting strategy to both assess the most cost effective way to provide suburban street lighting and also a blueprint document to direct and guide future extension and upgrades of the existing streetlight infrastructure. Deregulation of the power industry in Western Australia also means the COB can now look at choosing an energy provider other than Western Power.

Alternative lighting designs will be evaluated as part of the strategy with a regard to reduction of power consumption and maintenance costs. The new designs will address road and pedestrian users, environmental considerations, aesthetics and life cycle financial costs.

1.2 City of Bunbury

The City of Bunbury (COB) is a regional service centre located 200km south of Perth on the west coast of Western Australia. The city has a population of 30,540 people and it covers an area of 65.7 square kilometres (Australian Bureau of Statistics 2003). The city is the centre of the Greater Bunbury region, which has a total population of about 50,200. (Australian Bureau of Statistics, 2003). Bunbury is the third fastest growing urban centre in Australia. (City of Bunbury December 2005). Bunbury's major industries are government, commercial, retail, tourism and transport. The Port of Bunbury is currently Australia's ninth largest by volume and services the mining, manufacturing, agriculture and forestry industries in the South West of the state (City of Bunbury 2004).

Figure 1.1 Bunbury Location Map

Distance from Perth (km)	184
Area (sq km)	61.2
Length of sealed roads (km)	305
Length of unsealed roads (km)	2.39
Population	30,895
Number of Electors	20,810
Number of Dwellings	14,598
Total Rates Levied	$13. 56M
Total Revenue	$24.4 M
Number of Employees	204

Table 1.1 City of Bunbury Council Statistics 2003-04
(Source:WA Local Government Directory 2004-05)

2.0 Background

The suburban street lighting network within the City of Bunbury is majority owned and maintained by Western Australian power utility Western Power. The City of Bunbury pays an annual service fee, negotiated in three yearly contracts, for this service (Refer to Appendix B - Western Power & City of Bunbury Street Lighting Agreement). Western Power provides the city with a limited choice in streetlight styles and design and will only provide maintenance support on poles and lights they install (Refer to Appendix B - Western Power & City of Bunbury Street Lighting Agreement).

As a result, the COB has installed and maintains a series of small networks of decorative street lighting in a number of tourist, business and recreational areas of Bunbury. While Western Power provides the power for the lights, the COB is responsible for all maintenance costs incurred such as replacing bulbs and repairing electrical faults. (Refer to Appendix B - Western Power & City of Bunbury Street Lighting Agreement). These networks have been erected on an ad hoc basis, with no definitive strategy for consistency in the areas of appearance, vehicle and pedestrian safety, output and energy consumption.

Additionally, the City of Bunbury maintains a request register of street lighting upgrade submissions received from the general public. Once a year, requests are assessed against a primitive assessment matrix that attempts to identify the need and consequence of undertaking the required upgrade. Funds are used from a specific budget, known as "Hotspot Lighting" to undertake works ranked in priority to a predetermined budget. This system does not allow for long term planning requirements. There is also no definite plan of the extent of the suburban street lighting network owned by the City of Bunbury.

In the past five years the City of Bunbury has had an average 1.6% population growth rate with associated urban expansion (Australian Bureau of Statistics, 2003). This expansion rate is expected to continue with a series of new subdivisions planned, including within the key tourist area of the inner harbour (Data Analysis Australia March 2005). Combined with the deregulation of the power industry in WA, and the impending end of the existing Western Power Service Agreement next year, the City of Bunbury feels this is an opportune time to review the suburban street lighting network.

3.0 Objectives

The City of Bunbury has three key objectives in developing the Cost effectiveness of suburban street lighting study. These objectives are financial, technical management and environmental. As a Local Government Authority, the City of Bunbury has a duty to ratepayers to provide essential services, such as suburban street lighting, in a safe and financially responsible manner. It also has a duty to manage such services responsibly, with due consideration to the built and natural environment of the municipality.

3.1 Financial

The primary financial objective in determining the most cost effective way to deliver suburban street lighting in Bunbury has two key elements. The first element to be determined is the most cost effective way of purchasing power for the network in a newly deregulated market. The second financial objective to be determined is the most cost effective way of managing the existing elements of the City owned existing network, taking into account both maintenance (whether to be conducted in house or externally) and future extensions (Western Power owned or City owned).

3.2 Technical

There are a number of objectives relating to technical management to be addressed by this report. The first and foremost technical management objective is to ensure a safely lit area for road users, both vehicular and pedestrian. Other network management objectives for the development of the report are to develop a comprehensive network map of the existing and proposed future street lighting networks; provide an assessment of the legal liabilities the COB faces relevant to the ownership and maintenance of the network; and liability relating to any network designs which do not adhere to Australian Standards.

Technical objectives of the report are to provide a blueprint for future capital upgrade work and replacement of the overhead network with an underground network and assessment of lighting specifications such as comparing different lighting structures with luminaire output against the existing and other available lights.

3.3 Environmental

The primary environmental objective of the report is to identify the most suitable lighting network for the built and natural environment. For the natural environment, this includes assessment of the use of alternative energy sources, such as solar power and the impact of light pollution. For the built environment, the report will address the aesthetics of the existing lighting structure as is appropriate to various urban scapes within the City and also the effectiveness of the street lighting network in both deterring criminal activities and the public perception of the network's ability to deter crime as it relates to the number of hours per night the lighting is on.

4.0 Project Methodology

The methodology for this project has involved a series of stages which can be broadly grouped as information collection, information assessment, network design, network costing and conclusion. The specific stages of the project were:

- Research and review relevant Australian Standards on street lighting
- Audit and disseminate capital and operating cost of City of Bunbury Street lighting and Western Power owned street lighting.
- Review existing service agreement between Western Power and City of Bunbury
- Audit capital and operating cost of existing streetlight networks which are owned and maintained by City of Bunbury.
- Collect data from Western Power relating to unscheduled and scheduled maintenance callouts and costs; pole location; and light type and wattage.
- Evaluate and analyse existing literature on most cost effective lighting and environmentally appropriate structures and network designs, including solar and underground power systems.
- Review traffic crash data relating to the location and wattage of existing lights.
- Consult with police, local safety community groups, and other relevant stakeholders on the location and suitability of existing streetlights as a crime deterrent.

- Assess the visual aesthetics of moving streetlights from existing Western Power owned power poles on to separate council owned poles.

- Design most cost effective council owned network that meets Australian standards.

- Assess the cost of out sourcing maintenance of council owned network compared with in-house maintenance.

- Submit project report and recommendations on findings to City of Bunbury for consideration.

4.1 Information Sources

Research information for the project was collected from a wide variety of sources. The majority of the information required to complete this project was contained within existing government, industry and research documentation. The primary sources of information used for the project were:

- Reference texts
- Australian Standards
- City of Bunbury technical reports and documentation
- City of Bunbury consultant reports
- Western Power technical reports
- Western Power statistical data
- WA Police Technical Reports
- WA Police statistical data
- Department of Environmental Protection technical reports
- Office of Road Safety reports and documentation

- Main Roads technical reports
- Industry information
- Internet sites

A list of the specific documentation reviewed and assessed is included in the Bibliography.

5.0 Literature Review

5.1 History of Streetlighting

The web site <http://www.answers.com/topic/history-of-street-lighting-in-the-united-states> provides a brief history of the early forms of streetlights. The first recorded use of street lights occurred in London in 1417 when "Sir Henry Barton, the mayor, ordered lanterns with lights to be hanged out on the winter evenings between Hallowtide and Candlemasse". Britain began to light their street with gas lights in 1792 after William Murdoch invented gas lighting. Electric lighting first began to appear in the late nineteenth century due to the invention of the electric light globe through Thomas Edison. By the early 20th Century the use of candle lit streetlights was dwindling as safer and more reliable forms of providing streetlighting were sought by developers.

The Local Government Energy Toolbox website <www.energy-toolbox.vic.gov.au/publiclighting> states that street lights consists of four basic elements, other than the pole itself, and as outlined in Figure 5.1 are:

- The luminaire, or light fitting, attached to the pole.
- The lamp.
- The ballast/control gear.
- The on-off switching control, usually a photoelectric (PE) cell.

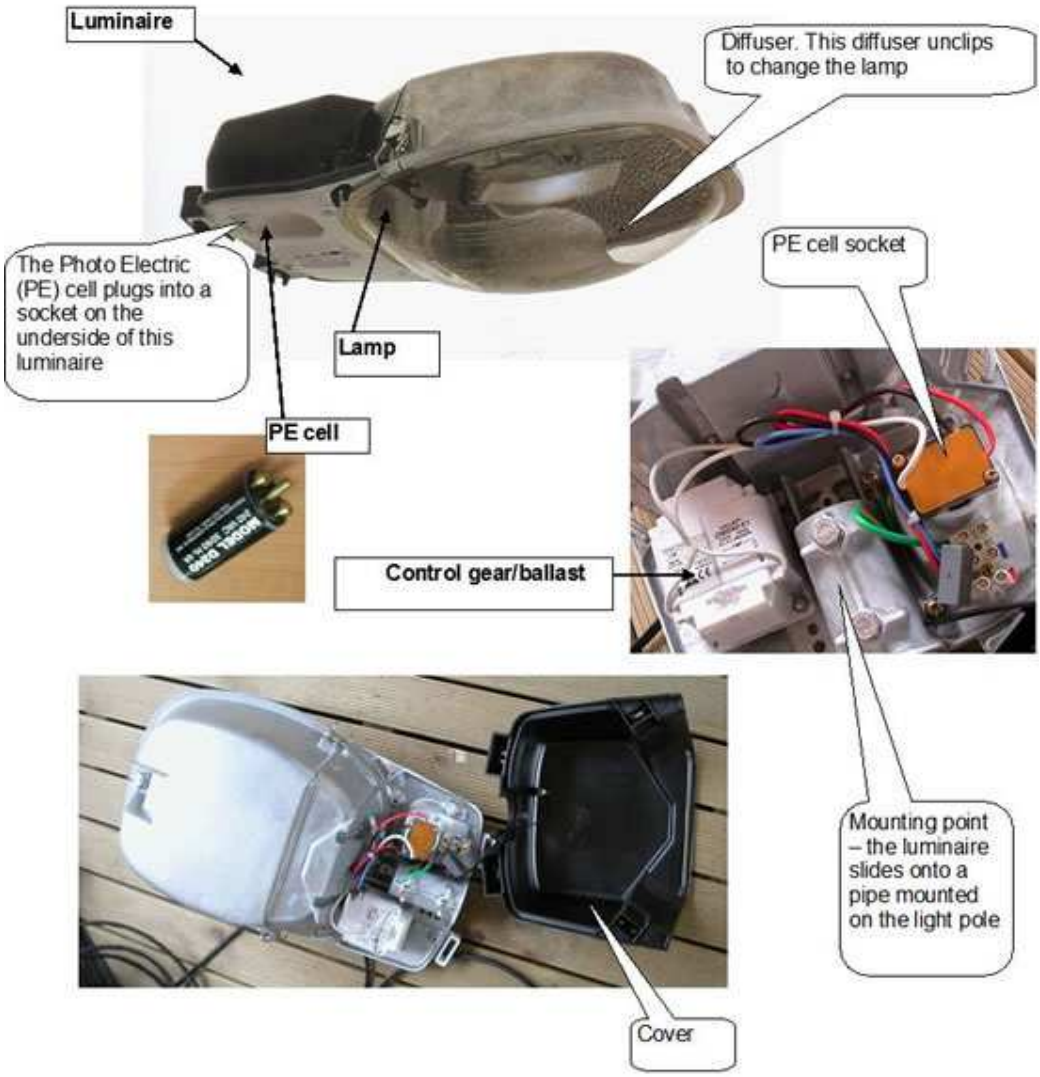

Figure 5.1 Outline of the basic elements of a street light luminaire
Source:www.energy-toolbox.vic.gov.au/publiclighting

5.2 Australian standards on street lighting

The AS/NZS 1158 series of standards gives information to assist in the lighting requirements of road users and users of outdoor areas either adjacent to road carriageways or isolated from.

The following standards are used in the design of street lighting

- *AS/NZ 1158.0:1997, Road lighting: Part O: Introduction.*
- *AS/NZS 1158.1.1:1997, Road lighting: Part 1.1: Vehicular traffic (Category V) lighting - Performance and installation design requirements.*
- *AS/NZ 1158.1.3:1997, Road lighting: Part 1.3: Vehicular traffic (Category V) lighting - Guide to design, installation, operation and maintenance.*
- *AS/NZS 1158.3.1:1999, Road lighting: Part 3.1: Pedestrian area (Category P) lighting - Performance and installation design requirements.*
- *AS 1158.2-2005, Lighting for roads and public spaces: Part 2 Computer procedures for the calculation of lighting technical parameters for Category V and Category P lighting.*
- *AS 1158.4:1997, SAA Public Lighting Code: Part 4: Supplementary Lighting at Pedestrian Crossings.*
- *AS/NZS 1158.6:2004, Lighting for roads and public spaces: Part 6: Luminaires*.

The standards refer to either Category V where the visual requirements of motorists are dominant such as arterial roads and freeways or Category P, where the areas are intended primarily for pedestrian use or for mixed pedestrian, vehicle and bicycle use. To ascertain the classification of a lighting requirement the road classification or road hierarchy must be determined. The Local council or the relevant State/Federal Government would have predetermined the road hierarchy status.

"V" category road classifications are given in table 1.1 of AS/NZS 1158.1.1:1997 and are broken down into five sub-categories. Technical parameters for the five categories are provided in Table 2.1 of AS/NZS 1158.1.1:1997.These tables have been reproduced in Table 5.1 and Table 5.2.

TABLE 1.1

CATEGORY V LIGHTING AND TYPICAL APPLICATIONS

Typical applications		Lighting category
Description of road or area type	**Operating characteristics**	
Arterial or main roads in central and regional activity centres of capital and major provincial cities, and other areas with major abutting traffic generators	—Mixed vehicle and pedestrian traffic —High to very high vehicle volume —High to very high pedestrian volume —Moderate to low vehicle speeds —Stationary vehicles alongside the carriageway —Through and local traffic —High traffic generation from abutting properties	V1
Arterial roads that predominantly carry through traffic from one region to another, forming principal avenues of communication for traffic movement, with major abutting traffic generators	—Mixed vehicle and pedestrian traffic —High vehicle volume —High pedestrian volume —Moderate to high vehicle speeds —Stationary vehicles alongside the carriageway —Through and local traffic —High traffic generation from abutting properties	V2
Freeways, motorways and expressways consisting of divided highways for through traffic with no access for traffic between interchanges and with grade separation at all intersections	—Vehicle traffic only —High to very high vehicle volume —High speeds	V3
Arterial roads that predominantly carry through traffic from one region to another, forming principal avenues of communication for traffic movements	—Mixed vehicle and pedestrian traffic —Moderate to high vehicle volume —High pedestrian volume —Moderate to low vehicle speeds —Stationary vehicles alongside the carriageway —Through and local traffic —Moderate traffic generation from abutting properties	
Sub-arterial or principal roads which connect arterial or main roads to areas of development within a region, or which carry traffic directly from one part of a region to another part	—Mixed vehicle and pedestrian traffic —Moderate traffic volume —Low pedestrian volume —Moderate to low vehicle speeds —Low traffic generation from abutting properties	V4* or V5

* V4 is the minimum category recommended for application in New Zealand.

Table 5.1 Category ‘V’ Lighting and Typical Applications

TABLE 2.1

VALUES OF LIGHT TECHNICAL PARAMETERS FOR CATEGORY V LIGHTING

1	2	3	4	5	6	7	8	9	10	11	12
	Light technical parameters* (Notes 2 and 3)										
	For straight sections, curves and intersections (Note 4)							For intersections, junctions and other specified locations (Note 5)			For all applications
Lighting category (Note 1)	Minimum average carriageway luminance ($\bar{L}$) cd/m²		Minimum overall luminance uniformity† (U_O)	Minimum longitudinal luminance uniformity (U_L) (Note 6)		Maximum threshold increment (TI)	Minimum surround illuminance ratio (E_s)	Minimum illuminance (E_{min}) lx		Maximum illuminance uniformity, i.e. ratio E_{max}/E_{min}	Maximum upward waste light ratio ($UWLR$)
	Initial	Maintained		In Australia	In New Zealand	percent	percent	Initial	Maintained	(U_V)	percent
V1	2	1.5	0.33	0.5	0.3	20	50	20	15	8	6
V2	1.5	1.0	0.33	0.5	0.3	20	50	15	10	8	6
V3	1	0.75	0.33	0.5	0.3	20	50	10	7.5	8	6
V4‡	0.75	0.5	0.33	0.5	0.3	20	50	7.5	5	8	6
V5	0.5	0.35	0.33	0.5	0.3	20	50	5	3.5	8	6

* For the purpose of determining compliance with Table 2.1, the specified light technical parameters should be taken as being justified to two decimal places.

† The calculated value for U_O may be less than 0.33 but shall in no case be less than 0.31, provided the corresponding value for $\bar{L}$ is 10% or more above the specified minimum.

‡ V4 is the minimum category recommended for application in New Zealand.

NOTES:

1 See Table 1.1 for typical applications of each of the lighting categories for which light technical parameters are specified.

2 Brief descriptions of the light technical parameters are given in Clause 2.3.2 and design procedures necessary to determine compliance with these parameters are set out in Section 3.

Table 5.2 Values of Light Technical Parameters for Category ‘V’ Lighting

Table 1.1, 1.2, 1.3, 1.4, and 1.5 on Pages 8-10 of AS/NZS 1158.3.1:1999 assign applicable lighting categories ranging from P1 through to P12. Tables 2.1, 2.2, 2.3 and 2.4 on pages 14 -17 of the same code provides light technical parameters and permissible luminaire types for the 12 lighting categories. Table 1.1 on page 8 of AS/NZS 1158.3.1:1999 relates to Lighting Categories for roads in local areas and as such the assessment of streetlighting will only utilise Table 2.1 on page 14 of AS/NZS 1158.3.1:1999 for technical information. These tables have been reproduced in Table 5.3 and Table 5.4 below.

TABLE 1.1

LIGHTING CATEGORIES FOR ROADS IN LOCAL AREAS

1	2	3	4	5	6
Type of road or pathway		Selection criteria*			Applicable lighting category†
General description	Basic operating characteristics	Pedestrian/cycle activity	Risk of crime	Need to enhance prestige	
Collector roads or non-arterial roads which collect and distribute traffic in an area, as well as serving abutting properties	Mixed vehicle and pedestrian traffic	Medium Low	Low Low	Medium N/A	P3 P4‡
Local roads or streets used primarily for access to abutting properties, including residential properties	Mixed vehicle and pedestrian traffic	Medium Low Low	Low Low Low	Medium N/A N/A	P3 P4‡ P5‡
Common areas, forecourts of cluster housing	Mixed vehicle and pedestrian traffic	Medium Low	Low Low	Medium N/A	P3 P4‡

* The selection criteria of Columns 3 to 5 should be separately evaluated. The highest level of any of the selection criteria that is deemed appropriate for the road will determine the applicable lighting category.

† Lighting categories P3, P4 and P5 apply across the whole of the road reserve width. Lighting categories P1 or P2 in Table 1.2 may be selected where there is a significant risk of crime or need to enhance the prestige of the area, however, such lighting only applies over the physical extent of any formed pathway.

‡ The lighting categories P4 and P5 are comparable to the superseded categories B1 and B2 as set out in AS 1158.1—1986.

Table 5.3 Category ‘P’ Lighting and Typical Applications

TABLE 2.1

VALUES OF LIGHT TECHNICAL PARAMETERS AND PERMISSIBLE LUMINAIRE TYPES FOR ROADS IN LOCAL AREAS AND FOR PATHWAYS

1	2	3	4	5	6
Lighting category	Light technical parameters				
	Maintained average horizontal illuminance ($\bar{E}_{h\ maint}$) lx	Maintained horizontal illuminance ($E_{h\ maint}$) lx	Maintained horizontal illuminance uniformity, ($U_{P\ maint}$)	Maintained vertical illuminance ($E_{v\ maint}$) lx	Permissible luminaire types (see Table 2.5)
P1*	7	2	10	2	Type 4 where part of a road reserve or Types 2, 3 or 4 elsewhere.
P2*	3.5	0.7	10	0.7	
P3‡	1.75	0.3	10	0.3†	
P4‡	0.85	0.14	10	N/A	
P5‡	0.5	0.07	10	N/A	

* Where there are good vertical reflecting surfaces alongside the pathway, the next lower lighting category may be selected.

† The vertical illuminance requirement only applies when Category P3 is selected for application to pathways, i.e. it does not apply for local roads.

‡ In New Zealand, when the luminaires are to be supported on existing reticulation poles, the following reduced levels may be applied:

For Category P3 - $(\bar{E}_{h\ maint}) = 1.25$; $E_{h\ maint} = 0.15$; no requirement on $E_{v\ maint}$ is applicable.

For Category P4 - $(\bar{E}_{h\ maint}) = 0.7$; $E_{h\ maint} = 0.07$;

Category P5 lighting shall not be used in this situation.

Table 5.4 Values of Light Technical Parameters and Permissible Luminaire Types for Category ‘P’ Lighting

The design phase of streetlighting entails the predetermined road classification assigned to the carriageway and the undertaking of a trial and error process. The designer is required to select a specified spacing of the streetlights and select a specified luminaire with associated technical properties. This information is inputted into the computer program supplied with *AS 1158.2-2005, Lighting for roads and public spaces: Part 2 Computer procedures for the calculation of lighting technical parameters for Category V and Category P lighting.* Refer to **Figure 5.1** for an example of a screen dump of the program. It must be noted that the program supplied with the AS1158.2-2005 only calculates designs for straight line sections of 'V' Category Roads. For the detailed design of intersections and curve sections & 'P' category road systems, the purchase of specified street lighting computer design programs such as **"Candela GIS**" is required.

Light Technical Parameters (LTP) for Category 'V' lighting include

- Minimum average carriageway luminance (Ĺ) – units (cd/m^2)
- Minimum overall luminance uniformity (U_O)
- Minimum longitudinal uniformity (U_L)
- Maximum threshold increment (TI)
- Minimum surround illuminance ratio (E_s)

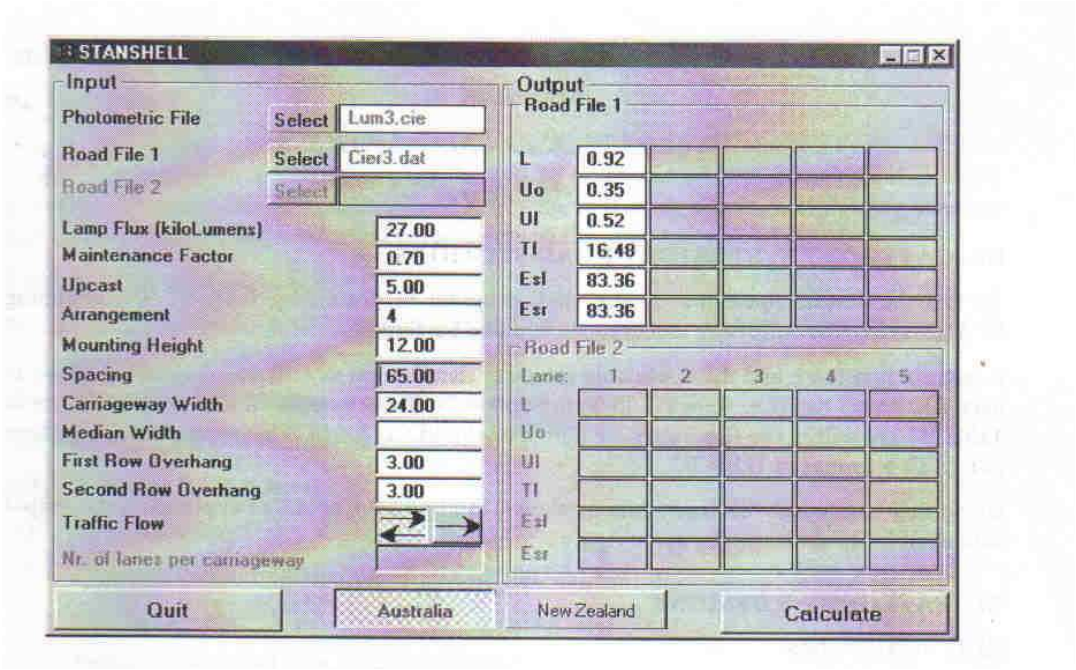

Figure 5.2 Screen Output of StanShell Lighting Program

A user of the computer program StanShell is required to input the following into the program:

- Photometric file in .cie format. This information is unique to the particular luminare type and depends on the wattage and type of light source available. Users must attain this information from light manufactures direct. Photoelectric information is used to produce Isolux diagrams of a luminaire. These diagrams show the level of illuminance on a road way a given distance from a luminaire mounted at a specified height and angle. This information can then be used to determine the spacings between light poles to meet the illuminance levels of the lighting standard applicable to that road.
- Input the road file. For Australia this file will always be Cier3.dat
- Input the lamp luminous flux in kiloLumens. This figure again is unique to the specified luminaire chosen to base the design from.
- Input maintenance factor – currently at a maximum level of 0.7 for the current AS 1158 Standards.
- Input an upcast angle of the luminaire
- Select an appropriate arrangement of the luminaire spacing. (Refer to **Figure 5.2**)
- Select an approved mounting height of commonly supplied streetlight poles
- Put an arbitrary spacing of the luminaries. This figure will most probably have to change to enable LTP to reach acceptable levels.
- Input carriageway width of existing or proposed road
- Input overhang of luminaire.

Once the above data is inputted into the program and analysed the resulting LTP can be assessed as to whether they met AS 1158 specifications.

As stated previously Category 'P' lighting must be designed by hand or designed through other computer programs other than StanShell.

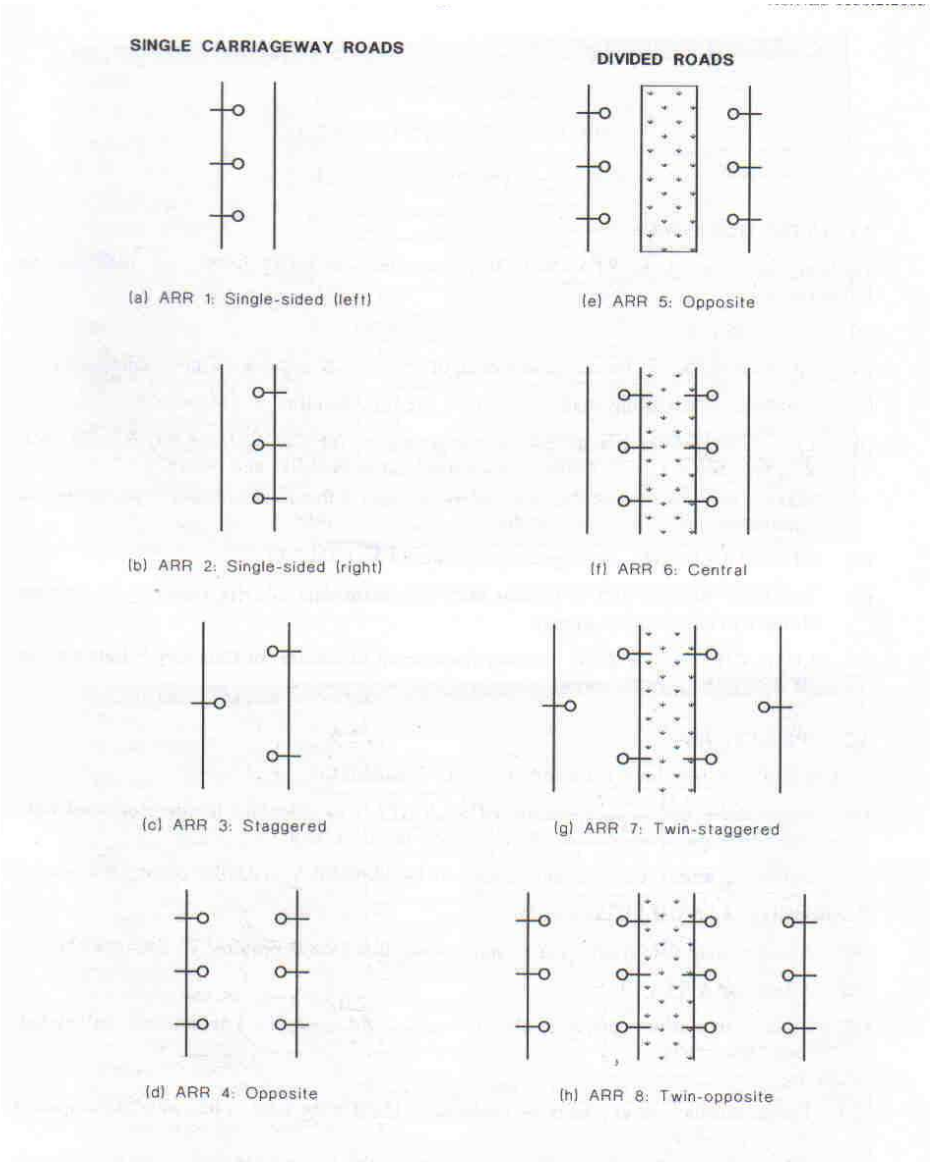

Figure 5.2 Designated Arrangements for Single Carriageway and Divided Roads

An analysis was undertaken Using Stanshell and Isolux diagrams from Sylvania Lighting Company on the following road classifications of Bunbury.

The following road hierarchy was assumed:

- Primary Distributor Category V3 Road
- District Distributor Category V5 Road
- Local Distributor Category V5 Road
- Access Road Category V5 Road

Wattage, Light type, pole height and spacings were determined that met current AS 1158 requirements. Mercury Vapour luminaires were not utilised due to their deficient light technical parameters and environmentally unfriendly mercury disposal requirements.

Refer to Appendix F for a full detailed analysis of the findings.

6.0 Existing City of Bunbury Lighting Network

6.1 Network specifications

The COB owns and maintains approx 420 street lighting fixtures (Refer to Appendix D). These fixtures are decorative in nature and were not supplied by Western Power nor maintained by the utility. This is because Western Power will only maintain lights it has installed and it only provides a limited choice of decorative street lights (Refer to Appendix B). The COB has opted to install non Western Power decorative streetlighting which the municipality believes were more aesthetically appropriate in specific areas of the city, and hence must maintain these lights themselves. The City Engineer of COB states that the choice to install such lights is mainly politically driven by businesses or groups lobbying the Council to install specific styles and colours or fixtures. The COB has never undertaken a detailed cost/benefit analysis to justify their decision to install decorative street lighting especially where the decision involves the installation of non Western Power supported luminaires.

The COB lighting network is spread somewhat spasmodic throughout the city however is mainly concentrated throughout the Central Business District (CBD) and along tourist coastal precincts. (Refer to Figure 6.1) The COB engaged the services of OPUS International to undertake an audit of the COB owned street lighting within the CBD as records held by the City were lacking in information and were viewed to be unreliable. OPUS presented its findings to the City in June 2005, having collected information on some 420 fixtures. Information collected included the type of luminare fixture, wattage of globe, height of pole, arm overhang, GPS coordinate and a photo of each light visited. (Refer to Appendix D and Table 6.1).

Additional information, such as location of feeder power supply was omitted due to budgetary constraints (Refer to Appendix D)).

	Solar	50W MV	70W MV	80W MV	125W MV	70W HPS	150W HPS	250W HPS	400 W HPS	TOTAL
Back Beach					15			4		19
CBD	8		12	6		51	40	2,	19	138
Koombana Bay					20					20
Leschenault Inlet		10				28	1		11	50
Marlston Hill					5		84		7	96
Marlston Water Front			59				38			97
TOTAL	8	10	71	6	40	79	163	6	37	420

Table 6.1 Existing City of Bunbury Street Light Data

Source: Appendix D modified to give total streetlight numbers in specified locations

The City of Bunbury network can be grouped into six specific regions. These locations are the Back Beach, Central Business District, Koombana Bay, Leschenault Inlet, Marlston Hill and Marlston Waterfront.

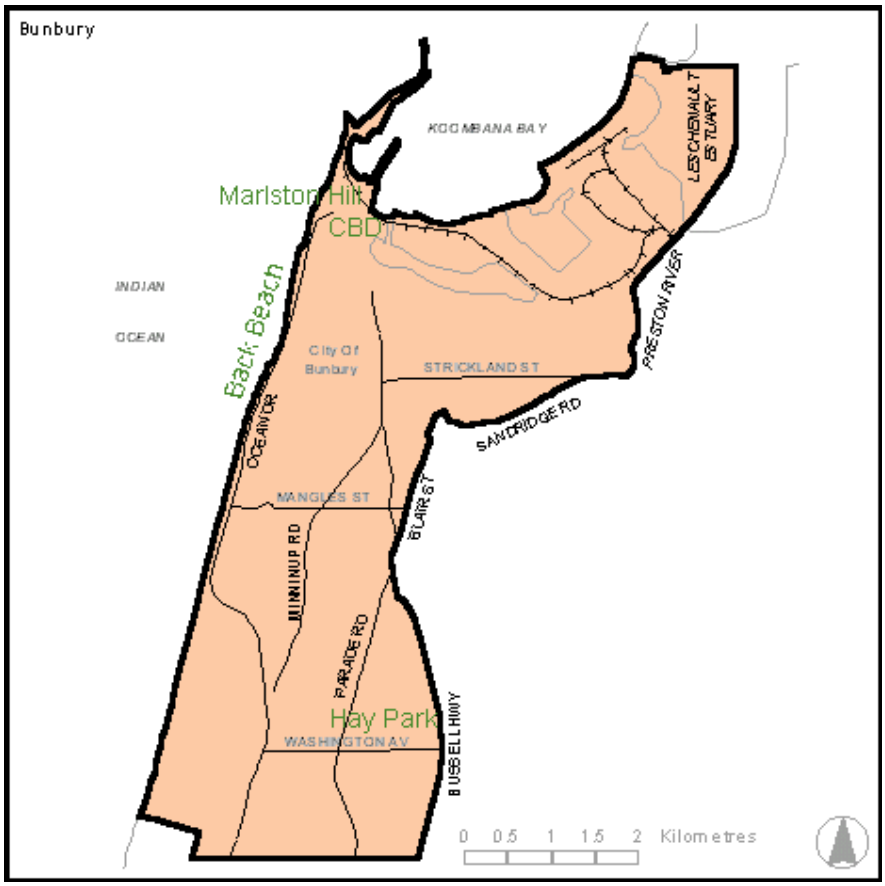

Figure 6.1: Locations of City of Bunbury Lighting Network

6.1.1 Central Business District

By far the majority of COB lighting is concentrated in this region. There are some 138 lights located along 8 roads. The City has nearly finished road construction works aimed at keeping traffic flow through the City via the installations of roundabouts at all major intersection within the CBD. The result of these roundabouts has been to upgrade the street lighting. Businesses in the region were consulted on the overall plan of upgrading the CBD and through consultation meetings the streetscape concepts of the area were formalised. The streetscape concept included planting of shrubs and foliage near intersections and along carriageways to improve the city's aesthetics.

The streetscaping of the area also identified specific styles of streetlighting to be utilised. These styles were unable to be supplied by Western Power and as such these structures were sourced through private lighting firms and installed by local electrical contractors.

Figure 6.2 Decorative lighting in the Central Business District – Stephen Street

Figure 6.3 Decorative lighting in the Central Business District – Victoria Street

6.1.2 Back Beach

The Back Beach area is a coastal region along Ocean Drive from Symons to Scott Street Refer to Figure 6.9. This area has attracted some $12M from the State Government as part of the "Back Beach Enhancement Project" (South West Times – Thursday 8th December). The project, carried out in three stages, aimed to enhance the area by: protecting the sand dunes from erosion during times of strong storms; removing the northbound carriageway and converting the area into public open space; and extending the carpark near the surf club (South West Times – Thursday 8th December). The overhead lighting system was placed underground and decorative lighting was employed along Ocean Drive with complimenting lighting structures installed throughout the public open space. A total of thirty two 250 W streetlights were installed during the back Beach Enhancement Project.

Figure 6.4 Decorative lighting at Back Beach

6.1.3 Marlston Hill

Marlston Hill was previously the siting for the light industrial area due to its proximity to the Port, with large petroleum tanks and wasteground encompassing the area. The State Government's sub divisional department - LandCorp began the process of cleaning up the area and offering the lots for residential housing in 1995. Due to the high cost of cleanup the lots were offered for a reasonably high price and attracted affluent families to the area. The area is prime real estate with the majority of the having ocean views. The Marlston Hill precinct attracts a differential rate per block to cover additional landscaping maintenance costs. The area initially wanted to attain a completely new look from anything else in Bunbury and specifically sought to enhance the area by the addition of decorative streetlighting that was not commercially available through Western Power. To date there are ninetysix lights in the precinct.

Figure 6.5 Decorative lighting at Marston Hill – Ommanney Street

Figure 6.6 Decorative lighting at Marston Waterfront – Jetty Road

Figure 6.7 Decorative lighting at Koombana Bay

Figure 6.8 Decorative lighting at Leschenault Inlet

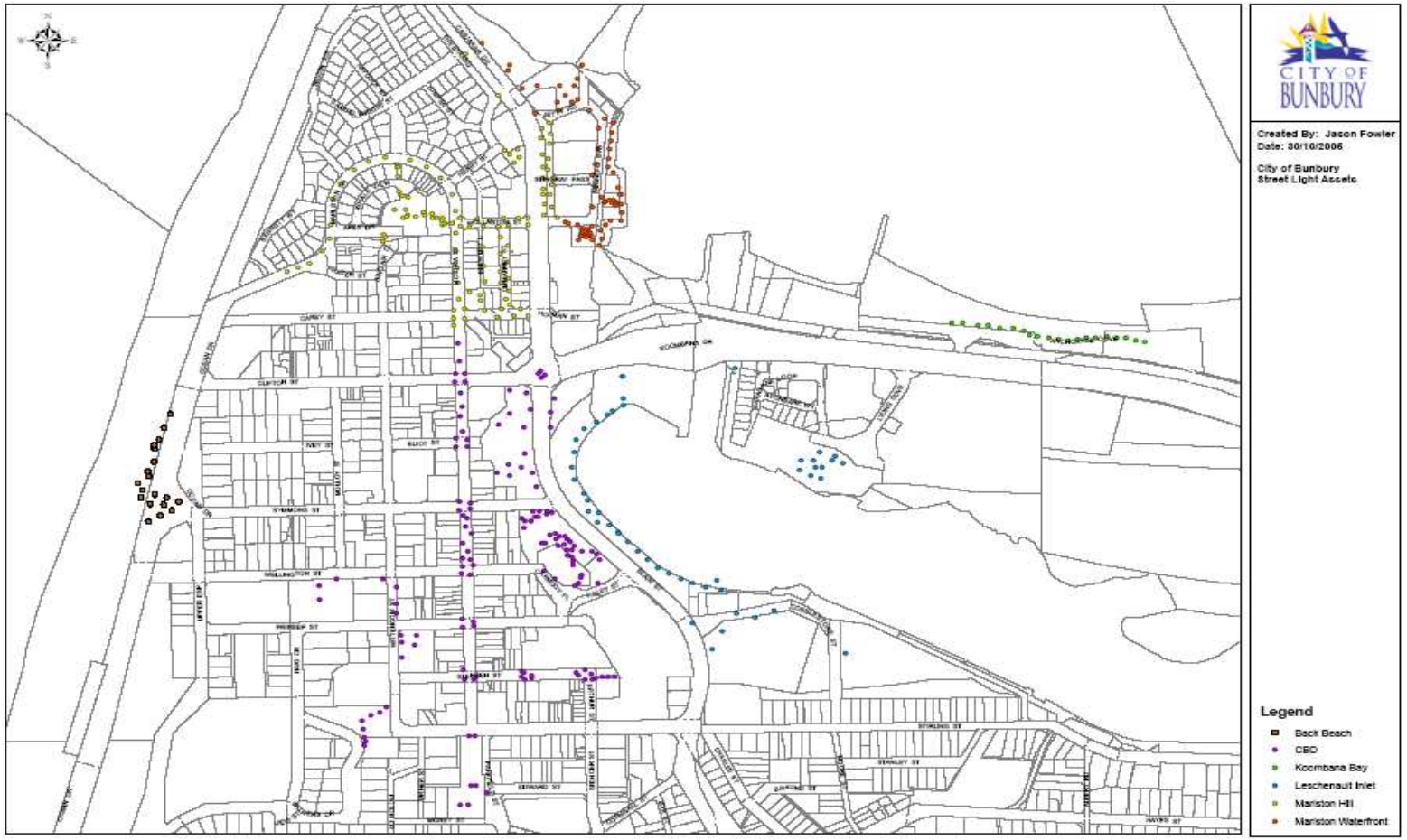

Figure 6.9 COB Owned Street Lighting Network

6.2 Capital Costs

The COB is financially responsible for the initial purchase and installation costs associated with the street light fixture (Refer to Appendix B). Capital costs are based on three elements: equipment cost, installation cost and connection to Western Power supply cost. The freedom of engaging a private electrical contractor to install such streetlighting exists, however Wester Power technicians or Western Power approved sub-contractors must connect up to the power network as per Western Power internal Quality Control safety procedures.. No data is available from the City of Bunbury on the capital cost of establishing the existing lighting network. However, capital costs for the replacement for lightings in each of the four network areas are outlined in Table 6.2.

Network Location	Lighting Style	Number of Units	Equipment Cost per light structure $	Installation Cost	Total Cost per unit $
CBD - Victoria Street	Bega 150W Metal Halide	56	3,750	5,195	8,945
Backbeach	Sylania 150W High Pressure Sodium	32* (Not yet installed)	-	-	4,860
Backbeach	Bega 150W Metal Halide	44* (Not yet installed)	-	-	6,760

Table 6.2 Equipment cost of replacing City of Bunbury network lights.
Source: Sylvania Lighting Company quote

6.3 Operating Costs

As previously stated, all financial costs relating to the COB owned streetlighting fixture are borne by the City. Figure 6.13 shows City of Bunbury financial data of the breakdown of the operating costs incurred over previous years.

Year	Electricity Costs ($)	O/M/R Costs ($)	Total Costs ($)	# of Lights	Cost/Light/Year ($)
2004/05	32,388	29183	61571	420	144.29
2003/04	39,387	40331	79718	400	199.30
2002/03	38890	33186	72076	360	200.20

Table 6.3 City of Bunbury Streetlighting Cost Comparison
(COB Financial Records)

6.3.1 Maintenance issues

The COB Building & Maintenance Manager states that maintenance of the COB lighting network is currently undertaken in an adhoc fashion with faults only being dealt with once customers reports have been made. The COB engaged preferred electrical contractor deals with all lighting maintenance issues and only on request by City staff. The approach is reactive only, with no nighttime audit of exiting lights being undertaken. Additionally there is no bulk globe replacement program in place. A bulk globe replacement program similar to the one that Western Power currently employ would go in part towards a proactive maintenance approach by the City.

Issues affecting maintenance relate to the varying types of luminaries and light poles existing throughout the City. Western Power has four varying decorative lighting styles and five varying standard styles within the COB while the City have nine decorative styles with further variations on light pole structures with reference to style and colour. The variations make storing stock not economical thus ensuring a greater turn around time with replacement of faulty or broken parts once required. There is no internal policy on maintenance levels of customer satisfaction with repair and or replacement. A detailed process exists for the maintenance intervention criteria of road and drainage repairs. This intervention criteria process is suitable for modification to relate to the provision of streetlighting.

7.0 Existing Western Power Lighting Network

7.1 Network specifications

As of April 2005 there existed 3,512 streetlights within the COB under the ownership of Western Power. (Refer to Appendix E) This figure includes 52 decorative streetlight structures.

Western Power only uses two types of luminaries as street lighting within the COB, mercury vapour and high pressure sodium. (Refer to Appendix E) Both light types are available in a variety of wattage configurations.

	80W MV	125W MV	250W MV	70W HPS	150W HPS	250W HPS	TOTAL
Standard	2548	151	361	1	27	372	3460
Decorative	10	27			2	13	52
TOTAL	2558	178	361	1	29	385	3512

Table 7.1 Western Power StreetVision Asset Breakdown
(Refer to Appendix E)

The 250 HPS street lights are used on Primary and District distributor roads due to their functional hierarchy dictating that their predominant use or need for streetlighting is for vehicular traffic – Category 'V'. (Refer to Section 11 for greater detail) These lights account for just over 10% of the total Western Power supplied and maintained street lighting network. (Refer to Appendix E)

Over 70 % of the lighting network is made up of 80 W MV lights. (Refer to Appendix E) These have been installed along access roads or 'P' category roads due to their high colour rendition enabling a pedestrian to distinguish features more clearly in the dark. Typically old land parcels in the COB were the old ¼ acre block with an approx 20m frontage. Western Power installed overhead power system poles at the boundary of adjoining blocks to provide feeder lines to the various property residences. Western Power installed streetlighting on every second power pole effectively creating a street lighting spacing of 80m. It can be proven through computer program StanShell that spacings of 80m for 80W mercury vapour luminaire does not met current Australian Standards. Sage Consulting Engineers commissioned to undertake a Lighting Strategy for the City of Swan also state that current Western Power mercury vapour spacings of 80m for their 80W range does not conform to AS 1158 .

The COB GIS system shoes that the remaining 568 luminiares encompassing 125W MV, 250W MV and 150W HPS lights are erected on Local Distributor Roads. The majority of these roads are classified as 'P' category roads.

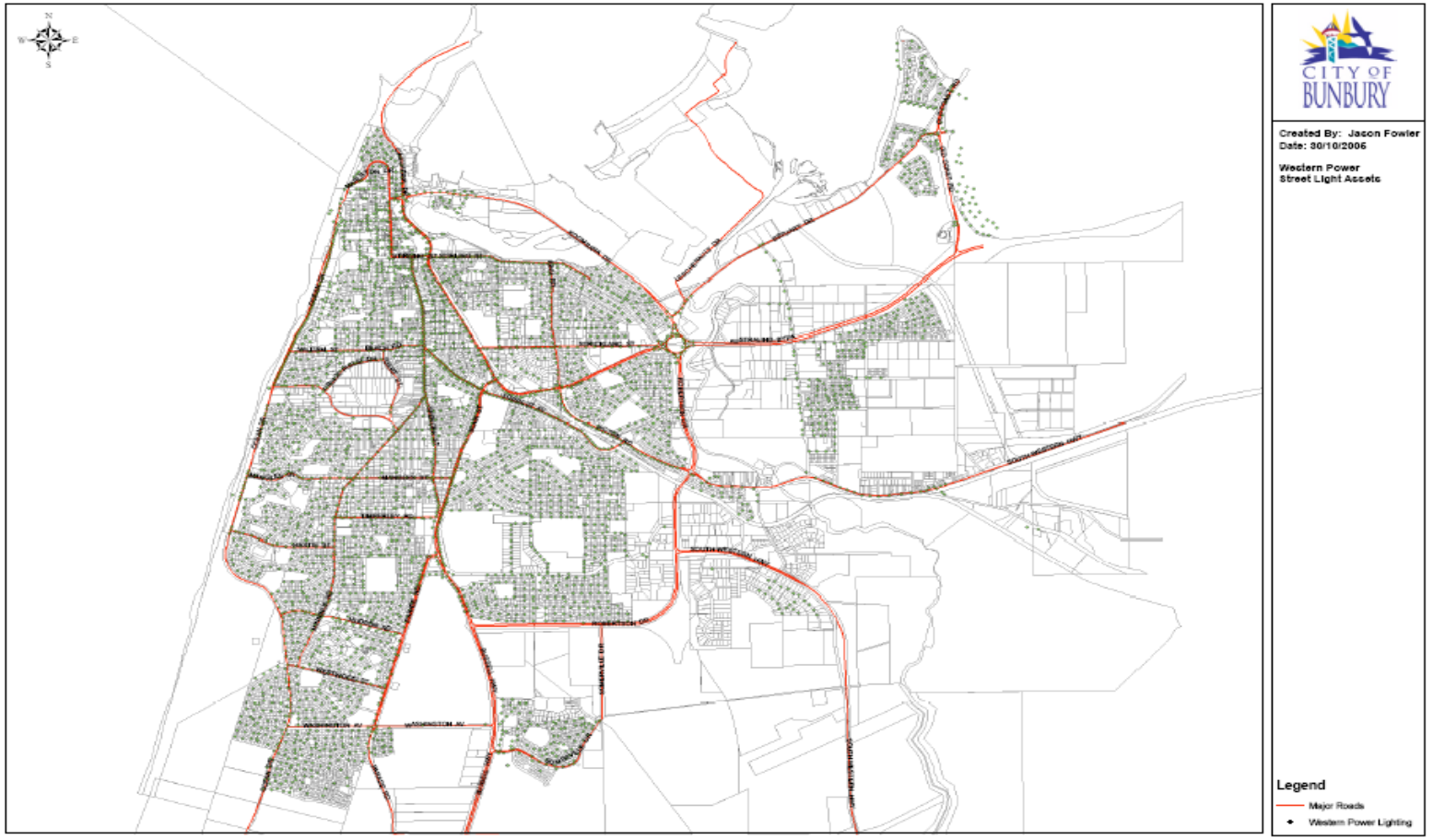

Figure 7.1 Western Power Owned Street Lighting Network

7.2 Maintenance

Both scheduled maintenance and unscheduled callouts to Western Power supplied network is borne by Western Power itself (Refer to Appendix B). The costs are recouped via a gazetted street lighting tariff first introduced in 1923. (http://www.westernpower.com.au/business/products_services/streetlights.html) For the COB this tariff takes the form of the StreetVision Lighting Agreement. As part of this agreement, Western Power are responsible for the following:

Energy supply (dusk to dawn)

Network connectoin

Operation, maintenance and replacement (O,M&R)

Billing and customer management

Table 7.2 shows an approx break down of costs that the City incurs from Western Power. An indicative split of 30:70 was given for electricity and O,M&R costs from a Western Power Product Manager spokesperson.

Year	Electricity Costs ($)	O/M/R Costs ($)	Total Costs ($)	# of Lights	Cost/Light/Year ($)
2005/06	111,442	260,032	371,474	3512	105.80
2004/05	89,934	209,847	299,781	3477	86.20
2003/04	89,934	209,847	299,781	3476	86.25

Table 7.2 Western Power Streetlighting Cost Comparison

8.0 Current Lighting Trends

8.1 Network Designs

Western Power's current power distribution network for the South West Interconnected Grid consists of feed lines transferring 66kV, 132kv 220kV or 330kV (Western Power Annual Report 2005) This network is a collaboration of underground and overhead configurations. While the installation of overhead lines is cheaper to install initially than underground trenched networks, there are greater maintenance issues with damage and/or faults causing power blackouts.

The undergrounding of power to a subdivision in WA first occurred in 1972 however it only became mandatory for new subdivisions in 1991 <http://www.energy.wa.gov.au/3/3050/64/state_undergrou.pm>. The May 1994 storms that created wide spread blackouts in Perth formed the catalyst of a parliamentary inquiry to alleviate the widespread power blackouts from occurring again. <http://www.energy.wa.gov.au/3/3050/64/state_undergrou.pm> The Inquiry into the Storm Blackouts found that 80 per cent of damage to power lines was caused by falling trees. The main recommendation centred on the creation of a scheme to reduce low voltage overhead distribution via placing distribution cables underground. The Government recognised that this initiative would result in a markedly improved security of supply and safety in extreme weather conditions <http://www.energy.wa.gov.au/3/3050/64/state_undergrou.pm>

In 1996, the government of WA commenced an initiative known as the Underground Power Program. This initiative would seek to fulfil a bold statement made to have half the houses in Regional Perth supplied by underground power by 2010 and to have a vast improvement in supply reliability in regional areas of the State. <http://www.energy.wa.gov.au/3/3050/64/state_undergrou.pm> The Major Residential Underground Power Program receives funding through a 50/50 joint venture of Western Power and the Office of Energy and a matching contribution from relevant local councils. Local Councils typically pass on this cost to affected ratepayers through a differential rate scheme over a typical 10 year period. The Underground Power Scheme began in 1996 with the release of Round One – Major Residential Underground Power Program. The scheme aimed at converting pre 1991 residential areas to below ground power supply. This scheme is currently assessing draft submissions for Round Four as of January 2006. Both the State Government and Western Power have set aside $5M for the Round Four stage with a further $10M coming from matching local government sources – creating a total budget of $20m per funding round. (Round Four Major Residential Underground Scheme Guidelines) The Scheme gives advice to allow approx $3,500 per ratepayer to install underground power and that there must be between 650 and 1300 lots to be eligible for funding. (Round Four Major Residential Underground Scheme Guidelines) Ideally the residential area should be zoned R30 or greater to justify the expense per population density. (R30 relates to 30 residential dwellings per hectare - 10,000m2 or one dwelling per 333m2.) It must be noted that with areas approved for upgrade and under grounding of the power supply, supply to streetlights will be undertaken in unison.

8.2 Lighting Designs

It is important to have an understanding of street lamp characteristics when referring to differing technologies of lamp types. Common terms and their associated definitions are detailed below and are referenced from : ***(www.energy-toolbox.vic.gov.au /publiclighting/index)***

Efficacy measures how efficient the lamp is in converting electrical energy into light. Units are lumens per watt

Lumen depreciation measures how much the light output of the lamp diminishes over its useful life. This concept is employed in lighting design with reference to a maintenance factor applied, currently a maximum figure of 0.7 is allowed in the AS/NZS 1158. Refer to Figure 8.1 for common lumen depreciation curves for various luminare types.

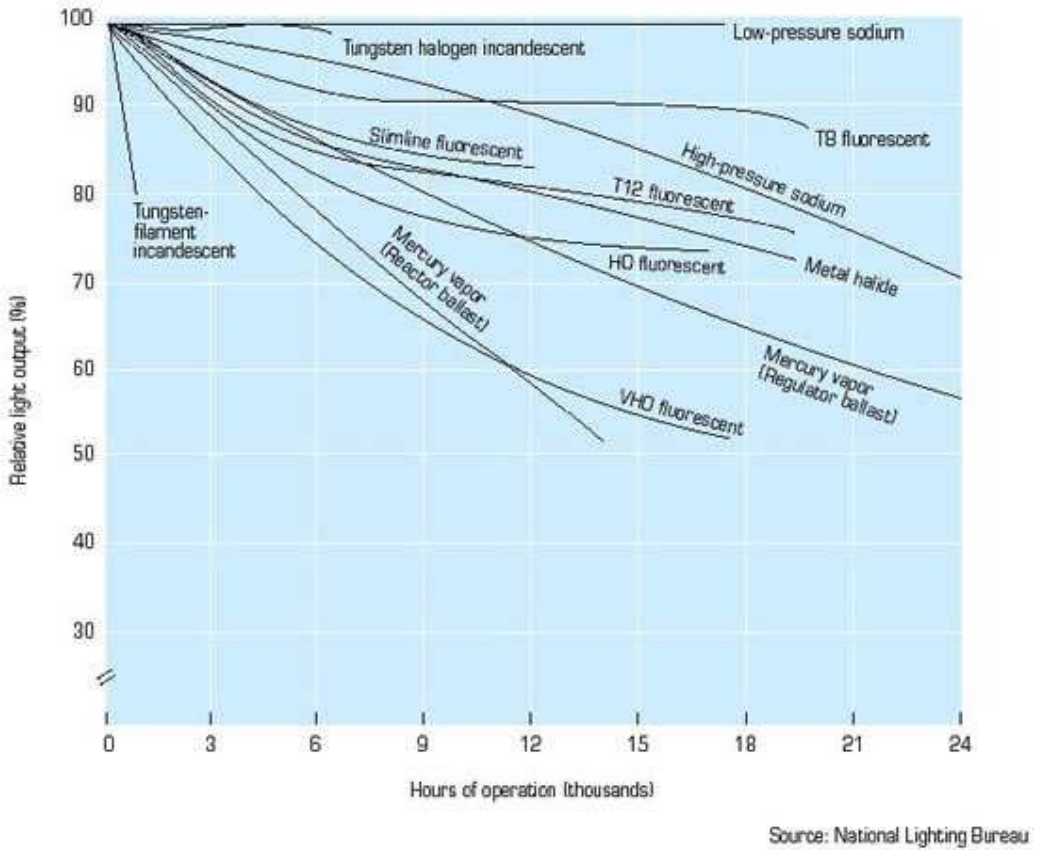

Figure 8.1 Lumen Depreciation Curves
(Source: ***www.energy-toolbox.vic.gov.au /publiclighting/index)***

Light colour is measured by both the lamp's "temperature" and the colour rendition index (CRI) of the resulting light.

The **Colour Rendition Index** measures how close a colour is rendered by the lamp to the "real" colour, on a scale from 1 to 100. A CRI of 100 means that all colours are correctly rendered.

The **lamp temperature** measures the colour temperature of the light from the lamp, and is measured in degrees Kelvin. Metal halide lamps, with very good quality light, have lamp temperatures of 3,000 to 4,000 K.

Lamp life measures the life of the lamp, usually expressed as the number of hours of operation by which X % of a group of lamps has failed. The percentage X may vary from manufacturer to manufacturer, making comparisons difficult.

Lamp reliability and toughness is a subjective assessment of the lamp's ability to deal with adverse conditions, such as over voltage, under voltage, spikes, transients, vibration, rough handling, etc. Its electrical reliability and toughness depends to a large extent on the ballast used and the degree of protection the ballast offers the lamp.

Lamp temperature performance measures the ability of the lamp to perform and to produce its rated output at a given temperature. Some lamps may produce less than their rated output if temperatures are too cold or too hot.

Western Power only provide three types of streetlights – mercury vapour, metal halide and high pressure sodium. Streetlighting within the COB precinct only employ mercury vapour and high presuure sodium technology. (Refer to Appendix E)

Detailed below are differing streetlight luminaires utilised as public street lighting in Australia. Whilst some are becoming obsolete others are experiencing greater popularity with increased use.

(Refer to Local Government Victoria – Energy Toolbox www.energy-toolbox.vic.gov.au /publiclighting/index)

Mercury vapour lamps have been around since the 1930's and have been successful employed in the street light arena since that time. Mercury vapour lamps employ mercury as the primary light-producing element. They emit a white light with an efficiency of 55 lumens per watt (lm/W). A lumen is a measure of the quantity of light and is typically measured in all directions, ie total light emitted (Sylvania Fixtures 2003/2004). The useful life of such a light is in the order of 12,000 hours. For comparison the COB lights are on average energised for 11.***88 (Refer to Appendix E - StreetVision Agreement Pricing Matrix)*** hours per day- thus 12,000 hours would equate to 2 years and 9 months.

These lamps are cheap, robust, reliable and pedestrian friendly as the white light gives a clear outline of objects. (***www.energy-toolbox.vic.gov.au /publiclighting/index)*** Their downside is that they possess a low efficiency rating as detailed above, display a rapid lumen depreciation and are non-environmental friendly on disposal due to the high amount of mercury present. The rapid luminaire depreciation results in over designing of a street light environment to cater for when the luminiare fades at a later date.

Mercury vapour lights are the backbone of P category streets in Australia however due to the above disadvantages of this type of luminaire authorities in the Europe and most of America have phased out the use totally. (***www.energy-toolbox.vic.gov.au /publiclighting/inde)*** At present there are no current plans for Australian authorities to commence down the same path.

Metal halide lamps were first developed in the 1960s (www.greenhouse.gov.au Department of the Environment and Heritage – Australian Greenhouse Office). Like mercury vapour lamps, they also emit a white light however produces a blue/white crisp tone light.(www.greenhouse.gov.au/lgmodules/wep/streetlighting/training) Mercury is added to halide additives to create the light producing element. Their useful life is less than mercury vapour with only 8,000 hours but produce an efficiency of 80 lm/W. (Sylvania Fixtures 2003/2004)

Although metal halide technology has been around for some 40 years, Australia has been slow to grasp this 'new' technology. Europe and America have transferred to metal halide luminaires during the advent of totally phasing out mercury vapour luminaires. Melbourne is the dominant users of metal halide street light fittings within Australia. ***(Refer to Local Government Victoria – Energy Toolbox www.energy-toolbox.vic.gov.au /publiclighting/index)*** A spokesperson from the Western Power Operation Depot in Bunbury stated that the company is slowly making available this technology, however currently have in stock vast quantities of traditional 80W and 125W mercury vapour luminaries which they will expend first.

Metal halide lamps are not in common use mainly due to the initial higher costs for installation and lamp replacement costs. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***) Western Power do not utilise these lamps within the COB. The major advantage of metal halide lamps is their good colour rendering ability, due to their predominantly white light appearance and the enhanced efficiency of the luminaire. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***) The City of Swan, in metropolitan Perth, has recently installed 70W metal halide lights in lieu of 125W mercury vapour. (Sage Consulting)

High Pressure Sodium lamps emit a golden yellow/orange colour light through the use of sodium vapour in a high pressure arc tube. These lights have a typical useful life of 14,000 hours and possess an efficiency rating of 100 lm/W. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***) The orange colour of the lamp is absorbed by foliage along a carriageway and not reflected making it harder to distinguish details. Due to their high efficiency but poor colour rendition index they are utilised on 'V' category roads where the vehicular movement is considered as the predominant movement along the carriageway.

A relatively new concept with HPS lamps is the "Twin Arc". These lamps have a second arc path which is only used as a backup to the first. Manufacturers claim a life of up to 50,000 hours can be expected. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***)

Induction lamps are another new concept to the street lighting market. A life of 60-1000,000 hours is claimed which would make their installation very attractive. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***) The major draw back to date is the high initial costs and limited choice of luminaries from suppliers able to handle induction lamps.

Figure 8.2 Specially designed luminaires with induction lamps, Anzac Parade ACT

Light Emitting Diodes are another long life lamp. These lamps are also new to the market however they have very poor colour rendition typically only 15 lumens/watt. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***) The low colour rendition guarantees that these lamps will never serve as a replacement for proven street light lamps – they are however more than suited to installed in bollards and the like.

Incandescent street lamps are similar to normal household lamps. They attain a poor efficiency standard and exhibit a relatively short operating life. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***) These two factors combined result in a high operating cost and as such are not used for street lighting other than in some isolated heritage precincts.

Fluorescent lights are available in either monophosphor lamp or as a triphosphor lamp. The mono and tri use either one or three coatings of phosphor on the inside of the lamp tube to provide visible light respectively. The relatively new creations of Triphosphor lamps are available in either compact or traditional tubular formation. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***)

Compact fluorescent technology has been used in public lighting, especially in solar public lighting applications. It offers reasonable price and good efficacy. However its short life means greater replacements. The newer triphosphor lamps are available in 42W lamps that have an equivalent efficiency of an 80W mercury vapour. Their expected lamp life is a healthy 12,000 hours and they exhibit good colour rendition. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***) It is interesting to note that Energy Australia in Victoria recently upgraded some 10,000 old and unreliable twin fluorescent street lighting with 80W mercury vapour luminaries.

Lamp type	*Efficacy (lumens per watt, in the range 14 to 80 watts)*	*Typical lumen depreciation before replacement*	*Colour rendering index, Light colour*	*Lamp life (in the range 14 to 80 watts), hours*	*Reliability and toughness in public lights*
Mercury vapour	40 to 50	30 to 40%	40-60	14,000 to 20,000	Very good
High pressure sodium	70 to 85	20 to 30%	Up to 40, orange	24,000 to 40,000	Very good
Metal halide	70 to 80	20 to 25%	80-90	9,000 to 15,000	Fair
T5 fluorescent	90 to 105	10%	80-85	20,000	Good
Compact fluorescent	70 to 80	10 to 20%	80-85	10,000 to 12,000	Fair
LED (white)	10 to 20	NA	70	80,000 to 100,000	Fair
Induction	80	30 to 35%	80	60,000 to 80,000	Good, largely unproven

Table 8.1 Luminaire Technical Characteristic Comparison
.(www.greenhouse.gov.au/lgmodules/wep/streetlighting/training

Figure 8.1 shows a comparison of the various light types and differing properties. An assessment of the total characteristics of a certain light sources is required to enable the most suitable light source to be installed.

Sustainable public lighting technologies

Active reactor

Conventional street lighting has been vulnerable to variable power fluctuations especially with the aging of the units. A device that attempts to counteract this problem is the 'Active Reactor'. The City of Whitehorse, just out of Melbourne, through Active Reactor Company Pty Ltd are currently trialling fourteen 250 W high pressure sodium lamps and luminaires along a section of Springvale Road, Forrest Hill. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***)

These devises are fitted to high pressure sodium and metal halide lamps and work by electronically controlling a standard magnetic ballast for starting and operation of luminiares resulting in lamps operating from a reduced power outage. The theory of a more constant light output ensures a controlled stage of the luminiare that will result in increased lamp life and a more constant efficacy rating over the life of the lamp.
The Local Government Energy Toolbox claims that the bulk globe replacement should be extended by an estimated 50% through the use of this device.

Solar lights: The City of Bunbury currently has eight solar lights in use within the CBD near Boulters Heights. These lights are of a stand alone nature that gain energy through batteries that are in turn recharged via solar panels.

Figure 8.3 COB Solar Light at Boulters Heights in the CBD

Another type of solar light is the grid interactive solar light. Solar panels provide energy to the grid network during the day and retrieve energy at night form the grid network itself.

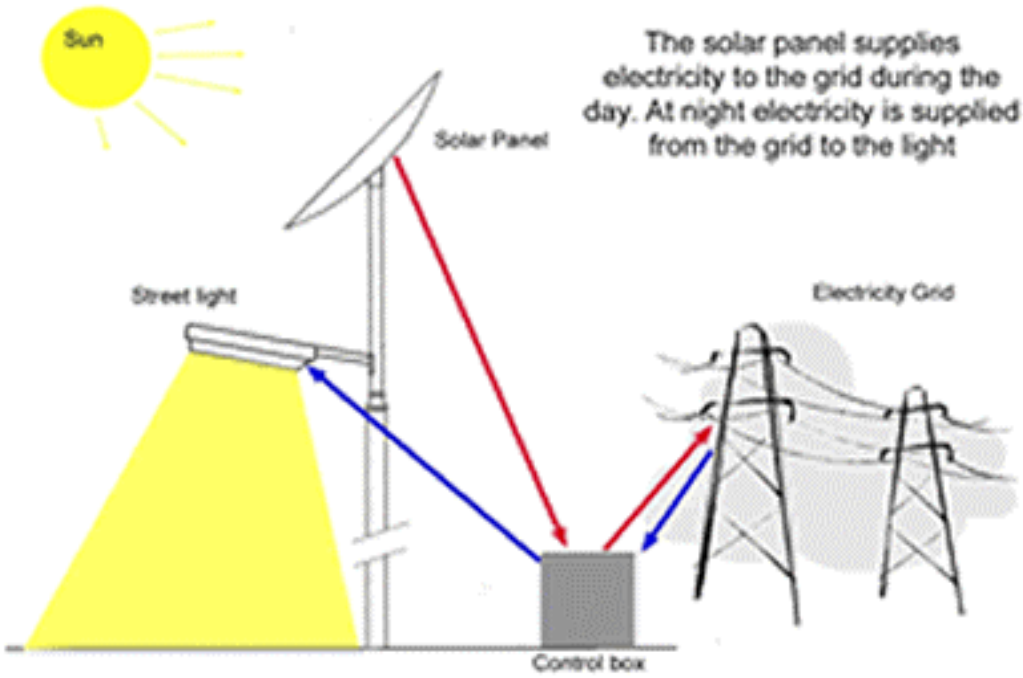

Figure 8.4 Grid Interactive Solar Public Light Schematic
(Source:

The grid interactive system is very environmental friendly however is currently not very economical. ***(www.energy-toolbox.vic.gov.au /publiclighting/index***) Indicative values as given by the (Victorian Energy Toolbox website state that a grid interactive solar pole, complete with solar panel and inverter, will typically be around $3,000 to $5,000 more expensive than a conventional pole.

9.0 Lighting impact on vehicle crashes

Accident Facts, Chicago National Safety Council, 1989 state that the ratio of night to day deaths has been found to be 2.5 when related to vehicle kilometres of travel. In a Lighting Strategy Report to the City of Swan, Sage Consulting Engineers state the following in relation to night time crash data studies undertaken throughout the world.

Chicago	Report 48% reduction in fatal night accidents in 7 years of progressive lighting
Kansas City	81% reduction in pedestrian fatal accidents over 12 years of progressive lighting
Long Island	Unlit roads had 1.5 the night/day rate of lit roads
New South Wales	Relighting to Australian Standards night accidents reduced 21%, fatalities reduced 29%, pedestrian fatalities reduced by 57%
Napierville, Illinois	Lighting of a 5 lane major route – night accidents reduced by 35%
CIE (International Lighting Commission)	Good or improved lighting – night accidents reduced by 9 to 75%

Table 9.1 Road Safety – Street Lighting Reports

It is obvious from the above that there are plenty of examples to substantiate the claim that road lighting can reduce night time accidents.

Road accident statistics within the COB are collected by police attending crash sites and/or persons notifying police stations of the relevant accident. Sections 55(1) and 56(1) of the Road Traffic Act (1974) of Western Australia requires that a road crash be reported to police when:

- any person is killed or injured or
- the crash results in property damage greater than $1,000

Crash statistics are forwarded to Main Roads WA who assemble and maintain data through the program database – "CrashStats". Data is released to local governments to help identify sections of roads eligible for 'BlackSpot Funding'. The term Black Spot refers to a section of road that exhibits a higher than usual crash history. State Blackspot funding is a two thirds state government and one third local council funded pool used to address these sections of roads.

A comparison of the WA Statewide crash statistics for night time crashes was compared to recent CrashStat data available to the COB. The comparison can be seen in Tables 9.1 and 9.2. Cost per crash severity was gained from page 7 Road Crashes in Western Australia 2000., a publication produced by the Road Safety Council of Western Australia through the Office of Road Safety (Refer to Table 9.4)

Crash Severity	Dark – Street Lights On	Dark – Street Lights Off	Dark – No Street Lights	Total
Fatal	23	1	43	67
Hospitalisation	490	17	189	696
Medical Attention	733	35	135	903
Property Damage Only	4329	171	953	5453
Total	**5575**	**224**	**1320**	**7119**

Table 9.2 Crashes by Severity and Road Lighting Conditions, Western Australia, 2002
(Page 34 Reported Road Crashes in Western Australia 2000)

Crash Severity	Dark – Street Lights On	Dark – Street Lights Off	Dark – No Street Lights	Total	**Average per Year**
Fatal	0	0	1	1	**0**
Hospitalisation	37	1	10	48	**10**
Medical Attention	54	3	5	62	**12**
Property Damage Only	325	20	48	393	**79**
Total	416	24	64	504	**101**
Average/ Year	**83**	**5**	**11**	**101**	

Table 9.3 Crashes by Severity and Road Lighting Conditions, City of Bunbury January 2000 –

December 2004

(Crash Stats Information from Main Roads WA)

Crash Severity	Number of Crashes	Cost per Crash ($)	Total Cost ($)
WA – State Wide	**Year 2002**		
Fatal	67	1,712,424	114.7M
Hospitalisation	696	422,658	294.2M
Medical Attention	903	14,271	12.9M
Property Damage Only	5453	6,017	32.8M
Total	**7119**		**454.6M**
City of Bunbury	**Average /Year 2000-2004**		
Fatal	0	1,712,424	0
Hospitalisation	10	422,658	4.2M
Medical Attention	12	14,271	0.2M
Property Damage Only	79	6,017	0.5M
Total	**101**		**4.9M**

Table 9.4 Estimated Cost of Crashes to the Western Australian Community Against Road Lighting Conditions: A Comparison between WA - State Wide and City of Bunbury

9.1 Lighting network

The COB has a road hierarchy as determined by their Town Planning Scheme with the "City of Bunbury Local Planning Policy - Road Hierarchy" classifying roads as primary distributor, district distributor, local distributor road or access road. Through the above tables and through detailed analysis of Main Roads CrashStats Data, the COB has successfully applied for 'BlackSpot Funding' for the following Projects identified in Table 9.4.

Road	**Road Classification**	**Number of Luminiares**	**Price ($)**	**Price per Luminaire ($)**
Sandridge Road	Primary Distributor	39	101,542	2,604
Bussell Hwy	Primary Distributor	32	91,745	2,867
Koombana Drive	Primary Distributor	99	410,000	4,141
Washington Ave	District Distributor	20	33,077	1,654

Table 9.5 BlackSpot Funded Street Lighting Projects within the COB.
Source of information from COB financial records.

10.0 Review and Analysis of the 2001 Western Power and City of Bunbury Service Agreement

Western Power provides a street lighting service to the City of Bunbury under a service agreement which is renewed every three years. A separate report on the review and analysis of the 2001 Western Power and City of Bunbury Service Agreement forms part of this document and is attached as an appendix.

10.1 Impact of Degregulation on Agreement

Deregulation means that energy generators and retailers are able to compete with Western Power to sell and supply electricity to Western Australian domestic and business customers if they wish to do so. The new market provides for competition in the generation and retailing of electricity in a similar way to that experienced with the telecommunications market. As a result, you may now able to choose the energy retailer you buy electricity from.

Deregulation means you may now be able to choose your electricity retailer if you use more than 50 megawatt hours per year at a single site (single distribution exit point).

10.1.1 How much is 50 megawatt hours per year?

Roughly this equates to a daily average consumption of around 137kW or more units per day. Your daily average consumption figure is located on the front page of your Western Power bill.

Typically, if you spend more than $8,000 each year on electricity at a single distribution exit point then you may be able to choose your supplier of electricity. (Western Power 2004)
(http://www.westernpower.com.au/business/contestability/deregulation_faqs.html)

The above statement however only relates to a single distribution exit point (www.wpcorp.com.au/html/business/contestability/deregulation_faqs.html) Western Power classify every separate street light as a single distribution For comparison purposes, a 250W High Pressure Sodium street light over a ten hour day only uses 2.5kW – well short of the required 137kW required every day for a year.

11.0 Comparative Network Costings

It can be seen when comparing to the Western Power maintained street lighting that the Western Power StreetVision agreement offers value for money per streetlight luminare.

There are a number of reasons that can be attributed to the difference as listed below:

- The provision of street lighting is not a core business of the COB. There currently exists limited if any procedures with regard to routine maintenance of lights. There is certainly no bulk replacement of globes as a precautionary process taking place. The COB contracts out its entire electrical works to ***BE Electrical*** Contractors and simply responds to customer enquiries as to any outages.

- The electricity costs are approx 50***%*** of the total operating costs while Western Power costs attribute to only ***30%*** of power costs (Refer to Table 6.4 and Table 7.2). Basically Western Power charges significantly more for unmetered supply for decorative COB owned street lights than those on the Western Power StreetVision Agreement. The COB is hamstrung given streetlighting is a necessity and Western Power are the only power providers to date for unmetered supply to street lighting fixtures.

- Not all of the COB streetlights have been picked up however it is felt that the majority of lights being within the CBD and the coastal tourist areas attribute to a minimal error rate in the Cost per Light per Year figure.

The Southern Sydney Regional Organisation of Councils (SSROC) consists of eleven local councils located in the southern region of Sydney. The group's task is to provide a forum for representatives from other councils to exchange ideas and philosophies and to provide a forum to produce collaborative submissions that affect all or the majority of Council members. SSROC established and currently oversees a Street Lighting Improvement (SLI) Program of which there are some 29 Councils taking part in from southern Sydney through to the Central Coast and Hunter. These 29 Councils account for approx 85% of the power provider and asset owner, EnergyAustralia's, base.

The key elements of the SLI Program in 2005 include:

> *Promoting councils' position in pricing and other regulatory matters;*
>
> *Leading negotiations with Energy Australia on improved technology and service arrangements;*
>
> *Monitoring the implementation of technology and service changes;*
>
> *Progressing lighting technology selection efforts;*
>
> *Assisting councils in resolving problems that may arise in their interactions with EnergyAustralia.*

The COB must take up the challenge and form an alliance with surrounding Shires to push for concerted and meaningful negotiations with Western Power over similar elements as to SSROC streetlighting charter. A forum currently exists within the South West of WA through the South West Regional Road Group. This group consists of 13 local government organizations and encompasses the whole of the South West region of WA. The group's primary task is to fairly and equitably allocate road funding to its members however the group has in the past taken up initiatives that affect the region as a whole.

The deregulation of Western Power enabling smaller energy producers a window of opportunity to access the previously closed shop of power provision does not unfortunately relate to streetlighting power. The previous statement relates to the provision of power through Western Power's grid network. Another service provider may opt to install their own network however with the installation of such infrastructure they will never be able to compete with Western Power for the supply of power on any commercial basis.

12.0 Risk Assessment

There are a number of significant risk factors that need to be addressed in the preparation of this report. Specifically these include risks associated with COB owned lighting assessment involving the identification of internal lighting structures.

There is a need to develop risk management schedules for each risk area associated with the lighting audit. (Sample included in appendices.) The following dot points are identified risk areas associated with the auditing of COB lighting network.

12.1 Traffic management

The contractor will need to take into consideration traffic management while performing pole assessments. The general public, both vehicular and pedestrian, will need to be considered, for their general safety and wellbeing while inspections are carried out. The preferred contractor has already indicated that certain streets in the CBD area will need assessing on a Sunday when traffic movements are at a minimum.

12.2 Machinery use

The use of a cherry picker to check globe type and wattage will be required to be operated by a suitable certified and experienced person.

12.3 Personnel

A qualified electrician is required to assess the wattage and type of bulb. The bulb cover will need to be removed for an assessment to be performed.

12.4 Insurance

The appointed contractor will be required to produce a current Certificate of Currency to prove that they carry adequate public liability insurance. This will limit liability exposed to the COB in the event of an incident.

13.0 Resource Requirements

A committed approach from the COB with reference to financial, internal resources and man hours has been required to commence this project. The COB have made funds ($10,000) available for the audit of existing COB owned lighting assets. The contractor, OPUS International, was required to provide a cherry picker to gain access to the light pole globes. The audit of COB owned lighting infrastructure has been transposed into the City's GIS software system with associated attribute data. Manpower is to be made available by the COB to undertake the collation of data to be collected by the contractor.

There are numerous external sources of data that has and will be accessed to undertake this project. (refer to Reference List). Data from Western Power, Crash stat data from Main Roads WA and data obtained by consultants of COB owned lighting are but just a few sources required.

14.0 Conclusions and Further Work

This report has focused on the financial cost of providing streetlighting to the City of Bunbury, both from Western Power maintained and owned infrastructure and COB owned and maintained infrastructure.

A comparison of Table 6.3 and Table 7.2 show that Western Power can supply street lighting services at a far lower cost than the COB can offer, $106 per light compared to $144 per light. It should be noted however that COB lighting is decorative lighting while the majority of Western Power lighting is Standard issue. The COB should remain on the Western Power StreetVision Streetlighting Agreement and renegotiate a further three year arrangement. Further negotiations should include the formulation of a working party through the South West Regional Road Group to enable a collective voice to lobby Western power, being the monopoly power provider for the South West Interconnected Grid. Negotiations would include the amalgamation of Streetlighting with regard to deregulation of power and the ability of a consumer selecting their power provider.

It is also recommended to upgrade existing lighting to meet current AS 1158 on a task-by-task basis. The COB has neither the current or future financial resources to upgrade existing suburban streetlighting, mainly 80W mercury vapour spaced at 80m between power poles. It is recommended to adopt Appendix F on new installations or where works warrant the renewal of existing streetlighting.

The COB should attempt to limit the amount or variety of decorative streetlighting installed. This will save on financial costs to the City of maintaining and controlling these privately owned luminaries and poles.

It is strongly recommended that the COB engage the services of a Lighting Engineering Consulting firm to produce a "COB Lighting Strategy". The following are a list of areas to be covered by such a report

Safety workplace and crime

The report will analysis Main Roads night time crash data to formulate a list of potential lighting upgrades. The foremost requirement of the COB is to ensure a safely lit area for road users, both vehicular and pedestrian. The report will also address community expectation/perception of dusk til dawn timed lighting to deter crime and unsocial able behaviour.

Financial

The COB will have a document with which to help gain the most competitive supply of power and that any agreement entered into with a service provider delivers the most benefit to the COB. If the final report states that it is more beneficial for the COB to acquire and maintain all street lighting assets, a forward structure plan would be put in place. The procurement of such a vast infrastructure base would require a well targeted approach and over a lengthy time frame.

Workplace reform internal structural changes

All COB lighting will be incorporated with the City's GIS software package. This will enable a clear picture in terms of a readable map delineating areas of lighting. There will also be the ability of interrogating the attribute data to acquire a multitude of reference maps. The document would bring about internal workplace reform due to its working nature. Any future developments or upgrade would have a lighting blueprint with which to follow. The nature of ad hoc upgrades as performed in the past would cease.

Environmental

Alternative energy sources such as solar will be suggested in areas that are best able to accommodate such infrastructure. The primary environmental objective of the report is to identify the most suitable lighting network for the built and natural environment.

Capital budget items

The report would become a source of reference to planned upgrades and improvement works associated with lighting. All future lighting works would be designed in accordance with relevant AS

Aesthetics

The COB has and will continue to install decorative street lighting. This document will detail the standard of such installation with respect to aesthetics

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17.0 APPENDICES

Appendix A: Project Specification

Appendix B: Western Power & City of Bunbury Street Lighting Agreement

Appendix C: Review and Analysis of the 2001 Western Power and City of Bunbury Service Agreement

Appendix D: City of Bunbury Owned Street Lighting Network Asset Data (Data Collected by OPUS International Consulting Firm)

Appendix E: Western Power Tariff and Street Lighting Asset Data

Appendix F: Summary of Lighting Recommendations

Appendix G: Risk Management Assessment Chart

APPENDIX A:

PROJECT SPECIFICATION

JASON FOWLER. * 2717109. *
8 MILLARD ST
EATON WA.
6232

0050010266
S1 EXT
ENG1111
(B. Bryan 1.4.05)

FACULTY OF ENGINEERING AND SURVEYING

ENG4111 / ENG4112 RESEARCH PROJECT

PROJECT SPECIFICATION

Version B – 16 March 2005

Student: Jason Fowler

Project Topic: Cost effectiveness of suburban street lighting

Supervisors: Associate Professor Ron Ayers (USQ)
Theo Naude (City Engineer, City of Bunbury)

Sponsorship: City of Bunbury

Project Aim:
To determine the cost effectiveness of suburban street lighting within the City of Bunbury.

Background:
The suburban street lighting network within the City of Bunbury is owned and maintained by Western Australian power utility Western Power, for which the City pays an annual service fee, negotiated in three yearly contracts. The City already owns and maintains some small networks of suburban street lighting in a number of tourist, business and recreational areas of Bunbury. This project will evaluate the cost effectiveness of the Western Power service provision, compared with the City replacing the Western Power network with a council owned and maintained network that meets Australian Standards.

Programme:
1. Research and review relevant literature relating to:
   - Street lighting design
   - Economic evaluation of street lighting systems
   - Australian Standards on street lighting
   - Correlation of road crashes and lighting standards
   - Lighting systems appropriate for the south west area of Western Australia
2. Review existing service agreement between Western Power and City of Bunbury
3. Review capital and operating cost of existing streetlight networks which are owned and maintained by City of Bunbury.
4. Collect data relating to unscheduled and scheduled maintenance callouts and costs; pole location; and light type and wattage for existing lighting system.
5. Evaluate and analyse existing literature on most cost effective lighting and environmentally appropriate structures and network designs, including solar and underground power systems.
6. Review traffic crash data relating to the location and wattage of existing lights.
7. Compare the costs of maintaining the existing supply arrangements with the alternative of the Council establishing, operating and maintaining its own network.
8. Report findings to peer group via oral presentations at Professional Practice 2 residential school and in the required written format.

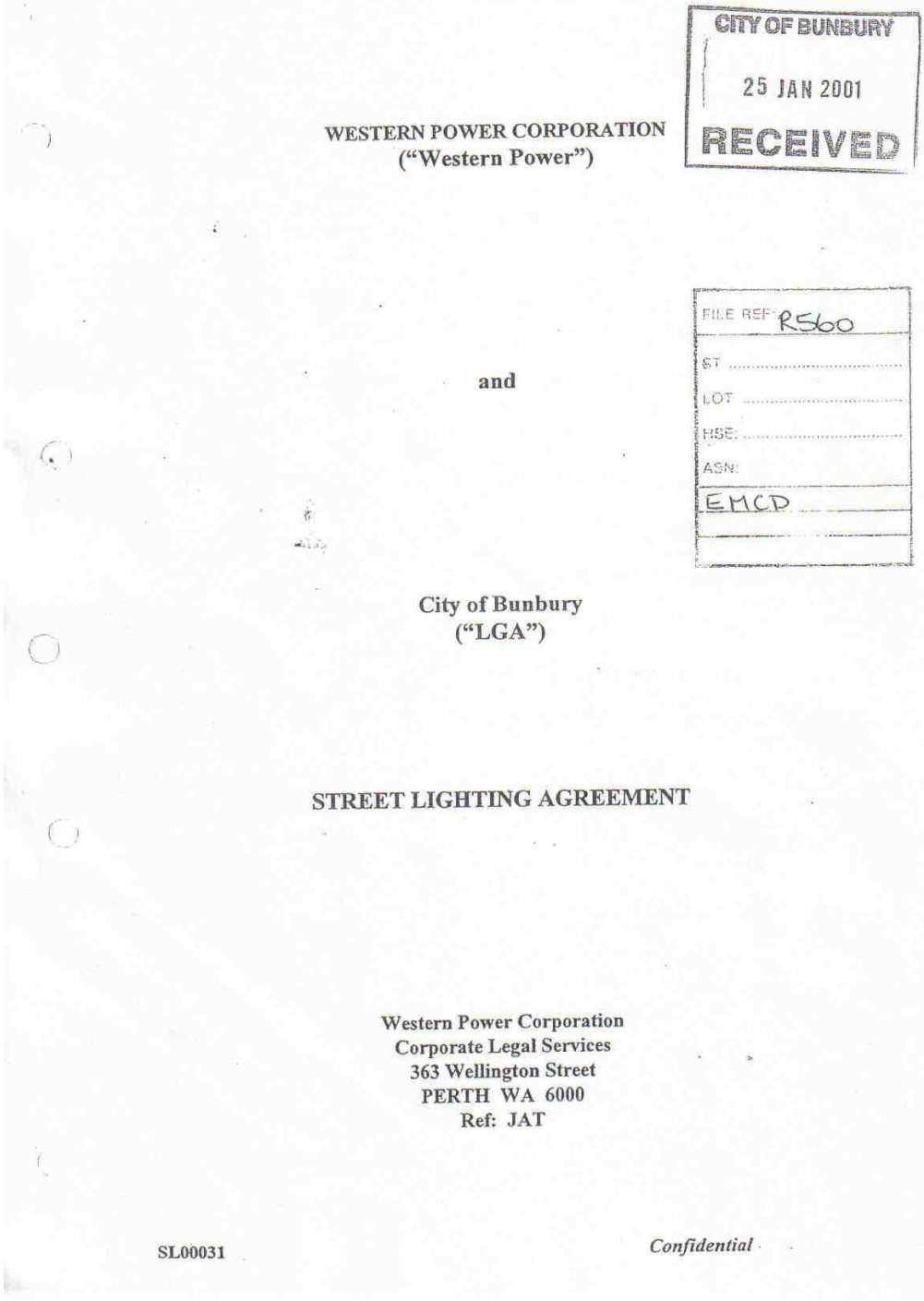
If Time Permits
Consider the effect on stakeholders controlling land affected by potentially relocated street light poles (e.g. Department of Environment, Main Roads WA, Aboriginal Land and Sea Council).

R. A. Ayers 1/4/05.

J Fowler 7/4/05

Appendix B:

Western Power & City of Bunbury Street Lighting Agreement



CITY OF BUNBURY
25 JAN 2001
RECEIVED

WESTERN POWER CORPORATION
("Western Power")

FILE REF: R560
ST
LOT
HSE:
ASN:
EMCD

and

City of Bunbury
("LGA")

STREET LIGHTING AGREEMENT

Western Power Corporation
Corporate Legal Services
363 Wellington Street
PERTH WA 6000
Ref: JAT

SL00031

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CONTENTS

CONTENTS

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STREET LIGHTING AGREEMENT

THIS AGREEMENT is made the Eleventh day of October 2000

BETWEEN:

1. PARTIES

1.1 **WESTERN POWER CORPORATION** a statutory corporation established pursuant to the Electricity Corporation Act 1994 of 363 Wellington Street, Perth WA 6000 ("Western Power"); and

1.2 **CITY OF BUNBURY** of Lot 224 Lerici Circle, Pelican Point WA 6230 ("LGA").

2. RECITALS

2.1 Western Power owns and operates streetlights, poles and wires, underground cables and other electricity distribution infrastructure in road reserves and elsewhere in the local government area administered by the LGA.

2.2 The LGA wishes to have road reserves and other areas within its local government area illuminated at night for the benefit of ratepayers, residents, road users, and the general public.

2.3 Western Power has agreed to provide a street lighting service to the LGA in accordance with the terms and conditions set out in this Agreement.

THE PARTIES AGREE AS FOLLOWS:

3. DEFINITIONS AND INTERPRETATION

3.1 In this Agreement, unless the context otherwise requires:

3.1.1 Words importing the singular include the plural and vice versa;

3.1.2 Words importing any gender include the other genders;

3.1.3 References to persons include corporations, associations, statutory authorities and bodies politic;

3.1.4 References to any party or persons shall mean and include a reference to that party or person, its successors or legal personal representatives, as the case may be, assigns and transferees;

3.1.5 If a word or phrase is defined, cognate words and phrases have corresponding definitions;

3.1.6 All references to "dollar" or the "$" sign, shall be references to the currency of the commonwealth of Australia; and

3.1.7 A reference to an Act of a Parliament shall include any regulations, rules, by-laws and orders made under that Act, and a reference to an Act of a Parliament shall include any amendment, reinactment, variation or extension thereof or statutory provision substituted therefor.

4. TERM

4.1 This Agreement commences as at the First day of January, 2001.

4.2 The initial term of this Agreement shall be for the period of 18 months from the date of execution unless terminated earlier in accordance with the provisions of this Agreement..

4.3 At the expiry of or during the initial 18 month term (and at the expiry of or during each subsequent 12 ,month term) the LGA shall have the option to extend the term of this Agreement by a further period of 12 months. The option to extend may be exercised on four (4) separate occasions resulting in a total maximum cumulative term of 66 months.

4.4 If an option is exercised by the LGA to extend the term of this Agreement, then the review of charges provision set out in Clause 6 applies.

5. STREETLIGHTING SERVICE

5.1 Western Power shall illuminate all existing Western Power streetlights in the LGA's local government area (excluding streetlights that are the subject of separate agreements with third parties, such as streetlights on freeways or security lighting and excluding disconnected or non-operational streetlights) from dusk to dawn;

5.2 Western Power shall conduct a rolling bulk glove replacement program to ensure that all streetlight globes are replaced every four years (regardless of whether or not the globe is operational at the time of replacement).

5.3 Western Power shall provide the other services, if any, set out in Schedule C (Services) on the terms and conditions set out in this Agreement and in accordance with Schedule B (Special Conditions).

5.4 For information purposes only the LGA's local government area and the proposed sectors for bulk globe replacement are set out in Schedule D (Map and Bulk globe Replacement Sectors).

5.5 For the convenience of the LGA, primary points of contact for information relating to this Agreement are set out in Schedule E (Points of Contact).

6. CHARGES

6.1 In consideration of Western Power providing the street lighting service as set out in Clause 5, the LGA agrees to pay Western Power the charges as set out in Schedule A (Prices & Rates).

6.2 The changes will be reviewed by Western Power on an annual basis and may be increased by such amount as is deemed reasonable by Western Power to take into account the installation of additional streetlights in the LGA's local government area and also changes in the cost of providing the street lighting service.

6.3 If payment of the charges set out in Schedule A (Prices and Rates) is not received by Western Power within 14 days of the due date then, without prejudice to Western Power's rights, the LGA shall pay interest on the unpaid balance from the due date at a rate percent per annum equal to three percentage points above the maximum rate of the range of the business indicator (small/medium sized business) rates as published in the Reserve Bank of Australia's Bulletin and quoted in respect of the month which includes the date from which interest commences to be payable. If there is no such rate published then the average of the maximum equivalent rates applicable as at last business day of such month and charged by BankWest, Australia and New Zealand Banking Group Limited and the Commonwealth Bank of Australia shall be used.

6.4 A breach of Clause 6 by the LGA shall entitle Western Power, without prejudice to its other rights, to terminate this Agreement on 30 days notice.

7. INVOICE AND PAYMENT

7.1 Western Power's invoice for payment will be submitted to the LGA at the end of each month (or such other reasonable period selected by Western Power) for the streetlighting services during the month and shall be paid in full within 21 days of receipt.

7.2 In the event of a dispute over an amount owing, the LGA, pending the resolution of the dispute, shall pay the undisputed portion of the invoiced amount. The matter shall be resolved in accordance with Clause 21 (Dispute Resolution).

8. FAULTY STREELIGHTS

Upon being notified by either the LGA or a member of the public that a streetlight is not operating, Western Power shall use its reasonable endeavours to replace the globe or otherwise remedy the fault as soon as is practicable.

9. UPGRADING OF STREETLIGHTS

As part of the bulk globe replacement program, Western Power shall replace mercury vapour 50 watt globes with mercury vapour 80 watt globes over the first 18 months of the Agreement. Western Power shall undertake other upgrade work as agreed with the LGA from time to time.

10. NEW STREETLIGHTS

Western Power will not provide any new streetlights pursuant to this Agreement. However, the parties acknowledge that new streetlights may be installed in the LGA's local government area during the term of this Agreement either by a separate agreement between Western Power and the LGA or as and when new subdivisions are created by developers. Disconnected or faulty streetlights may also be repaired. As streetlights are installed and connected to the distribution system they shall be supplied with electricity and illuminated initially free of charge. (Changes in the number of streetlights in the LGA's local government area will be taken into consideration during the annual assessment of the Charges pursuant to Clause 6.)

11. NO CAPITAL CHARGES

The parties acknowledge that the charges payable under this Agreement are only for the provision of the street lighting service and do not include any charge for (or any obligation in relation to) the capital cost of installing new streetlights. Any additional upgrade work undertaken in accordance with Clause 9 may incur capital and other charges.

12. SPACING

The parties acknowledge that this Agreement does not make any provision for the altering of the spacing between the existing streetlights. The parties acknowledge that certain standards apply to the spacing of streetlights in new subdivisions and that any special requirements for spacing will need to be the subject of a separate arrangement between Western Power, the LGA and the developer (if any).

13. STREET LIGHTING DESIGN

The parties acknowledge that this Agreement makes no provision with regard to the design of new streetlights. The LGA acknowledges that Western Power no longer undertakes street lighting design work for new subdivisions.

14. LOCATION OF LIGHTS

On request and on a fee for service basis, Western Power will provide a computer printout indicating location and wattage of streetlights in the LGA's local government area. The fee shall be as reasonably determined by Western Power from time to time.

15. LAMP SHADING

Streetlights that are shaded with manufacturer approved shading parts will be shaded again, at no charge as part of the bulk globe replacement program. The LGA may request additional shading at its cost.

16. VARYING SWITCH OFF TIME

Any variation to the dawn switch off time for streetlights shall be by agreement between Western Power and the LGA and shall be at the LGA's cost.

17. OUTAGES

17.1 Western Power shall be released from its obligation to provide the street lighting service in circumstances amounting to force majeure, during system emergencies or operational contingencies, during maintenance or upgrade work and in circumstances where there are faults on the electricity supply network.

17.2 "Force Majeure" means act of God; strikes lockouts, stoppages or restraints of labour or other industrial disturbances; war; acts of public enemies, riot or civil commotion or sabotage; fire, explosion, earthquake, landslide, flood, washout, lightning, storm or tempest; vandalism, breakdown of or accident to plant, machinery, equipment, lines or pipes; failure of suppliers to supply fuel, equipment or machinery; restraints, embargoes, or other unforeseeable actions of the Governments or Government agency or instrumentalities of Western Australia or of the Commonwealth of Australia and any other cause (whether specified above or otherwise) which is not reasonably within the control of Western Power.

18. CONSEQUENTIAL LOSS

If any breach or default under this Agreement gives a party right to damages, such damages shall be limited to damages for direct and foreseeable loss attributable to such breach or default. The rights of either party to damages for indirect or consequential loss are hereby excluded. Neither party shall be liable to the other for any loss of profit suffered by a party to this Agreement or any other person. Western Power shall not be liable to the LGA or to any third party in relation to any failure to illuminate any street light.

19. TERMINATION

19.1 The LGA or Western Power may terminate this Agreement at any time after the expiry of the initial one (1) year term provided that 30 days notice of such termination is given in writing.

19.2 Upon termination of this Agreement for any reason Western Power may in its sole discretion, cease to provide any streetlighting service to the LGA or may continue to provide a streetlighting service in which case the LGA shall be liable to pay the applicable tariffs (as determined by Western Power) set out in the Electricity Corporation (Charges) By-Laws 1996.

20. APPLICATION OF ACT AND BY-LAWS

Nothing in this Agreement shall in any way limit the operation or effect of the Energy Operators (Powers) Act 1979 or the Electricity Corporation Act 1994.

21. DISPUTE RESOLUTION

21.1 In the event of a dispute, the parties shall meet within 14 days (of one party issuing a dispute notice to the other party) to resolve the dispute. If they do not meet or having met, fail to agree within a further 14 days (such agreement being evidenced in writing and signed by both parties) then the dispute shall be determined by an Expert appointed by the parties. The Expert shall give a determination together with written reasons within a further 14 days and the Expert's determination shall be final and binding on the parties except in case of fraud, mistake or miscarriage.

21.2 The Expert appointed shall be suited by reason of his or her qualifications, experience and expertise for the determination in question. The Expert, shall unless otherwise agreed by the parties, be appointed and act as an expert and not as an arbitrator.

22. MISCELLANEOUS

22.1 The Customer shall not assign the whole or any part of its rights under this Agreement without the prior written consent of Western Power.

22.2 This Agreement constitutes the entire agreement between the parties and supersedes all prior negotiations, representing, proposals, understandings and agreements, whether written or oral, relating to the subject matter of this Agreement.

22.3 A purported modification, variation or amendment of this Agreement or any waiver of any rights of any party or any approval or consent shall have no effect unless and until the same is in writing executed by the parties.

22.4 If any term or other part of this Agreement is or becomes for any reason invalid or unenforceable at law, the remainder of this Agreement shall continue to be valid and enforceable and such term or other part of this Agreement shall be severed or modified without affecting the remainder of this Agreement.

22.5 No waiver by any party to this Agreement of any breach or default by the other party of any of the terms of this Agreement nor any delay in the exercise of any power or remedy which may become exercisable as a result of such breach or default shall operate or be construed as a waiver of any other preceding or succeeding breach or default by that other party whether of a similar or different character.

22.6 If any breach or default under this Agreement gives a party a right to damages, such damages shall be limited to damages for direct and foreseeable loss attributable to such breach or default. The rights of either party to damages for indirect or consequential loss are hereby excluded. Neither party shall be liable to the other for any loss or profit suffered by a party to this Agreement or any other person.

22.7 This Agreement is confidential. Neither party shall disclose any aspect of this Agreement without the prior written consent of the other party (except where such disclosure is required by law).

22.8 To the extent permitted by law Western Power's liability, howsoever arising, in relation to this Agreement shall be limited to the price and/or rates quoted in respect of the services to be undertaken pursuant to this Agreement.

Signed for and on behalf of LGA by:

Signature: _____

Print Name: KEN WEARY

Position/Title: ACTING CHIEF EXECUTIVE OFFICER

Date: 16/11/2000

Signed for and on behalf of WESTERN POWER CORPORATION by:

Signature: _____

Print Name: KEN WYLANDER

Position/Title: MANAGER MAJOR ACCOUNTS

Date: 20/11/2000

Confidential

SCHEDULE A

PRICES & RATES
(CLAUSE 6.1)

Annual Charge ($ per annum)	**$ 299,781**
Monthly Charge ($ per month)	**$ 24,982**
Infill Lighting Charges	Not Applicable
Capital Contributions	Not Applicable

SCHEDULE B
(CLAUSE 5.3)
SPECIAL CONDITIONS

SCHEDULE C

SERVICES
(CLAUSE 5.3)

1. **FAX-A-LIGHT – FAX NUMBER: (08) 9427 4379**

   The purpose of this service is to increase the ease of reporting faulty street lights via the use of facsimile.

   When reporting a faulty street light, it is important to ensure that you clearly identify the location and please **do not use the pole number** for identification. Accurate house numbers and/or business names and street junctions will enable a far more effective service.

2. **STREETLIGHT FAULT REPORTING HOTLINE – TELEPHONE: 1800 622 0088**

   This is another option for reporting faulty street lights.

   When reporting a faulty street light, it is important to ensure that you clearly identify the location and please **do not use the pole number** for identification. Accurate house numbers and/or business names and street junctions will enable a far more effective service.

3. **CUSTOMER CHARTER**

   Western Power recognises the need to have adequate street lighting and will strive to replace faulty street lights.

   - Within 5 working days of being reported in the Perth metropolitan area and in major regional towns.
   - Within 9 working days of being reported in remote towns and rural areas.

4. **BULK GLOBE REPLACEMENT**

   Please refer to Section 5.2 of the Street Light Agreement.

   A Bulk Globe Replacement Program outlining service scheduling and progress will be provided quarterly.

5. **DESIGN**

   Available on application on a fee for service basis.

6. **FAULT MAINTENANCE**

   Please refer to section 8 of the Street Light Agreement and Customer Charter

in Schedule C.
A performance report on service delivery against Customer Charter Standards will be provided quarterly.

7. ACCOUNT MANAGEMENT SERVICE

You have a single point of contact for ALL energy enquiries. Your Account Manager's name and contact details are set out in Schedule E. Western Power may allocate a different Account Manager to you from time to time.

8. FAX STREAM BROADCASTING SERVICE

Western Power will circulate System Emergency information to you via a Telstra Fax Stream Broadcasting Service.

The Fax Stream Broadcasting Service ensures that Western Power's major customers are kept informed of the status of any impending or actual electrical supply emergency situation and any special requirements of the situation, on a "24 HOURS/7 DAYS" basis, in a timely and organised manner.

The information may include an emergency level code 1 through 4 as defined below:

- A **Level 1** emergency is a **WARNING** level. This warning level may be initiated by a report of strong gale force winds anywhere in the metro area or widespread lightning or bushfires likely to cause system damage.

- A **Level 2** emergency is an **ALERT** level, which is triggered in the same way as a Level 1. It indicates a strong possibility of an event affecting supply to customers, business performance, normal customer activities, or employee safety and wellbeing within the next 24 hours.

- A **Level 3** emergency is initiated following an **ACTUAL OCCURRENCE** of loss of electrical supplies. This may be instantaneous generation or transmission failure which causes widespread and prolonged loss of electrical supply, damage due to storms or bushfires, pole top fires, or extensive low voltage faults affecting service quality in at least one metro district and requiring extraordinary media and customer communications.

- A **Level 4** emergency is initiated following **WIDESPREAD AND SEVERE DAMAGE** to the system, or any cause of **WIDESPREAD AND PROLONGED LOSS OF SUPPLY** requiring significant communication with customers and other bodies during a prolonged outage.

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SCHEDULE D

MAP AND BULK GLOBE REPLACEMENT SECTORS

DESCRIPTIONS OF THE SECTORS

SECTOR 1

Albert Road south to Forest Avenue
Beach Road
William Street

SECTION 2

Forest Avenue Beach Road intersection
Blair Street west
Hudson Road

SECTOR 3

Hudson Road south
Robertson Drive south
Centenery Road north

SECTOR 4

Albert Road Blair Street intersection
Robertson Drive north
Preston River west

SECTOR 5

Preston River east to Robertson Drive
Old Coast Road west

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SCHEDULE E

ACCOUNT MANAGEMENT – POINTS OF CONTACT

1. **ACCOUNT MANAGEMENT SERVICE**

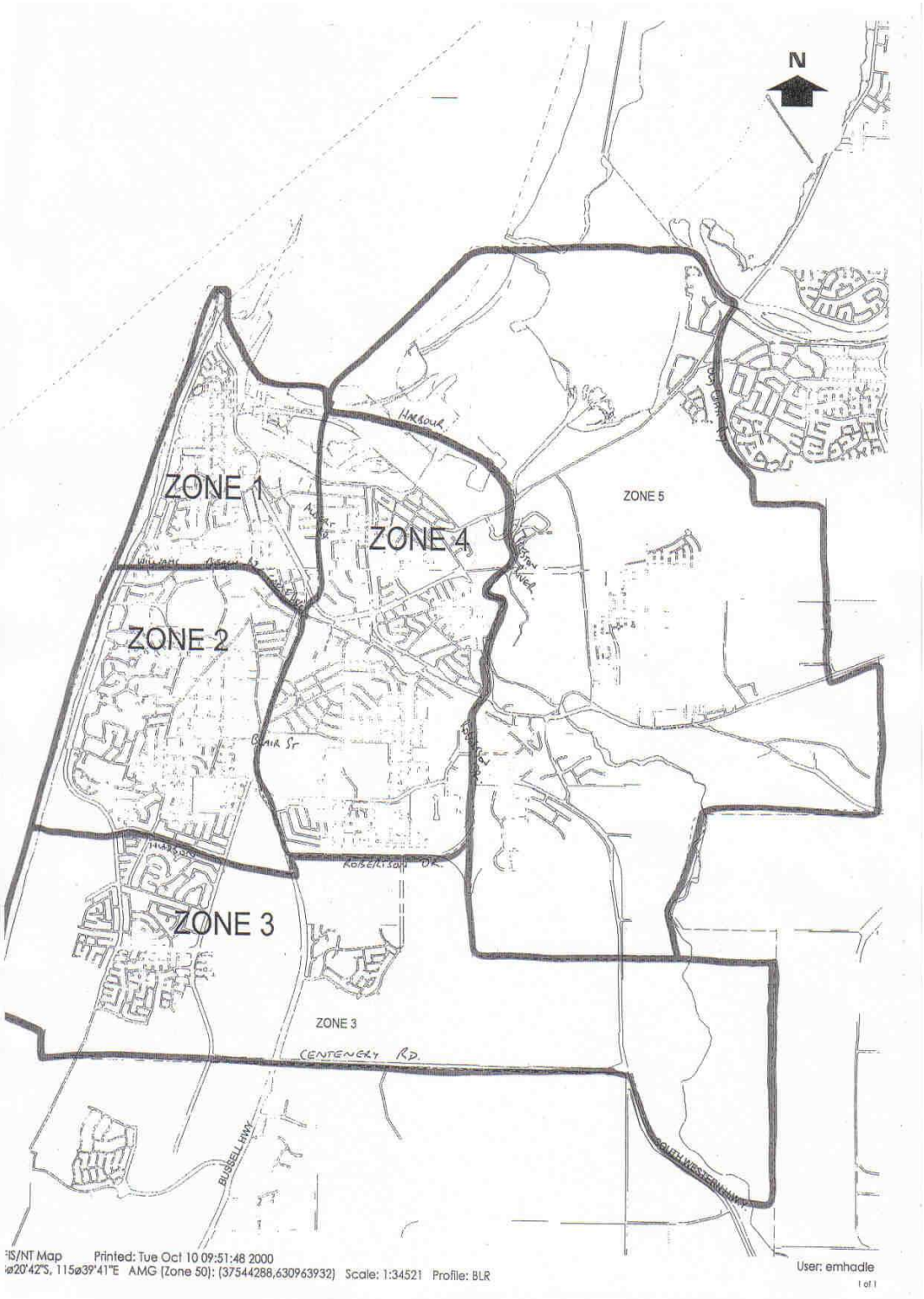
You have a single point of contact for **ALL** electricity enquiries. Your Account Manager's name and contact details are set out below. Western Power may allocate a different Account Manager to you from time to time.

- **ACCOUNT MANAGER**

  Mrs Kathleen Clayton

- **ACCOUNT MANAGER'S CONTACT DETAILS**

Telephone	(08) 9326 4989
Mobile Phone	0418 943 378
Pager	016 981 564
E-mail	kathleen.clayton@wpcorp.com.au
Facsimile	(08) 9326 4555
Courier Address	3 West, 363 Wellington Street, Perth WA 6000
Postal Address	GPO Box L921, Perth WA 6842


N
ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
HARBOUR
BLAIR ST
ROSEDALE DR
CENTENERY RD
BUSSELL HWY
SOUTH WESTERN HWY
ZONE 3
Printed: Tue Oct 10 09:51:48 2000
AMG (Zone 50): (37544288,630963932) Scale: 1:34521 Profile: BLR
User: emhadle

Appendix C:

Review and Analysis of the 2001 Western Power and City of Bunbury Service Agreement

1.0 Agreement Overview

This standard agreement between Western Australia Local Government Authorities and Western Power should be revised to incorporate clauses for the benefit of the City of Bunbury, and especially road users. The City of Bunbury and the Western Australia public deserve the provision of a service, which aims to improve the night-time environment especially with regard to the safe movement of traffic, both pedestrian and vehicular, whilst also improving the general night-time perception of security.

It is recommended that a nominated representative of the Council should endeavour to develop a good working relationship with Western Power and present the Council's case for the inclusion of additional and reasonable clauses to the agreement. In the event this action isn't successful the Council should then attempt to form a coalition with other provincial councils in the area to form a LGA working party. The working party should then make their collective case for a much improved, standardised and more efficient street lighting service.

2.0 Analysis of Existing Clauses Within the Agreement

2.1 Clause 8: Faulty Street Lights

Western Power only undertake to "use its reasonable endeavours" to rectify street lighting faults, if reported. No time frame is given and no promise of service is offered to the client. Western Power does not offer a night inspection service,

which should be part of any routine maintenance program.

It is normal for street lighting installations to be inspected for outages on a periodic basis. This ranges from 2 weekly intervals in more developed countries to 6 monthly in other parts of Australia. Reported outages are normally fixed within a time frame from 2 working days to 7 working days both in more developed countries and other parts of Australia.

Lamp outages can seriously affect the safety of road users, it is well documented that good lighting reduces night-time injury accidents by 30%. Where accidents have occurred there is a growing trend overseas towards proving liability against highway authorities, if there has been a failure to show 'reasonable care' in the maintenance of street lighting.

The public often perceive the presence of lighting in residential areas to offer a safer more comfortable environment with regard to crime and security. Failure to ensure lamp outages are repaired within a reasonable time frame can reduce the quality of life for residents.

2.1.1 Recommendation:

The City should seek to have this clause altered and a reasonable time frame being agreed upon between both parties. Western Power must be made to carry out routine night time inspections.

2.2 Clause 9: Upgrading of Street Lighting

As part of the bulk replacement program, Western Power replaced 50W Mercury lamps with 80W Mercury lamps. Mercury lamps have been considered as an inefficient and outdated light source throughout the Western world for some years now. More developed countries have almost completely phased it out and the world's largest lighting manufactures have not been producing lanterns to house this lamp for some time. For example the 50W Mercury lamp has a lamp flux of 2000 lumens (40 lm/W), its most common replacement throughout more developed countries has been the 50W High Pressure Sodium lamp with a lamp flux of 4400 lumens (88 lm/W) or even the 32W Compact Fluorescent lamp with a lamp flux of 1800 lumens (36 lm/W).

Since the Australian Government is trying to address the energy issue it is surprising that Western Power should undertake a project such as this one without considering lighting design implications or efficiency.

By installing lanterns incorporating 50W HPS lamps, lighting levels could have been improved, even beyond those provided by the higher wattage lamp, whilst also saving a substantial amount in energy consumption.

Note:

This action of changing over from 50W to 80W MV lamps by Western Power has increased the charges made against the COB by 36% per unit. This has resulted in a 53% increase in charges on just 80W MV lamps between 2003 and 2004. Yearly increases in energy/maintenance charges are normally in the region of 1.3%

2.2.1 Recommendation:

The decision on any type of upgrade which affects the COB and the performance of the highway environment should not be undertaken by the electricity supply corporation whose interests are not directed towards the improvement of road asset or the safety of road users. All upgrades of street lighting should be properly designed to comply with the AS/NZS standards and subsequently approved by the Council. The current practise of replacing 50W MV lamps should be reviewed with regard to energy conservation and road user safety.

2.3 Clause 12: Spacing of Street Lights

This clause acknowledges that lighting is generally not checked for its compliance with the AS/NZS standards for road lighting. It can also be assumed that any newly installed and proposed lighting is not checked for its compliance.

There is no justifiable reason for ignoring the AS/NZS Standards for Road Lighting. It has been proved conclusively that the installation of good lighting reduces night time injury accident rates by 30%.

Minimum standards can be achieved by careful design, selection of the right luminaire/lamp combination and if necessary additional infill lighting.

2.3.1 Recommendation

All existing lighting installations should be checked for their conformity with the lighting standards and a program of upgrading to be compiled in order of priority.

In addition, any proposed lighting whether as part of an upgrade or new development must be designed in accordance with the AS/NZS standard.

2.4 Clause 13: Street Lighting Design

Western Power does not undertake street lighting design work for new sub-divisions nor do they check it to ensure that the AS/NZS minimum standards are adhered to.

2.4.1 Recommendation

As part of the planning approval process the COB should insist that developers install lighting in accordance with the AS/NZS standards. A suitably qualified person should check designs submitted by the developer, to ensure they comply, before planning approval is granted. Lighting positions and equipment should be inspected for compliance with the approved scheme before the development is handed over to the COB for maintenance purposes.

2.5 Clause 14: Location of Lights

Western Power will provide on request a computer printout indicating location and wattage of streetlights. They charge a fee for this service.

2.5.1 Recommendation

The COB must update its current out of date lighting database and keep it up to date. This would negate the need to purchase information from Western Power. It could be argued that the COB should not have to purchase information for which

it pays an annual maintenance fee in the initial instance.

2.6 Clause 18: Consequential Loss

This clause should be investigated with regard to the likelihood of future claims made against the COB with regard to accidents related to the maintenance of the highway environment.

2.7 Clause 19: Termination

This clause should be further investigated. It seems unreasonable that a supply company have the power to cease lighting for such a critical asset.

Appendix D:

City of Bunbury Owned Street Lighting

Network Asset Data

CITY OF BUNBURY OWNED STREET LIGHTING NETWORK ASSET DATA

NORTHING	EASTING	HEIGHT	LIGHT_NO	LIGHT_TYPE	WATTAGE	COLUMN_TYP	COLUMN_MOU	BANNER_ARM	FINISH	ACCESS_PAN	PHOTO'S_ED	INDEX/NUMBE	NOTES	LOCATION
6312090	372576	48		Sylvania HIS	250 W	Upright	Fixed	No	Painted	Unknown	DSC0232	232	floodlight in rocky point	Back Beach
6312112	372583	45		Sylvania HIS	250 W	Upright	Fixed	No	Painted	Unknown	DSC0233	233	floodlight in rocky point	Back Beach
6312162	372603	44		Sylvania HIS	250 W	Upright	Fixed	No	Painted	Unknown	DSC0234	234	floodlight in rocky point damaged	Back Beach
6312221	372631	49		Sylvania HIS	250 W	Upright	Fixed	No	Painted	Unknown	DSC0235	235	floodlight in rocky point	Back Beach
6312195	372620	49		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0217	217	light in rocky point	Back Beach
6312172	372612	49		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0218	218	light in rocky point	Back Beach
6312155	372604	42		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0219	219	light in rocky point	Back Beach
6312130	372603	30		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0220	220	light in rocky point	Back Beach
6312103	372595	44		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0221	221	light in rocky point	Back Beach
6312077	372584	49		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0222	222	light in rocky point	Back Beach
6312068	372605	51		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0223	223	light in rocky point	Back Beach
6312062	372626	47		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0224	224	light in rocky point	Back Beach
6312055	372645	41		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0225	225	light in rocky point	Back Beach
6312038	372634	52		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0226	226	light in rocky point	Back Beach
6312028	372614	53		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0227	227	light in rocky point	Back Beach
6312017	372594	49		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0228	228	light in rocky point	Back Beach
6312049	372597	48		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0229	229	light in rocky point	Back Beach
6312062	372581	50		Sylvania HSL-BW	125 W	Outreach	Fixed	No	Painted	Base	DSC0230	230	light in rocky point	Back Beach
6312096	372644	45		Cigsal High Pressur	70 W	Post	Fixed	No	Painted	Base	DSC0231	231	light in rocky point	Back Beach
6312025	372648	43		GEC High Pressure So	70 W	Post	Fixed	No	Painted	Base	DSC0045	45	light at access to bricknell music	CBD
6312018	372641	45		GEC NAV T	400 W	Post	Fixed	No	Painted	Base	DSC0044	44	light at access to bricknell music	CBD
6312017	372630	45		GEC NAV T	400 W	Post	Fixed	No	Painted	Base	DSC0052	52	floodlight behind bricknell music	CBD
6312004	372629	45		GEC NAV T	400 W	Post	Fixed	No	Painted	Base	DSC0053	53	floodlight behind bricknell music	CBD
6311516	373148	46		HCL	250 W	Post	Fixed	No	Galvanised	Unknown	DSC0279	279	light in library car park	CBD
6311502	373166	48		HCL	250 W	Post	Unknown	No	Galvanised	Unknown	DSC0280	280	floodlight in library car park - o	CBD
6311925	373263	47		High Pressure Sodium	400 W	Post	Fixed	No	Galvanised	Base	DSC0366	366	floodlight at bus station	CBD
6311909	373261	44		High Pressure Sodium	400 W	Post	Fixed	No	Galvanised	Base	DSC0367	367	floodlight at bus station	CBD
6312037	373255	46		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0047	47	light opposite entertainment car p	CBD
6312037	373268	43		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0048	48	light opposite entertainment car p	CBD
6312034	373276	46		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0049	49	light in bicentenial park garden	CBD
6312030	373267	46		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0050	50	light in bicentenial park garden	CBD
6312025	373253	45		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0051	51	light in bicentenial park garden	CBD
6311975	373265	47		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0054	54	light in bicentenial park in garde	CBD
6311976	373259	46		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0055	55	light in bicentenial park in garde	CBD
6311973	373252	46		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0056	56	light in bicentenial park in garde	CBD
6311991	373243	48		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0057	57	light in bicentenial park in garde	CBD
6311985	373263	45		High Pressure Sodium	70 W	Unknown	Fixed	No	Painted	Base	DSC0058	58	light in bicentenial park in garde	CBD
6311989	373286	44		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0059	59	light in bicentenial park start of	CBD
6311989	373298	47		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0060	60	light in bicentenial park top of s	CBD
6311983	373302	50		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0061	61	light in bicentenial park top of s	CBD
6311979	373307	44		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0062	62	light in bicentenial park top of s	CBD
6311972	373314	41		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0063	63	light in bicentenial park end of s	CBD
6311962	373310	43		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0064	64	light in centennial park	CBD
6311951	373310	42		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0065	65	light in centennial park	CBD
6311942	373312	43		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0066	66	light in centennial park	CBD
6311933	373312	43		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0067	67	light in centennial park	CBD
6311953	373302	48		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0068	68	light in centennial park	CBD
6311963	373301	46		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0069	69	light in centennial park	CBD
6311974	373297	46		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0070	70	light in centennial park	CBD
6311971	373287	46		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0071	71	light in centennial park	CBD
6311916	373326	47		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0072	72	light in centennial park	CBD
6311910	373325	44		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0073	73	light in centennial park	CBD
6311901	373341	47		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0074	74	light in centennial park	CBD
6311894	373315	43		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0075	75	light in centennial park	CBD
6311945	373314	45		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0076	76	light in centennial park	CBD
6311945	373357	41		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0077	77	light in centennial park	CBD
6311954	373352	44		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0078	78	light in centennial park	CBD

CITY OF BUNBURY OWNED STREET LIGHTING NETWORK ASSET DATA

NORTHING	EASTING	HEIGHT	LIGHT_NO	LIGHT_TYPE	WATTAGE	COLUMN_TYP	COLUMN_MOU	BANNER_ARM	FINISH	ACCESS_PAN	PHOTO'S_ED	INDEXNUMBE	NOTES	LOCATION
6311960	373344	42		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0079	79	light in centennial park	CBD
6311961	373327	45		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0080	80	lights and clock in bicentenial pa	CBD
6311721	373350	57		High Pressure Sodium	70 W	Post	Fixed	No	Painted	Base	DSC0371	371	light near centrepoint	CBD
6311718	373345	44		High Pressure Sodium	70 W	Outreach	Fixed	No	Painted	Base	DSC0372	372	light on stephen street	CBD
6311727	373343	50		High Pressure Sodium	70 W	Outreach	Fixed	No	Painted	Base	DSC0373	373	light on stephen street	CBD
6311735	373332	43		High Pressure Sodium	70 W	Outreach	Fixed	No	Painted	Base	DSC0374	374	light on stephen street	CBD
6311731	373317	51		High Pressure Sodium	70 W	Outreach	Fixed	No	Painted	Base	DSC0375	375	light on stephen street	CBD
6311724	373321	46		High Pressure Sodium	70 W	Outreach	Fixed	No	Painted	Base	DSC0376	376	light on stephen street	CBD
6311718	373332	44		High Pressure Sodium	70 W	Outreach	Fixed	No	Painted	Base	DSC0377	377	light on stephen street	CBD
6311719	373342	61		High Pressure Sodium	70 W	Outreach	Fixed	No	Painted	Base	DSC0378	378	light on stephen street	CBD
6311716	373230	62		High Pressure Sodium	70 W	Outreach	Fixed	No	Painted	Base	DSC0379	379	light on stephen street	CBD
6311722	373224	57		High Pressure Sodium	70 W	Outreach	Fixed	No	Painted	Base	DSC0380	380	light on stephen street	CBD
6311732	373225	44		Osram HPS	400 W	Post	Fixed	No	Galvanised	Unknown	DSC0291	291	floodlight in pallen car park	CBD
6311908	373012	55		Osram HPS	400 W	Post	Fixed	No	Galvanised	Unknown	DSC0292	292	floodlight in leger gallery car pa	CBD
6312289	373258	44		Pierlite HPS	75 W	Uplight	Fixed	No	Unknown	Unknown	DSC0039	39	uplight is plastic	CBD
6312297	373253	48		Par 30 E 27	75 W	Uplight	Fixed	No	Unknown	Unknown	DSC0040	40	uplight is plastic	CBD
6312303	373257	44		Par 30 E 27	75 W	Uplight	Fixed	No	Unknown	Unknown	DSC0041	41	uplight is plastic	CBD
6312296	373264	46		Par 30 E 27	75 W	Uplight	Fixed	No	Unknown	Unknown	DSC0042	42	uplight is plastic	CBD
6312196	373229	47		Philips High Pressur	400 W	Post	Fixed	No	Galvanised	Base	DSC0086	86	floodlight in entertainment car pa	CBD
6312146	373230	47		Philips High Pressur	400 W	Post	Fixed	No	Galvanised	Base	DSC0087	87	floodlight in entertainment car pa	CBD
6311870	372983	50		Philips High Pressur	400 W	Post	Fixed	No	Galvanised	Base	DSC0293	293	light in art complex car park	CBD
6311894	372882	57		Philips High Pressur	400 W	Post	Fixed	No	Galvanised	Base	DSC0294	294	light in art complex car park	CBD
6311844	373013	49		Pierlite HPS	400 W	Post	Fixed	No	Galvanised	Base	DSC0288	288	floodlight in wittenoom st car pair	CBD
6311862	373013	47		Pierlite HPS	400 W	Post	Fixed	No	Galvanised	Base	DSC0289	289	floodlight in wittenoom st car pair	CBD
6311893	373013	47		Pierlite HPS	400 W	Post	Fixed	No	Galvanised	Base	DSC0290	290	floodlight in wittenoom st car pair	CBD
6311610	373146	47		Qi	300 W	Uplight	Unknown	No	Galvanised	Unknown	DSC0261	261	light at war memorial	CBD
6311610	373136	47		Qi	300 W	Uplight	Unknown	No	Galvanised	Unknown	DSC0262	262	light at war memorial	CBD
6312024	373225	41		Sodium Vapour	70 W	Post	Fixed	No	Painted	Base	DSC0043	43	light opposite rivers store	CBD
6311800	373020	45		Sodium Vapour	70 W	Post	Fixed	No	Galvanised	Base	DSC0283	283	light in bcc park	CBD
6311760	373047	49		Sodium Vapour	70 W	Post	Fixed	No	Galvanised	Base	DSC0284	284	light in bcc park	CBD
6311782	373041	53		Sodium Vapour	70 W	Post	Fixed	No	Galvanised	Base	DSC0285	285	light in bcc park	CBD
6311798	373021	53		Sodium Vapour	70 W	Post	Fixed	No	Galvanised	Base	DSC0286	286	light in bcc park	CBD
6311798	373021	66		Sodium Vapour	70 W	Post	Fixed	No	Galvanised	Base	DSC0287	287	light in bcc park	CBD
6312564	373114	47		Sylvania High Pressu	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0275	275	light in median Victoria st	CBD
6311723	373148	54		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0384	384	light on stephen street	CBD
6311716	373144	82		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0385	385	light on stephen street	CBD
6311716	373128	57		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0386	386	light on stephen street	CBD
6311735	373126	48		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0387	387	light on stephen street	CBD
6311820	373144	40		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0388	388	light on prinsep street	CBD
6311817	373125	46		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0389	389	light on prinsep street	CBD
6311832	373124	45		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0390	390	light on prinsep street	CBD
6311828	373143	64		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0391	391	light on prinsep street	CBD
6312390	373110	62		Sylvania High Pressu	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0392	392	light in median victoria street	CBD
6312354	373117	54		Sylvania High Pressu	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0393	393	light in median victoria street	CBD
6312322	373120	45		Sylvania High Pressu	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0394	394	light in median victoria street	CBD
6312297	373129	44		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0395	395	light on clifton street	CBD
6312298	373113	44		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0396	396	light on clifton street	CBD
6312281	373112	43		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0397	397	light on clifton street	CBD
6312261	373129	44		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0398	398	light on clifton street	CBD
6312250	373124	45		Sylvania High Pressu	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0399	399	light on victoria street	CBD
6312254	373122	45		Sylvania High Pressu	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0400	400	light on victoria street	CBD
6312216	373121	63		Sylvania High Pressu	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0401	401	light on victoria street	CBD

CITY OF BUNBURY OWNED STREET LIGHTING NETWORK ASSET DATA

NORTHING	EASTING	HEIGHT	LIGHT_NO	LIGHT_TYPE	WATTAGE	COLUMN_TYP	COLUMN_MOU	BANNER_ARM	FINISH	ACCESS_PAN	PHOTO'S_ED	INDEXNUMBE	NOTES	LOCATION
6312188	373125	46		Sylvania High Pressu	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0402	402	light on victoria street	CBD
6312172	373133	45		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0403	403	light on eliot street	CBD
6312160	373133	47		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0404	404	light on eliot street	CBD
6312159	373114	47		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0405	405	light on eliot street	CBD
6312174	373114	46		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0406	406	light on eliot street	CBD
6312051	373138	47		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0407	407	light on symmons street	CBD
6312042	373138	46		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0408	408	light on symmons street	CBD
6312039	373119	44		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0409	409	light on symmons street	CBD
6312055	373120	46		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0410	410	light on symmons street	CBD
6312027	373126	31		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0411	411	light on wellington street	CBD
6312024	373133	34		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0412	412	light on wellington street	CBD
6312007	373130	45		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0413	413	light on wellington street	CBD
6311944	373140	28		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0414	414	light on wellington street	CBD
6311977	373125	48		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0415	415	light on victoria street	CBD
6311998	373134	50		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0416	416	light on victoria street	CBD
6311944	373138	51		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0417	417	light on victoria street	CBD
6311941	373139	42		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0418	418	light on victoria street	CBD
6311932	373125	47		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0419	419	light on victoria street	CBD
6311919	373123	44		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0420	420	light on victoria street	CBD
6311916	373138	47		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0421	421	light on victoria street	CBD
6311935	373143	48		Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0422	422	light on victoria street	CBD
6311623	372957	79		Sylvania Solar Power		Outreach	Fixed	No	Painted	Unknown	DSC0237	237	light at boulters heights with sol	CBD
6311638	372955	72		Sylvania Solar Power		Outreach	Fixed	No	Painted	Unknown	DSC0238	238	light at boulters heights with sol	CBD
6311649	372970	67		Sylvania Solar Power		Outreach	Fixed	No	Painted	Unknown	DSC0239	239	light at boulters heights with sol	CBD
6311653	372985	63		Sylvania Solar Power		Outreach	Fixed	No	Painted	Unknown	DSC0240	240	light at boulters heights	CBD
6311665	372996	54		Sylvania Solar Power		Outreach	Fixed	No	Painted	Unknown	DSC0241	241	light at boulters heights	CBD
6312266	373205	45		Thorn Beta 70	70 W	Outreach	Fixed	No	Galvanised	Base	DSC0081	81	light in cinema car park	CBD
6312223	373205	45		Thorn Beta 70	70 W	Outreach	Slip Base	No	Galvanised	Base	DSC0082	82	light in cinema car park	CBD
6312202	373186	42		Thorn Beta 70	70 W	Outreach	Slip Base	No	Galvanised	Base	DSC0083	83	light in cinema car park	CBD
6312231	373240	44		Thorn Beta 70	70 W	Outreach	Slip Base	No	Galvanised	Base	DSC0084	84	light in cinema car park	CBD
6312260	373233	49		Thorn Beta 70	70 W	Outreach	Slip Base	No	Galvanised	Base	DSC0085	85	light in cinema car park	CBD
6312129	373203	38		Thorn Beta 79	80 W	Post	Fixed	No	Galvanised	Base	DSC0088	88	light in entertainment car park	CBD
6312110	373183	51		Thorn Beta 79	80 W	Post	Fixed	No	Galvanised	Base	DSC0089	89	light in entertainment car park	CBD
6312105	373205	54		Thorn Beta 79	80 W	Post	Fixed	No	Galvanised	Base	DSC0090	90	light in entertainment car park	CBD
6312119	373224	48		Thorn Beta 79	80 W	Post	Fixed	No	Galvanised	Base	DSC0091	91	light in entertainment car park	CBD
6312093	373243	46		Thorn Beta 79	80 W	Post	Fixed	No	Galvanised	Base	DSC0092	92	light in entertainment car park	CBD
6311480	373135	55		Thorn Sodium Vapour	400 W	Outreach	Fixed	No	Galvanised	Unknown	DSC0275	275	floodlight in library car park.	CBD
6311478	373121	58		Thorn Sodium Vapour	400 W	Outreach	Fixed	No	Galvanised	Unknown	DSC0277	277	floodlight in library car park.	CBD
6311517	373139	47		Thorn Sodium Vapour	400 W	Post	Fixed	No	Galvanised	Unknown	DSC0278	278	light at library car park.	CBD
6311607	372969	86		Unknown		Outreach	Fixed	No	Painted	Unknown	DSC0236	236	light at boulters heights with sol	CBD
6311600	372961	84		Unknown		Post	Fixed	No	Painted	Unknown	DSC0242	242	bollard light at boulters heights	CBD
6311591	372959	85		Unknown		Post	Fixed	No	Painted	Unknown	DSC0243	243	bollard light at boulters heights	CBD
6312394	379853	46		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0185	185	light at dolphin beach	Koombana Bay
6312394	379971	44		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0186	186	light at dolphin beach	Koombana Bay
6312390	379997	48		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0187	187	light at dolphin beach	Koombana Bay
6312388	374014	41		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0188	188	light at dolphin beach	Koombana Bay
6312384	374034	46		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0189	189	light at dolphin beach	Koombana Bay
6312385	374057	46		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0190	190	light at dolphin beach	Koombana Bay
6312379	374074	45		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0191	191	light at dolphin beach	Koombana Bay
6312370	374084	45		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0192	192	light at dolphin beach	Koombana Bay
6312368	374098	43		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0193	193	light at dolphin beach	Koombana Bay
6312366	374117	45		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0194	194	light at dolphin beach	Koombana Bay
6312363	374133	44		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0195	195	light at dolphin beach	Koombana Bay
6312361	374146	45		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0196	196	light at dolphin beach	Koombana Bay
6312365	374165	46		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0197	197	light at dolphin beach	Koombana Bay
6312366	374181	44		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0198	198	light at dolphin beach	Koombana Bay
6312368	374196	44		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0199	199	light at dolphin beach	Koombana Bay

			CITY OF BUNBURY OWNED STREET LIGHTING NETWORK ASSET DATA									
NORTHING	EASTING	HEIGHT	LIGHT_NO	LIGHT_TYPE	WATTAGE	COLUMN_TYP	COLUMN_MOU	BANNER_ARM	FINISH	ACCESS_PAN	PHOTO'S_ED	INDEXNUMBE	NOTES	LOCATION
6312367	374215	50		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0200	200	light at dolphin beach	Koombana Bay
6312366	374231	46		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0201	201	light at dolphin beach	Koombana Bay
6312365	374247	46		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0202	202	light at dolphin beach	Koombana Bay
6312361	374264	42		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0203	203	light at dolphin beach	Koombana Bay
6312358	374279	45		Mercury Vapour	125 W	Post	Slip Base	No	Painted	Base	DSC0204	204	light at dolphin beach	Koombana Bay
6311886	375562	49		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0008	8	light in front of rowing club. boa	Leschenault Inlet
6311906	375555	42		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0009	9	start of boardwalk- 1st light	Leschenault Inlet
6311893	375537	47		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0010	10	2nd light on boardwalk	Leschenault Inlet
6311900	375514	44		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0011	11	3rd light on boardwalk	Leschenault Inlet
6311908	375494	45		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0012	12	4th light on boardwalk	Leschenault Inlet
6311918	375474	46		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0013	13	5th light on boardwalk	Leschenault Inlet
6311930	375455	44		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0014	14	6th light on boardwalk	Leschenault Inlet
6311944	375438	46		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0015	15	7th light on boardwalk	Leschenault Inlet
6311961	375421	43		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0016	16	8th light on boardwalk	Leschenault Inlet
6311978	375405	44		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0017	17	9th light on boardwalk	Leschenault Inlet
6311993	375389	47		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0018	18	10th light on boardwalk	Leschenault Inlet
6312010	375373	46		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0019	19	11th light on boardwalk	Leschenault Inlet
6312034	375353	45		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0020	20	light at the sail shaped bust	Leschenault Inlet
6312036	375338	43		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0021	21	light on the sail shaped bust	Leschenault Inlet
6312057	375337	45		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0022	22	light flag of usher bust	Leschenault Inlet
6312071	375330	47		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0023	23	13th light on boardwalk	Leschenault Inlet
6312097	375314	45		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0024	24	14th light on boardwalk	Leschenault Inlet
6312119	375310	46		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0025	25	15th light on boardwalk	Leschenault Inlet
6312149	375314	46		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0026	26	16th light on boardwalk	Leschenault Inlet
6312172	375317	45		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0027	27	17th light on boardwalk	Leschenault Inlet
6312192	375331	44		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0028	28	18th light on boardwalk	Leschenault Inlet
6312206	375351	44		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0029	29	19th light on boardwalk	Leschenault Inlet
6312220	375370	44		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0030	30	20th light on boardwalk	Leschenault Inlet
6312226	375379	44		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0031	31	21st light on boardwalk	Leschenault Inlet
6312238	375397	45		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0032	32	22nd light on boardwalk	Leschenault Inlet
6312252	375397	45		High Pressure Sodium	70 W	Post	Fixed	No	Galvanised	Base	DSC0033	33	23rd light on boardwalk	Leschenault Inlet
6312308	375566	56		Lvalox Sodium	150 W	Post	Fixed	No	Galvanised	Base	DSC0034	34	24th light on boardwalk	Leschenault Inlet
6311806	375564	45		Philips Sodium	400SN	Post	Fixed	No	Galvanised	Base	DSC0205	205	light near flood gate	Leschenault Inlet
6311776	375547	43		Philips Sodium	400SN	Post	Fixed	No	Galvanised	Base	DSC0001	1	light at skate park	Leschenault Inlet
6311825	375514	43		Philips Sodium	400SN	Post	Fixed	No	Galvanised	Base	DSC0002	2	light at skate park	Leschenault Inlet
6311843	375488	46		Philips Sodium	400SN	Post	Slip Base	No	Galvanised	Base	DSC0003	3	base of post painted, queens garde	Leschenault Inlet
6311849	375467	44		Philips Sodium	400SN	Post	Slip Base	No	Galvanised	Base	DSC0004	4	base of post painted, camera atatc	Leschenault Inlet
6311836	375620	42		Philips Sodium Vapou	400SN	Post	Slip Base	No	Galvanised	Base	DSC0005	5	base of post painted, queens garde	Leschenault Inlet
6311767	375773	46		Philips Sodium Vapou	80 W	Outreach	Fixed	No	Painted	Unknown	DSC0006	6	base of post painted, queens garde	Leschenault Inlet
6312292	373395	45		Sodium Vapour	400 W	Post	Slip Base	No	Galvanised	Base	DSC0007	7	light at base of post painted grey	Leschenault Inlet
6312251	373280	44		Sodium Vapour	400 W	Post	Slip Base	No	Galvanised	Base	DSC0035	35	base of car park floodlight painte	Leschenault Inlet
6312224	373274	45		Sodium Vapour	400 W	Post	Slip Base	No	Galvanised	Base	DSC0036	36	base of car park floodlight painte	Leschenault Inlet
6312196	373274	45		Sodium Vapour	400 W	Post	Slip Base	No	Galvanised	Base	DSC0037	37	base of car park floodlight painte	Leschenault Inlet
6312133	373750	43		SoN Sodium	400 W	Outreach	Slip Base	No	Galvanised	Base	DSC0038	38	base of car park floodlight painte	Leschenault Inlet
6312134	373696	48		Thorn MBF	50 W	Post	Fixed	No	Painted	Base	DSC0216	216	floodlight in park near bun/p/boat	Leschenault Inlet
6312114	373695	53		Thorn MBF	50 W	Post	Fixed	No	Painted	Unknown	DSC0206	206	bollard light in park near bun/p/b	Leschenault Inlet
6312105	373714	44		Thorn MBF	50 W	Post	Fixed	No	Painted	Unknown	DSC0207	207	bollard light in park near bun/p/b	Leschenault Inlet
6312098	373731	36		Thorn MBF	50 W	Post	Fixed	No	Painted	Unknown	DSC0208	208	bollard light in park near bun/p/b	Leschenault Inlet
6312119	373733	32		Thorn MBF	50 W	Post	Fixed	No	Painted	Unknown	DSC0209	209	bollard light in park near bun/p/b	Leschenault Inlet
6312119	373722	45		Thorn MBF	50 W	Post	Fixed	No	Painted	Unknown	DSC0210	210	bollard light in park near bun/p/b	Leschenault Inlet
6312132	373719	48		Thorn MBF	50 W	Post	Fixed	No	Painted	Unknown	DSC0211	211	bollard light in park near bun/p/b	Leschenault Inlet
6312149	373729	39		Thorn MBF	50 W	Post	Fixed	No	Painted	Unknown	DSC0212	212	bollard light in park near bun/p/b	Leschenault Inlet
6312142	373765	40		Thorn MBF	50 W	Post	Fixed	No	Painted	Unknown	DSC0213	213	bollard light in park near bun/p/b	Leschenault Inlet
6312127	373768	42		Thorn MBF	50 W	Post	Fixed	No	Painted	Unknown	DSC0214	214	bollard light in park near bun/p/b	Leschenault Inlet
6312895	373031	22		High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0215	215	bollard light in park near bun/p/b	Leschenault Inlet
6312877	373048	72		High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0166	166	light on lookout stairway from vic.	Marlston Hill
6312893	373059	64		High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0167	167	light on lookout stairway from vic.	Marlston Hill
											DSC0168	168	light on lookout stairway from vic.	Marlston Hill

CITY OF BUNBURY OWNED STREET LIGHTING NETWORK ASSET DATA

NORTHING	EASTING	HEIGHT	LIGHT_NO	LIGHT_TYPE	WATTAGE	COLUMN_TYP	COLUMN_MOU	BANNER_ARM	FINISH	ACCESS_PAN	PHOTO'S_ED	INDEXNUMBE	NOTES	LOCATION
6312598	373061		59	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0169	169	light on lookout stairway from vic	Marlston Hill
6312602	373073		61	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0170	170	light on lookout stairway from vic	Marlston Hill
6312593	373075		54	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0171	171	light on lookout stairway from vic	Marlston Hill
6312592	373080		55	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0172	172	light on lookout stairway from vic	Marlston Hill
6312594	373082		28	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0173	173	light on lookout stairway from vic	Marlston Hill
6312592	373091		49	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0174	174	light on lookout stairway from vic	Marlston Hill
6312587	373090		51	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0175	175	light on lookout stairway from vic	Marlston Hill
6312579	373091		54	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0176	176	light on lookout stairway from vic	Marlston Hill
6312582	373096		51	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0177	177	light on lookout stairway from vic	Marlston Hill
6312582	373094		48	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0178	178	light on lookout stairway from vic	Marlston Hill
6312633	373033		58	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0179	179	light in whale view access way	Marlston Hill
6312636	373023		62	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0180	180	light in whale view access way	Marlston Hill
6312642	373018		58	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0181	181	light in whale view access way	Marlston Hill
6312562	372962		67	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0182	182	light on lookout stairway from sin	Marlston Hill
6312490	372828		60	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0244	244	light in median Marlston drive	Marlston Hill
6312498	372847		60	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0245	245	light in median Marlston drive	Marlston Hill
6312507	372866		60	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0246	256	light in median Marlston drive	Marlston Hill
6312553	372885		59	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0247	247	light in median Marlston drive	Marlston Hill
6312581	372902		62	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0248	248	light in median Marlston drive	Marlston Hill
6312629	372905		62	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0250	250	light in median Marlston drive	Marlston Hill
6312659	372919		61	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0251	251	light in median Marlston drive	Marlston Hill
6312685	372942		62	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0252	252	light in median Marlston drive	Marlston Hill
6312700	372966		58	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0253	253	light in median Marlston drive	Marlston Hill
6312707	372994		58	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0254	254	light in median Marlston drive	Marlston Hill
6312704	373036		55	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0255	255	light in median Marlston drive	Marlston Hill
6312691	373064		52	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0256	256	light in median Marlston drive	Marlston Hill
6312670	373088		49	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0257	257	light in median Marlston drive	Marlston Hill
6312638	373107		50	High Pressure Sodium	150 W	Outreach	Fixed	yes	Painted	Base	DSC0258	258	light in median Marlston drive	Marlston Hill
6312607	373113		47	High Pressure Sodium	150 W	Outreach	Fixed	yes	Painted	Base	DSC0259	259	light in median Marlston drive	Marlston Hill
6312693	373014		56	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0260	260	light in Marlston drive laneway	Marlston Hill
6312688	373015		58	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0261	261	light in Marlston dr. laneway ligh	Marlston Hill
6312671	373016		64	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0262	262	light in Marlston drive laneway	Marlston Hill
6312905	373130		52	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0263	263	light in Marlston opposite jetty b	Marlston Hill
6312844	373205		46	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0264	264	light in jetty baths park	Marlston Hill
6312874	373227		46	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0265	265	light in jetty baths park	Marlston Hill
6312845	373251		46	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0266	266	light in jetty baths park	Marlston Hill
6312840	373265		48	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0267	267	light in jetty baths park	Marlston Hill
6312827	373185		49	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0268	268	light in jetty baths park	Marlston Hill
6312922	373025		37	HPS Type H 575E H100		Uplight	Unknown	No	Painted	Unknown	DSC0162	162	light in Marlston lookout globe da	Marlston Hill
6312909	373010		74	HPS Type H 575E H100		Uplight	Unknown	No	Painted	Unknown	DSC0163	163	light in Marlston lookout	Marlston Hill
6312908	373029		84	HPS Type H 575E H100		Uplight	Unknown	No	Painted	Unknown	DSC0164	164	light in Marlston lookout	Marlston Hill
6312598	373032		66	HPS Type H 575E H100		Uplight	Unknown	No	Painted	Unknown	DSC0165	165	light in Marlston lookout	Marlston Hill
6312447	373154		46	Osram HCL MBF-V	125 W	Post	Fixed	No	Painted	Base	DSC0298	298	light in guppy park	Marlston Hill
6312435	373156		46	Osram HCL MBF-V	125 W	Outreach	Fixed	No	Galvanised	Base	DSC0299	299	light in guppy park	Marlston Hill
6312451	373137		49	Osram HCL MBF-V	125 W	Outreach	Fixed	No	Galvanised	Base	DSC0300	300	light in guppy park	Marlston Hill
6312420	373128		48	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0301	301	light on victoria street	Marlston Hill
6312417	373162		47	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0302	302	light on carey street	Marlston Hill
6312421	373191		49	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0303	303	light on carey street	Marlston Hill
6312421	373223		48	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0304	304	light on carey street	Marlston Hill
6312407	373236		44	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0305	305	light on carey street	Marlston Hill
6312407	373212		46	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0306	306	light on carey street	Marlston Hill
6312405	373163		49	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0307	307	light on carey street	Marlston Hill
6312402	373126		48	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0308	308	light on victoria street	Marlston Hill
6312401	373110		44	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0309	309	light on victoria street	Marlston Hill
6312419	373110		46	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0310	310	light on victoria street	Marlston Hill
6312440	373118		47	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0311	311	light in median Victoria st	Marlston Hill

				CITY OF BUNBURY OWNED STREET LIGHTING NETWORK ASSET DATA									
NORTHING	EASTING	HEIGHT	LIGHT_NO	LIGHT_TYPE	WATTAGE	COLUMN_TYP	COLUMN_MOU	BANNER_ARM	FINISH	ACCESS_PAN	PHOTO'S_ED	INDEXNUMBE	NOTES	LOCATION
6312471	373117		47	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0312	312	light in median Victoria st	Marlston Hill
6312500	373116		46	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0313	313	light in median Victoria st	Marlston Hill
6312531	373114		31	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0314	314	light in median Victoria st	Marlston Hill
6312583	373107		42	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0315	315	light on Victoria st	Marlston Hill
6312592	373121		42	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0316	316	light on Victoria st	Marlston Hill
6312577	373122		49	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0317	317	light on Victoria st	Marlston Hill
6312576	373137		48	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0318	318	light on Victoria st	Marlston Hill
6312591	373149		48	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0319	319	light on wollaston st	Marlston Hill
6312577	373160		48	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0320	320	light on wollaston st	Marlston Hill
6312589	373171		49	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0321	321	light on wollaston st	Marlston Hill
6312577	373185		46	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0322	322	light on wollaston st	Marlston Hill
6312593	373194		45	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0323	323	light on wollaston st	Marlston Hill
6312579	373203		44	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0324	324	light on wollaston st	Marlston Hill
6312593	373219		46	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0325	325	light on wollaston st	Marlston Hill
6312594	373236		46	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0326	326	light on wollaston st	Marlston Hill
6312579	373236		48	Osram HPS	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0327	327	light on wollaston st	Marlston Hill
6312542	373251		45	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0362	362	light on ommarney st	Marlston Hill
6312508	373300		43	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0363	363	light on ommarney st	Marlston Hill
6312492	373189		46	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0364	364	light on ommarney st	Marlston Hill
6312478	373203		43	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0365	365	light on ommarney st	Marlston Hill
6312469	373190		46	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0366	366	light on ommarney st	Marlston Hill
6312455	373204		45	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0357	357	light on ommarney st	Marlston Hill
6312440	373198		56	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0358	358	light on ommarney st	Marlston Hill
6312429	373205		45	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0359	359	light on ommarney st	Marlston Hill
6312537	373159		46	Philips High Pressur	400 W	Post	Fixed	No	Painted	Base	DSC0360	360	light on ommarney st	Marlston Hill
6312502	373160		46	Philips High Pressur	400 W	Post	Fixed	No	Painted	Base	DSC0295	295	floodlight in Marlston hill car pa	Marlston Hill
6312472	373162		46	Philips High Pressur	400 W	Post	Fixed	No	Painted	Base	DSC0296	296	floodlight in Marlston hill car pa	Marlston Hill
6312723	373218		45	Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0297	297	floodlight in Marlston hill car pa	Marlston Hill
6312709	373221		46	Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0270	270	light in Marlston bpa	Marlston Hill
6312699	373212		48	Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0271	271	light in Marlston bpa	Marlston Hill
6312714	373205		54	Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0272	272	light in Marlston bpa	Marlston Hill
6312721	373196		49	Sylvania High Pressu	150 W	Outreach	Fixed	No	Painted	Base	DSC0273	273	light in Marlston bpa	Marlston Hill
6312657	372964		58	Sylvania HSL-SW	125 W	Outreach	Fixed	No	Painted	Base	DSC0274	274	light in Marlston bpa	Marlston Hill
6312649	372960		54	Sylvania HSL-SW	125 W	Outreach	Fixed	No	Painted	Base	DSC0183	183	light on lookout stairway from sin	Marlston Hill
6312796	373377	45	2023	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0184	184	light on lookout stairway from sin	Marlston Hill
6312781	373366	47	1022	High Pressure Sodium	150 W	Outreach	Fixed	Yes	Painted	Base	DSC0152	152	light in waterfront complex	Marlston Waterfront
6312791	373398	47	1021	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0154	154	light in waterfront complex	Marlston Waterfront
6312764	373385	47	1003	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0155	155	light in waterfront complex	Marlston Waterfront
6312723	373364	50	1004	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0156	156	light in waterfront complex	Marlston Waterfront
6312694	373350	58	1005	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0157	157	light in waterfront complex	Marlston Waterfront
6312675	373344	51	1011	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0158	158	light in waterfront complex	Marlston Waterfront
6312653	373350	42	1006	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0159	159	light in waterfront complex	Marlston Waterfront
6312613	373345	45	1007	High Pressure Sodium	150 W	Outreach	Fixed	No	Painted	Base	DSC0160	160	light in waterfront complex	Marlston Waterfront
6312593	373298	53	1010	HQI-E	70 W	Outreach	Fixed	No	Painted	Base	DSC0161	161	light in waterfront complex	Marlston Waterfront
6312594	373325	53	1009	HQI-E	70 W	Outreach	Fixed	No	Painted	Base	DSC0094	94	light in silos waterfront	Marlston Waterfront
6312580	373320	50	2026	HQI-E	70 W	Outreach	Fixed	No	Painted	Base	DSC0095	95	light in silos waterfront	Marlston Waterfront
6312571	373326	49		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0096	96	light in silos waterfront	Marlston Waterfront
6312570	373328	51		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0097	97	light in silos waterfront	Marlston Waterfront
6312565	373326	47	2030	HQI-E	70 W	Outreach	Fixed	No	Painted	Base	DSC0098	98	light in silos waterfront	Marlston Waterfront
6312593	373328	42		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0099	99	light in silos waterfront	Marlston Waterfront
6312594	373327	44		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0100	100	light in silos waterfront	Marlston Waterfront
6312611	373321	45	2027	HQI-E	70 W	Outreach	Fixed	No	Painted	Base	DSC0101	101	light in silos waterfront	Marlston Waterfront
6312611	373345	44	2028	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0102	102	light in silos waterfront	Marlston Waterfront
6312586	373342	66		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0103	103	light in silos waterfront	Marlston Waterfront
6312599	373337	51		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0104	104	light in silos waterfront	Marlston Waterfront
6312595	373341	50	2029	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0105	105	light in waterfront complex	Marlston Waterfront
6312572	373337	47		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0106	106	light in waterfront complex	Marlston Waterfront
											DSC0107	107	light in waterfront complex	Marlston Waterfront

CITY OF BUNBURY OWNED STREET LIGHTING NETWORK ASSET DATA

NORTHING	EASTING	HEIGHT	LIGHT_NO	LIGHT_TYPE	WATTAGE	COLUMN_TYP	COLUMN_MOU	BANNER_ARM	FINISH	ACCESS_PAN	PHOTOS_ED	INDEXNUMBE	NOTES	LOCATION
6312670	373337	45		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0108	108	light in waterfront complex	Marlston Waterfront
6312672	373334	56		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0109	109	light in waterfront complex	Marlston Waterfront
6312568	373332	51		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0110	110	light in waterfront complex	Marlston Waterfront
6312558	373333	41		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0111	111	light in waterfront complex	Marlston Waterfront
6312556	373334	43		HQI-E	70 W	Upright	Fixed	No	Aluminium	Unknown	DSC0112	112	light in waterfront complex	Marlston Waterfront
6312577	373344	47	2025	HQI-E	70 W	Outreach	Fixed	No	Painted	Base	DSC0113	113	light in waterfront complex	Marlston Waterfront
6312542	373356	51	2001	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0114	114	light in waterfront complex	Marlston Waterfront
6312555	373361	44	2002	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0115	115	light in waterfront complex	Marlston Waterfront
6312569	373358	48	2003	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0116	116	light in waterfront complex	Marlston Waterfront
6312581	373367	47	2004	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0117	117	light in waterfront complex	Marlston Waterfront
6312589	373375	47	2005	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0118	118	light in waterfront complex	Marlston Waterfront
6312589	373383	47	2006	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0119	119	light in waterfront complex	Marlston Waterfront
6312604	373395	47	2007	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0120	120	light in waterfront complex	Marlston Waterfront
6312617	373383	47	2008	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0121	121	light in waterfront complex	Marlston Waterfront
6312628	373374	41	2010	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0122	122	light in park near taffys	Marlston Waterfront
6312635	373362	48	2015	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0123	123	light in waterfront complex	Marlston Waterfront
6312617	373392	48	2016	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0124	124	light in waterfront complex	Marlston Waterfront
6312604	373384	44	2009	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0125	125	light in park near taffys	Marlston Waterfront
6312621	373389	45		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0126	126	light in park near taffys	Marlston Waterfront
6312621	373397	48		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0127	127	light in park near taffys	Marlston Waterfront
6312621	373382	48		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0128	128	light in park near taffys	Marlston Waterfront
6312621	373378	48		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0129	129	light in park near taffys	Marlston Waterfront
6312620	373372	46		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0130	130	light in park near taffys	Marlston Waterfront
6312620	373370	42		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0131	131	light in park near taffys	Marlston Waterfront
6312620	373363	51		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0132	132	light in park near taffys	Marlston Waterfront
6312620	373367	47		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0133	133	light in park near taffys	Marlston Waterfront
6312630	373364	45		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0134	134	light in park near taffys	Marlston Waterfront
6312630	373366	42		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0135	135	light in park near taffys	Marlston Waterfront
6312630	373370	42		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0136	136	light in park near taffys	Marlston Waterfront
6312630	373372	42		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0137	137	light in park near taffys	Marlston Waterfront
6312631	373379	42		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0138	138	light in park near taffys	Marlston Waterfront
6312631	373382	42		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0139	139	light in park near taffys	Marlston Waterfront
6312631	373386	42		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0140	140	light in park near taffys	Marlston Waterfront
6312631	373397	42		HQI-E	70 W	Upright	Fixed	No	Painted	Unknown	DSC0141	141	light in park near taffys	Marlston Waterfront
6312639	373375	48	2013	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0142	142	light in park near taffys	Marlston Waterfront
6312630	373365	48	2014	HQI-E	70 W	Upright	Fixed	No	Painted	Base	DSC0143	143	light in park near taffys	Marlston Waterfront
6312616	373405	48	2011	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0144	144	light in park near taffys	Marlston Waterfront
6312636	373407	48	2012	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0145	145	light in park near taffys	Marlston Waterfront
6312671	373391	48	2017	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0146	146	light in waterfront complex	Marlston Waterfront
6312679	373380	48	2018	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0147	147	light in waterfront complex	Marlston Waterfront
6312689	373371	49	2019	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0148	148	light in waterfront complex	Marlston Waterfront
6312705	373372	45	2020	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0149	149	light in waterfront complex	Marlston Waterfront
6312723	373373	50	2021	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0150	150	light in waterfront complex	Marlston Waterfront
6312740	373376	47	2022	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0151	151	light in waterfront complex	Marlston Waterfront
6312774	373380	48	2024	HQI-E	70 W	Outreach	Fixed	Yes	Painted	Base	DSC0153	153	light in waterfront complex	Marlston Waterfront
6312982	373327	47		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0328	328	light on jetty road	Marlston Waterfront
6312856	373319	46		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0329	329	light on jetty road car park	Marlston Waterfront
6312817	373320	43		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0330	330	light on jetty road	Marlston Waterfront
6312798	373288	46		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0331	331	light on jetty road	Marlston Waterfront
6312791	373248	49		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0332	332	light on jetty road	Marlston Waterfront
6312774	373271	44		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0333	333	light on jetty road unit car park	Marlston Waterfront
6312764	373259	49		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0334	334	light in unit car park	Marlston Waterfront
6312753	373274	48		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0335	335	light in unit car park	Marlston Waterfront
6312744	373257	55		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0336	336	light in unit car park	Marlston Waterfront
6312734	373272	48		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0337	337	light in unit car park	Marlston Waterfront
6312705	373269	48		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0338	338	light in unit car park	Marlston Waterfront
6312705	373270	47		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0339	339	light in unit car park	Marlston Waterfront
6312690	373262	49		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0340	340	light in unit car park	Marlston Waterfront

CITY OF BUNBURY OWNED STREET LIGHTING NETWORK ASSET DATA

NORTHING	EASTING	HEIGHT	LIGHT_NO	LIGHT_TYPE	WATTAGE	COLUMN_TYP	COLUMN_MOU	BANNER_ARM	FINISH	ACCESS_PAN	PHOTO'S_ED	INDEXNUMBE	NOTES	LOCATION
6312686	373269	52		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0341	341	light in unit car park	Marlston Waterfront
6312666	373261	49		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0342	342	light in unit car park	Marlston Waterfront
6312670	373279	51	1013	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0343	343	light on stingray pa	Marlston Waterfront
6312656	373276	46		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0344	344	light in unit car park light missi	Marlston Waterfront
6312648	373262	43		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0345	345	light in unit car park	Marlston Waterfront
6312638	373262	48		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0346	346	light in unit car park	Marlston Waterfront
6312637	373273	50		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0347	347	light at unit car park centre exit	Marlston Waterfront
6312620	373264	43		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0348	348	light in unit car park	Marlston Waterfront
6312615	373276	41		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0349	349	light in unit car park	Marlston Waterfront
6312599	373263	49		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0350	350	light in unit car park	Marlston Waterfront
6312594	373285	45		Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0351	351	light on bornello bld	Marlston Waterfront
6312814	373265	45	2053	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0361	361	light in vat 2 carpark	Marlston Waterfront
6312813	373310	44	2054	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0362	362	light in vat 2 carpark	Marlston Waterfront
6312826	373299	44	2052	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0363	363	light in vat 2 carpark	Marlston Waterfront
6312843	373289	45	2051	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0364	364	light in vat 2 carpark	Marlston Waterfront
6312843	373314	45	2050	Osram HPS	150 W	Outreach	Fixed	No	Painted	Base	DSC0365	365	light in vat 2 carpark	Marlston Waterfront

Appendix E:

Western Power Tariff and Street Lighting Asset Data

ZE01	ZE02	ZE03	ZE04	ZE05	ZE06	ZE07	ZE08	ZE09	ZE10	ZE12	ZE13	ZE14	ZE15	ZE16	ZE17	ZE19
50	80	125	140	250	400	250	250	250	400	400	150	150	250	250	250	70
MV	MV	MV	HPS	MV	MV	MV	MV	MV	MV	MV	HPS	HPS	HPS	HPS	HPS	HPS
17.21	23.53	30.54	33.02	47.38	63.51	47.36	47.36	47.36	63.51	63.51	34.28	34.28	44.16	44.16	44.16	22.55
16.34	22.23	29.46	32.18	46.14	61.90	46.14	46.14	46.14	61.90	61.90	33.17	33.17	43.06	43.06	43.06	21.55
o. of Daily Operation Hours				11.88												
-	2,548	151	-	1	-	360	-	-	-	-	27	-	372	-	-	1
4	2,515	150	-	1	-	352	-	-	-	-	24	-	368	-	-	12
-4	33	1	-	-	-	8	-	-	-	-	3	-	4	-	-	-11
-	972,280	90,030	-	1,192	-	429,284	-	-	-	-	19,318	-	443,593	-	-	334
239	204,066	16,129	-	168	-	59,281	-	-	-	-	2,906	-	57,838	-	-	944
-	218,834	16,832	-	173	-	62,231	-	-	-	-	3,378	-	59,960	-	-	82

ZE20	ZE21	ZE22	ZE60	ZE61	ZE62	ZE63	ZE64	ZE65	ZE66	ZE67	ZE68	ZE69	ZE70	ZE71	ZE72
70	150	250	80	125	70	150	250	70	150	250	80	125	70	150	250
MH	MH	MH	MV	MV	HPS	HPS	HPS	MH	MH	MH	MV	MV	HPS	HPS	HPS
35.41	47.13	57.01	36.30	49.01	40.63	61.29	70.77	61.07	76.68	86.91	49.75	60.48	52.11	70.52	89.18
			37.33	47.70	39.60	59.74	68.98	59.52	74.74	84.71	48.49	58.95	50.79	68.73	86.93
-	-	-	-	-	-	-	7	-	-	-	-	-	-	2	6
-	-	-	-	-	-	-	7							2	5
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
-	-	-	-	-	-	-	8,347	-	-	-	-	-	-	1,431	7,155
-	-	-	-	-	-	-	1,762	-	-	-	-	-	-	502	1,586
-	-	-	-	-	-	-	1,808	-	-	-	-	-	-	515	1,953

ZE73	ZE74	ZE75	ZE76	ZE77	ZE78	ZE79	ZE80	ZE81	ZE82	ZE83	ZE84	ZE85	ZE86	TOTAL
70	150	250	125	70	150	250	70	150	250	80	125	70	70	
MH	MH	MH	MV	HPS	HPS	HPS	MH	MH	MH	MV	MV	HPS	MH	
72.67	92.88	105.69	29.82	21.82	34.14	44.29	65.83	79.30	87.32	37.13	44.16	37.87	54.58	
70.83	90.53	103.02	29.06	21.27	33.28	43.17	64.17	77.29	85.11	36.19	43.04	36.91	53.20	
-	-	-	-	-	-	-	-	-	-	10	27	-	-	3,512
										10	27			3,477
-	-	-	-	-	-	-	-	-	-	-	-			35
-	-	-	-	-	-	-	-	-	-	3,816	16,098	-	-	1,992,878
-	-	-	-	-	-	-	-	-	-	1,321	4,242	-	-	350,984
-	-	-	-	-	-	-	-	-	-	355	4,352	-	-	371,474

n 05		35
		1.01%
	$	350,984
	$	371,474
		5.84%
004/05)		51
etlights (2004/05)	$	9,413
005/06)		52
etlights (2005/06)	$	9,983

Appendix F:

Summary of Lighting Recommendations

City of Bunbury Street Lighting Recommendations

Road Area	AS/NZS 1158	Wattage	Type	Pole Height	Spacing
Primary Distributor	V3	250	HPS	12.5	65
District Distributor	V5	150	HPS	12.5	55
Local Distributor	P3	70	MH	6.5	60
Access	P4	70	MH	6.5	80

HPS High Pressure Sodium

MH Metal Halide

Appendix G:

Risk Management Assessment Chart

Appendix 3: Risk Management Assessment Chart

Appendix 3: Risk Management Assessment Chart

Description of Hazards	People at Risk	Number at Risk	Parts of Body	Risk Level
Pedestrian and vehicular safety within operation zone of cherry picker machine within main street of CBD.	All in area	> 30 at any one instance	All	Moderate if no procedures in place Low given operators are adhering to an approved Traffic Management Plan for the intended use

Categories	Short Term Controls	Long Term Controls	Completion Details
Design	If undertaking works for a duration of less than 5 minutes works are permitted without a Traffic management Plan under the short term work allowance.	Use of an approved Traffic Management Plan prepared by a current Main Roads WA Advanced Worksite Traffic Management (AWTM) accredited person	Employer : Engineering Services City of Bunbury Prepared by: Jason Fowler Date: 01/06/05 Assented to by: Theo Naude Position: City Engineer Signature: Date:
Personal Protective Equipment	Approved safety vests must be worn Works to occur on a day when traffic and pedestrian flow is expected to be the least such as on a Sunday.		

Project Appreciation: Cost Effectiveness of Suburban Street Lighting
Jason Fowler