

Southern Light

A lighting Strategy for the Queenstown Lakes District

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Prepared by the Queenstown Lakes District Council

The strategy has been based on earlier input from the Draft Queenstown Lakes District Council Lighting Strategy 2004 prepared by Premier Consultants Ltd.

Material from the City of Melbourne Lighting Strategy has also been used.

Cover photograph of Aurora australis and Orion over Frankton Arm, Lake Wakatipu kindly provided by Henriette Beikirch, Queenstown 2005

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Summary

The Queenstown Lakes District is internationally renowned for its outstanding landscape. Outdoor lighting should contribute to our appreciation of this landscape by night and enhance our safe enjoyment of our townships and public places.

Sadly little attention has been paid to the night time view of the district and the effects of development on our district when viewed at night. While most townships still have relatively low levels of light, the impact of the existing lighting is disproportional to the benefits gained. As growth occurs, new subdivisions are created and previously dark rural areas are being transformed into bright urban areas. It does not need to be this way.

As a community we have an opportunity to create a unique experience for residents and visitors by employing best practice lighting techniques and implementing simple controls.

Through the community planning process the Council has identified that both urban and rural communities want a level of lighting that provides safe and comfortable night time travel while protecting the night time sky and rural character of the district. Communities want both the day time and night time appearance of lighting to be simple, unobtrusive and subtle.

This strategy aims to improve our outdoor lighting in two main ways:

1. For the Council to provide a sustainable and energy efficient network of public lighting that; provides a safe night time environment, protects and enhances our view of the night sky and surrounding landscape, and celebrates our heritage through the considered application of light, and;
2. For residents and businesses to assist in creating a distinctive nightscape by following best practice lighting methods and meeting district plan rules and guidelines within this strategy.

This strategy addresses what the **council** will do in the next five years with regard to:

- **Public street lighting** - Provide an appropriate level of street lighting in streets in townships for safe passage.
- **Asset management** - Implement improvement, renewal and maintenance programmes that are sustainable.
- **Environmental standards** - Implementing standards and systems that minimise the negative environmental impacts of outdoor lighting and ensure responsible energy use.
- **Celebration** - Identifying and carefully lighting some special buildings, artworks, monuments, landforms and public places

This strategy also identifies what the **community** can do to improve our night time environment.

Night-time vision

One of the most influential factors in determining the night time image of a city, town or district is sensitive lighting. It also provides an indicator of the economic prosperity and environmental standards. It is important therefore to project an image of visual pleasure with feelings of safety and security and an impression of quality and well being. This picture promotes and describes a district's identity and is the memory that inhabitants and visitors carry of that place.

Application of this strategy will reinforce our night time presentation and enable the visual identity of the Queenstown Lakes District to be firmly established.

Lighting can be considered to have two distinct functions:

1. to enable 'visibility' i.e. literally the ability to see, and;
2. to create a night - time 'visual impression'. This is the aesthetic element, which shapes a favourable view of the district at night.

In most places, the first function is generally the responsibility of the local authority. Lighting initiatives undertaken by the private sector substantially create the second.

Consideration must be given to the question of integrating the two functions that jointly define the overall perception of the district at night. The aim of this strategy is to achieve such integration for the Queenstown Lakes District.

Achieving this aim will create a night time environment for residents and visitors that will equal and, at times, surpass the daytime architectural aesthetics of the various townships.

Action regarding the first function should be rapidly implemented, especially with the rapid growth rate of the district and development of rural subdivisions, to ensure that the lighting and the environment is in harmony.

The emphasis should be on the quality of light rather than the quantity, with greater protection of natural amenity values.

To date, this aspect has been substantially compromised at night because of the lack of attention to detail and inappropriate equipment and designs. It is proposed that the Queenstown Lakes District Council takes the leading role by encouraging and developing a holistic approach to all aspects of external lighting and, by extension, the shaping of the district's future night time image.

The Council also has an exemplary role to play in shaping the district's visual impression by increasing the night time economy through the lighting of its own buildings and selected statues, monuments, landscaped and lakeside areas and notable features within townships.

Background

There has been little or no emphasis on providing visual appeal or a cohesive identity for the night time image of the district. Historically, illumination in public spaces was installed at strategic locations that served to provide guidance and orientation to road users.

With the development of the townships within the district, lighting has evolved historically and almost exclusively for a single user – the motorist.

With the increased use of roads by cars at night, Codes of Practice were developed by engineers to improve the safety of road users. This method of determining the lighting was crude by today's modern standards; indeed up until the mid 1960's all street lighting design in New Zealand was based on locating lights in a pre-defined arrangement depending on the type of road being lit. The aim of this was merely to achieve a minimum level of illuminance (the amount of light falling on a surface). No consideration was given to the reflectance of the road surface, the type of surface, or the effect from glare.

In the 1960's with the increase in the amount of technical information that became available, luminance calculations and a new Code of Practice was produced by Standards New Zealand. This was based on a prescriptive design method using luminance (the amount of light the eye sees being given off from a surface) as the basis for the design. This provided a better perception of the visual appearance of any lit surfaces. Together with this advance, two categories of roadway were defined by their vehicular volume to become major and minor roadways; major roadways were designated to have the greater luminance.

By 1997 the increase in both volume and speed of vehicular traffic meant that lighting conditions prescribed in this old standard were not sufficient to satisfy safety criteria, and a new standard was produced. This current standard recognises the need to also provide lighting for pedestrians, and therefore includes for both vehicles and pedestrians in public spaces, with four categories addressing vehicular use and twelve categories addressing combined pedestrian and vehicular use. In 2005, these standards were revised to incorporate significant technical changes including a reduction in the allowable Upward Wasted Light Ratio from 6% to 3%.

It is important to recognise that Standards and Codes of Practice only relate to the performance of the lighting for safety of the motorists and pedestrians.

Functional lighting comes from a stark design approach that considers only the quantity of light rather than the quality of light. Importantly, this quantitative approach ignores aspects of unity, a greater urban and rural vision and ultimately the end user - the inhabitants.

There has been rapid growth in the district and development of rural subdivisions. Over this period there has been little direction and control provided by the Council with each project being treated in isolation from its adjacent space, resulting in a fragmented approach of the greater urban night time picture. Varying design approaches and standards have in places compromised the night time appearance of the district and these issues will take time to correct. In 2005 the Council adopted minimum standards for public lighting as the first step in addressing this issue.

Public street lighting

The Council currently funds a network of public street lights in town centre’s, residential streets and at some rural road intersections.

Ownership and supply

Lighting in Kingston is supplied via the Lumsden substation. The electricity reticulation network supplying these streetlights is managed by PowerNet.

Lighting in the Wakatipu Area is supplied via the Frankton substation and in the Wanaka area via the Cromwell substation.

The electricity reticulation network supplying these streetlights is managed by Aurora Energy and DELTA.

The power poles and the lines form part of the electricity reticulation network owned by either PowerNet or Aurora.

Across much of the district, street lighting has historically been provided by attaching a *lantern* to an existing pole, supplying over head power supply to homes and businesses in the area.

In the case of Wakatipu and Wanaka areas, all lanterns attached to power poles carrying overhead lines were owned by DELTA and the Council pays a lease charge for the use of the DELTA owned lantern, as well as a maintenance charge for each lantern. In the case of Kingston, all lanterns attached to PowerNet poles are owned by the QLDC.

In addition to the overhead electricity reticulation network, the Council owns standalone light poles and lanterns which either supplement the lighting provided by the overhead electricity reticulation network, or provide the sole source of lighting in areas where all reticulation is underground. The Council has an arrangement with DELTA for the maintenance of these lanterns.

The other provider of public lighting is Transit New Zealand, which supplies street lighting at key intersections on State Highway 6 and along the length of State Highway 6A between Frankton and Shotover Street.

The Council currently provides an estimated 2744 street lights across the district as shown the in the following table.

Figure 1. Number of lanterns funded by QLDC at April 2006

Lantern Ownership	Wanaka	Wakatipu	Kingston	Total
Leased from DELTA	307	372	0	679
Owned by QLDC	778	1250	37	2065
Total	1085	1622	37	2744

Leased from DELTA	28%	23%	0%	25%
Owned by QLDC	72%	77%	100%	75%

Lantern and lamp type

There is a diverse range of lanterns of varying condition present.

Generally all lanterns attached to power supply poles are in the region of 20 plus years old and are in need of replacement as they have suffered from moisture, dust and insect egress. These lanterns are generally fitted with mercury vapour discharge lamps and are of a low performance design. The light being emitted from these lanterns is on average only 50% of the light emitted from a new, well maintained lantern, yet the Council is paying more energy cost for the supply to the older style 80W mercury vapour lanterns.

The remainder of lanterns are located on QLDC owned dedicated light poles and have arisen from subdivisions dating from around the early 1980’s to the present day. Those installed prior to 2000 are generally of a similar nature to the previous category, being low performance lanterns either running mercury vapour discharge lamps, or high pressure sodium discharge lamps.

From the late 1990’s there has been a trend towards decorative lanterns being installed. While these lanterns generally have better optical performance they are of variable quality and the wide range of lanterns used may cause on-going supply and maintenance issues. Most lanterns post 1990 have been fitted with high pressure sodium lamps, apart from some notable exceptions where Mercury vapour lamps have been fitted.

Typical mounting heights are as follows:

70 and 100 Watt HPS	6 to 9m
150 Watt HPS	10m
250 Watt HPS	10 to 12m

There is no coherent hierarchy of pole and lantern mounting heights to distinguish the variety of usage and importance of differing urban elements. Similarly, there does not appear to be a cohesive or clarified plan of colour, temperature and brightness levels. Almost all lanterns are of the drop lens style or fitted with refractors. Poor choices of equipment and mounting create glare and visual discomfort.

In 2005, Council adopted a **Minimum Standard for Lighting Infrastructure to be Vested in QLDC**. This standard requires the installation of high performance lanterns of a full cut off variety so that there is zero upward wasted light and improved dust, insect and egress protection. In early 2006, the Council selected a preferred fitting which meets the minimum standards and this is now the standard fitting for non-decorative street lighting installations.

Figure 2: Street Lantern Ownership and Lamp Type by area Aug 2006

Area	QLDC	DELTA	MV Lamp	HPS Lamp	MH/CF Lamp	Total
Makarora	0	2	0	2	0	2
Kingston	37	0	10	27	0	37
Arrowtown	156	202	83	139	0	358
Glenorchy	42	17	6	53	0	59
Arthurs Point	56	9	0	31	34	65
Kelvin Pen	44	15	39	20		59
Luggate	12	8	2	18	0	20
Lake Hawea	43	58	16	85	0	101
Frankton	47	113	42	118	0	160
Queenstown Town centre	135	10	6	124	15	145
Queenstown	236	163	101	288	10	399
Fernhill	132	10	81	61	0	142
Quail Rise	55	0	52	3	0	55
Lake Hayes Estate	168	0	0	155	13	168
Hawea	0	2	2	0	0	2
Wanaka Town Centre	87	5	5	87	5	96
Wanaka	402	134	440	96	0	535
Total	1652	748	885	1307	43	2403¹

¹ The difference in the total number of lantern shown in figure 1 to that in figure 2 illustrates a discrepancy between the DELTA database and QLDC database.

There is a need to improve the accuracy of information relating to lighting assets. The Council is currently collecting asset information and Delta also holds asset information, however neither are considered to be fully complete. Improved information would assist in life cycle planning and maintenance scheduling.

Lighting Design

Prior to 2006, lighting design has generally had as its main objective the placement of the minimum number of lanterns at a pre-determined maximum spacing and minimum cost, and/or the selection of lanterns and poles according to the daytime aesthetics rather than night time performance.

As a result, the night time visual environment often bears no relationship with ambient light levels or with the surrounding architectural or natural elements. The type of visual environment produced by this kind of relationship lacks clarity, contrast and focus. Way finding for inhabitants and visitors becomes difficult at night. Important visual elements and markers are diminished through lack of contrast.

Typically, where decorative elements have been installed, e.g. Queenstown town centre, the emphasis has been on the architectural style of the lights, not the effect that they produce. As such there exists a proliferation of styles and often a higher than required quantity. This simply results in an intrusion into the space of visual clutter during day time and light pollution and glare during night time.

Issues arising from current installations include:

- Excessive tilting of lanterns with horizontal lamp placement resulting in glare and upward light spill.
- Poor lantern design, construction and installation resulting in water, dust and insects entering the lantern causing premature failure of lamps and control equipment and reduction in light output
- Poor lantern design and construction resulting in structural damage to the lantern by wind or materials failure
- Substandard painting of galvanized octagonal poles resulting in paint failure
- Inconsistent illumination of streets due to variable application of standards and lack of direction from Council.
- An asset which is largely at the end of its economic life.

Lantern Performance

The district is subjected to extremes of weather conditions over the course of a calendar year. These include snow and ice with very low temperatures during the winter months and hot temperatures and high winds in the summer months.

The district can also receive heavy rainfall with resulting flooding of the low level areas. This can also have an effect on the street lighting equipment, especially those of the lower quality that in turn will affect the maintenance costs and service life.

The extremes of hot and cold weather, especially when combined with strong winds, places extra stress on the lighting equipment. As a result there is likely to be an increase in condensation, water and dirt ingress and premature failure of the light. To avoid or at least minimise the impact of the climatic conditions, the fittings and poles need to be of high quality with an ingress protection (IP) rating of IP65 or greater for the lanterns.

Unlike most of New Zealand, this district does not have a highly corrosive environment, with steel and alloy material performing well. An emphasis on specifying lanterns with a lower copper content material is not considered necessary.

Appropriate standards

The Council has an obligation, sometimes statutory, to fulfil the expectations of current good practice in all fields of its service to the community, including lighting. The guiding instruments for good road and street lighting design practice are the following Australian and New Zealand Standards:

- **AS 4282 1997** Control of the Obtrusive Effects of Outdoor Lighting
- **AS/NZS 1158.0:2005** Road lighting - Introduction
- **AS/NZS 1158.1.1:2005** Road lighting - Vehicular traffic (Category V) lighting - Performance and design requirements
- **AS/NZS 1158.1.3:1997** Road lighting - Vehicular traffic (Category V) lighting - Guide to design, installation, operation and maintenance
- **AS/NZS 1158.3.1:2005** Road lighting - Pedestrian area (Category P) lighting - Performance and design requirements
- **AS 2560.1 – 2002** Sports Lighting – General Principles

In general, all new and improved road and street lighting should be designed to comply with the details of these Standards. Whilst the Standards are not mandatory and are, in some areas, open to interpretation by specialists, there is no doubt that installations completed in accordance with these ensure that the authority is not open to criticism for failing to comply.

It should be noted that standards or codes do not exist to guide the design of lighting for the exterior of buildings, structures, and landscapes, other than AS 4282 – 1997 — *Control of the Obtrusive Effects of Outdoor Lighting*. This Standard only addresses issues relating to the prevention of light pollution.

In addition to the Standards, it is recommended that the broader visual objectives defined in this document be considered as a part of the guiding principles for appropriate lighting throughout the district.

In particular AS/NZS 1158.1.1:2005 *Road lighting - Vehicular traffic (Category V) lighting* and AS/NZS 1158.3.1:2005 *Road lighting - Pedestrian area (Category P) lighting - Performance and design* requirements are used by roading engineers and lighting specifiers to determine the number and performance of lanterns used on any particular road. At present there would be very few areas of the district where these standards are met, apart from some new subdivisions.

Repeatedly, our communities have expressed concern with over-lit subdivisions and areas, particularly within the rural areas. For this reason it is considered justified for the Council to consider adopting reduced levels of illumination in some situations.

Funding

The Queenstown Lakes District Council Community Plan – 2006/2016 details approved funding for street lighting. The following table shows funding available for street lighting improvements in years 2006 – 2009, including funding carried over from the 2005/2006 Annual Plan.

Project	2006 (1)	2006/07	2007/08	2008/09
Wakatipu - Town Centre	\$24	\$50	\$51	\$53
Wakatipu - Other	\$30	\$50	\$51	\$53
Wanaka - Town Centre	\$98	\$50	\$51	\$53
Wanaka - Other	\$92	\$50	\$82	\$84
Total	\$244	\$200	\$235	\$243

(1) Available funding carried over from 2005/06 to 2006/07 year.

The above budgets are considered satisfactory to make many of the improvements to the existing lighting network, as detailed in this strategy. Additional funding will be required in the 20010/11 and 2011/12 year to complete implementation of this strategy.

Strategy One: Council Ownership

At present the Council owns 75% of the poles and lanterns used for street lighting. The remaining 25% is leased from DELTA at a monthly cost of \$3.70 per lantern. Currently this equates to an annual lease charge of \$31,000 across the district.

A sample condition assessment of the condition of leased lanterns versus lanterns owned by QLDC in Arrowtown, Kingston and Kelvin Heights has shown that 68% of leased lanterns are in either poor or very poor condition whereas 56% of Council owned lanterns are in similar condition.

Condition	DELTA		QLDC		Total	
	No.	Percent	No.	Percent	No.	Percent
Excellent	0	0%	11	5%	11	4%
Good	26	32%	123	58%	149	51%
Poor	50	61%	49	23%	99	34%
Very Poor	6	7%	30	14%	36	12%
Total	82		213		295	

Based on an installed replacement cost of \$500 per lantern, the Council could replace all 679 lanterns leased from DELTA for a capital cost of \$340,000. Given the current budget for residential lighting improvements and applying 60 percent to lanterns renewals and 40 percent to new lanterns, the Council could achieve full ownership of the lantern stock within four years. This can be achieved without any increase in existing capital budgets and makes a saving on total current lease costs of \$78,000 over the four year period, with on going savings of at least \$30,000 per annum thereafter on lease costs. The Council will then incur all replacement costs for QLDC owned lanterns.

In addition the replacement of the existing lantern stock with new lanterns has the following benefits:

- Significantly improves the overall condition of the assets managed.
- Significantly improves the performance of the lantern stock by providing high performance lanterns with a high ratio of effective lumen output.
- Replaces low performance lanterns with high performance lanterns that will eliminate excessive glare and upward light spill, resulting in an improved night sky and environmental outcomes
- Result in energy savings of at least \$3500 per annum by replacing leased lanterns running mercury vapor lamps with high pressure sodium lamps.
- Provides new lamp stock providing consistent colour rendition, improved lumen output and maintenance savings.
- Introduces electronic ballasts, which provide further energy savings over traditional wire wound ballast.

These benefits will accrue with the change from the current lanterns to the new lanterns specified by the Council regardless of who funds the replacement.

Implementation

- 1.1 Initiate a replacement programme of DELTA leased lanterns with QLDC owned lanterns to achieve 100% ownership of lantern stock by 2010.

Strategy Two: A Better Environment

Current street lighting is generally provided with a range of older style lanterns. These lanterns do not typically control light well and generally use refractors to disperse light rather than reflectors to control and direct light.

Lanterns where the lamp or light source is visible cause glare and discomfort. Obtrusive outdoor lighting is often a source of complaints or sometimes direct action by residents (eg painting out lights or vandalism).

This results in a portion of light being spilt upwards which is wasted and creates a glow in the sky (Sky glow) which limits our ability to see the stars and surrounding landscape at night. Many visitors who have come from large cities to our district will be astonished with the clarity of our night sky. Yet as our district grows sky glow is increasing. The glow of Queenstown for example can be readily seen from Arrowtown and within town centres. Sky glow threatens to obscure views of major constellations such as the Southern Cross.

Sky glow also represents wasted energy – energy which we are paying for but is not being directed to where it can be usefully used. The New Zealand Standards permit an upward wasted light ratio (UWLR) of between 40 % to 3% of total output.

There is a significant difference in the visual amenity of lanterns with 0% UWLR however, and it is recommended that a policy of 0% UWLR be continued. A 0% UWLR for example means that light sources are not visible from above the lamp source or generally from a distance. These two factors contribute significantly to the night time effect of subdivisions. For example if lighting at Lake Hayes Estate was implemented with lanterns meeting 0% UWLR, street lighting would not be visible from the State Highway.

The downside of this approach is that in some circumstances up to a quarter more lanterns will be required to reach the same illumination levels. Given the negative feedback the Council has received from lighting schemes at Lake Hayes Estate and Quail Rise, compared to the positive feedback on the Councils implementation of a replacement programme of old lanterns with 0% UWLR lanterns, the benefits of improved amenity are considered worthwhile.

Discharge lamps contain quantities of heavy metals such as mercury, and for this reason opportunities for recovery of these metals prior to lamp disposal should be investigated.

Implementation

- 2.1 Ensure all new lanterns provide for a zero upward wasted light ratio by following the QLDC specifications for lighting assets
- 2.2 Ensure all pole outreach arms maintain the lantern at the correct horizontal angle (zero degrees) to prevent upward light spill.
- 2.3 Progressively replace as lanterns reach the end of their life with lanterns that provide a zero upward wasted light ratio
- 2.4 Seek recycling and recovery opportunities for used mercury vapor lamps
- 2.5 Seek recycling and recovery opportunities for other lantern materials
- 2.6 Include recycling and recovery requirements in street lighting maintenance contracts
- 2.7 Produce a best practice guideline for the residential and business community.

See also implementation of Strategy Four: Energy Efficiency and Strategy Five: Working Together.

Strategy Three: Good Stewardship

Street lighting, like all assets requires care in selection of product and ongoing maintenance to maintain performance and asset life.

The Council currently has an historical arrangement in place with DELTA for the maintenance of street lighting in the District, other than in Kingston.

Lantern maintenance is charged on a monthly basis per lantern and maintenance within the scope of this fee includes lamp replacements, lantern and line faults and cleaning on lamp replacement. The cost of other works such as repairs from accidents or vandalism or replacing faulty or defective lanterns is met by the Council.

Patrols are not undertaken to check on street light operation. Instead the Council and DELTA rely on customers and staff to report faults when and where they are observed.

An audit undertaken by the Council in 2006 shows that many lanterns have now reached the end of their economic life or are performing poorly due to:

- Dirty, discolored or broken lenses
- insect and/or water ingress
- being obscured by trees
- bent, skewed or damaged poles and outreaches

The maintenance of street lighting is a specialist task and a competitive environment exists for street lighting maintenance and installation. The Council receives some funding from Land Transport New Zealand for street lighting and as such is required to competitively tender the works.

In doing so the council needs to consider the scope of work required and the service levels desired by the Community.

Recommended Service Levels

Cleaning

All lanterns to be cleaned and inspected once every 12 months for ingress protection, alignment and correct operation.

Faults

Rectify Priority 1 faults within 24 hours of reporting – all lighting within defined town centres, car parks, safe walking routes and all pedestrian crossings.

Rectify Priority 2 faults within 2 days of reporting – lighting on arterial and collector roads.

Rectify Priority 3 faults within 5 days of reporting – lighting on local roads, amenity lighting and park lighting.

Patrols

A combination of faults seeking patrols and customer reporting is recommended to maintain cost effectiveness. Electronic remote sensing systems should also be considered (*see Strategy four*) especially for remote communities where the cost of patrols is potentially high or unable to be justified.

The following routine of patrols is recommended on the priority areas above:

Priority 1: Monthly during NZ Standard time, every second month during daylight saving time.

Priority 2: At start and end of Daylight Saving Time

Priority 3: At end of Daylight Saving Time

Asset Management

The primary asset management system for street lighting is held by DELTA. During 2006 the Council has partially completed an inventory of street lighting including the condition rating of the lantern. Neither system is accurate or fully complete. It is recommended that an asset management system be implemented urgently.

In order to provide the best information for decision making and provide the Council with full control over future decisions, asset information should always be held by the Council.

Lighting of Private Roads

Council's policy for street lighting on private roads was adopted in December 2003. The policy is:

- I. that the maintenance and operating costs of lights installed on private roads and rights of way after 01 January 2004 be the responsibility of lots serviced by such private access roads; and
- II. that all lights installed on private roads and Rights of Way after 01 January 2004 be isolated from the Council lighting network circuit.

It is recommended that no change be made to this policy.

Implementation

- 3.1 Improve inventory accuracy and asset management by developing protocols for asset recording and storing data in a proprietary asset management system such as SLIM (Street Lighting Inventory Management) to be held by the Council.
- 3.2 Include asset data management requirements in street light maintenance contracts including collection of information on all work undertaken on assets including repairs, cleaning and lamp replacements.
- 3.3 Implement a district wide contract for the maintenance and improvement of the district lighting network including service levels identified in this strategy
- 3.4 Review lighting control and metering systems of private roads installed after 1 January 2004 to ensure compliance with Council lighting policy for private roads.

Strategy Four: Energy Efficiency

Energy use is estimated by the electricity reticulation network operator and multiplied by the number, type and wattage of the lamps connected to the network. This data is forwarded to the electricity retailer who then bills the Council for the estimated amount of energy consumed.

Mercury vapour lanterns (MV) account for 25% of the lamps used throughout the District. The MV lamps are one of the least energy efficient lamp available with a typical efficacy of less than 40 lumens/watt when new and providing less than 60% of their initial light output at the end of their rated life (8000 hours).

Although mercury vapour lanterns account for 25% of the total energy consumed per month, they account for 37% of the monthly QLDC energy charges.

Total Energy Costs for February 2006 by Lamp Type

Description	Quantity	% of Total	Energy (kWh)	Cost for Month	% of Total
High pressure sodium	1,901	69%	43,517	\$3,486.79	58%
Mercury Vapour	698	25%	27,676	\$2,218	37%
Other	145	5%	3,443	\$275.87	5%
Total	2,744		74,636	\$5,980.19	

As can be seen from the following table, a minimum of \$12,000 per annum can be saved on energy charges by changing from MV to HPS lanterns. Given the relatively short lamp running times for February the actual savings are more likely to be in the order of \$15,000 to \$18,000 per annum. Light output will also be increased by 14% to 82% for no additional energy cost.

Potential energy savings for February by change of lamp type

Change		Saving	Increased	Saving/lamp	Current No.	Total saving
From	To	KWh (1)	Light (2)	for Month	Lamps	For month (3)
80W MV	70W HPS	2.75	82%	\$0.22	10	\$2.20
125W MV	70W HPS	15.68	51%	\$1.26	615	\$772.76
160W MV	70W HPS	23.39	25%	\$1.87	31	\$58.09
250W MV	150W HPS	28.89	14%	\$2.31	26	\$60.18
400W MV	250W HPS	42.65	25%	\$3.42	16	\$54.68
						\$947.91

- (1) Current value of KWh saved per lamp for Feb 06
- (2) Increased initial lumen output of the HPS lamp.
- (3) Energy cost saving for Feb 06

The Council will therefore derive immediate benefit from implementing a programme to replace the mercury vapour lanterns with either high pressure sodium or metal halide lanterns as appropriate.

The capital cost of replacing all old lanterns running MV lamps with new lanterns running HPS lamps will be \$350,000. It should be noted however that this cost will be incurred regardless of a change in lamp type as almost all lanterns running MV lamps are at no longer maintainable and require replacement.

An Energy Efficiency & Conservation Authority (EECA) study on street lighting energy efficiency determined that New Zealand could save in excess of \$1.9 million annually by changing from MV lamps to HPS or MH lamps. In addition, a further \$1 million could be saved by changing from wire wound to electronic ballasts. There is opportunity for the QLDC to benefit from these changes whilst improving the night time image of the district. Council's current lighting standards require electronic ballast as standard.

Switching

At present the switching of lights on/off is controlled by either ripple control based on the time and daylight conditions in Alexandra or by individual day sensor photocells on lanterns or lantern circuits.

Modern lighting technologies are now available that allow wireless electronic control of individual lanterns including the ability to dim individual lights during off-peak times e.g (midnight to 5am) resulting in reported energy savings of up to 40%.

Implementation

- 4.1 Implement a programme of replacing Mercury Vapor lamps with High Pressure Sodium or other more efficient lamps with the objective to replace all Mercury Vapour lanterns by 2010.
- 4.2 Investigate electronic switching systems for remote communities to reduce patrol and energy costs.
- 4.3 Investigate electronic switching systems for off peak dimming.
- 4.4 Follow adopted QLDC lantern specifications which require electronic ballast and regularly review specifications with respect to changing technology.

Strategy Five: Working Together

While the Council is the major provider of public lighting, it is not the only party that contributes to the overall quality of our high time environment. The lighting of businesses, private buildings and homes or landscape features can also impact on the overall lighting effect and quality of the environment in both positive and negative ways.

Unfortunately little thought appears to be given to outdoor lighting by some business and property owners. Often there is an over reliance on electrical contractors, who may not have a knowledge of lighting design principles or District Plan requirements, to specify and design lighting improvements. There is also a reliance on unshielded floodlights or poorly aimed spotlights to light commercial and residential properties and these in particular can cause nuisance to neighbours and be a hazard for road users and pedestrians. Often owners are simply unaware that they have created a problem or may be affecting others.

The Council can take a lead role in encouraging private individuals to implement good quality lighting. This can be done in a number of ways:

Setting a good example

By following the standards and specifications contained in this strategy and by careful consideration of lighting design in council facilities and venues, the Council can set a good example of how outdoor lighting can be applied.

Education

The Council can take a role in providing impartial information to the public on applying outdoor lighting. This could be achieved by producing a “Good Neighbour Guide to Outdoor Lighting” that could be made available new home builders and electrical retailers.

Recognise Excellence

There are some good examples of successful lighting applications that meet best practice in lighting design. The Council could recognise and publicise excellent lighting projects by an annual award for appropriate lighting.

Regulation

The District Plan contains rules relating to the amount of light that may be “spilt” beyond a site boundary. These are detailed in [Appendix A](#). The plan rules require monitoring and enforcement as there are many cases where these rules do not appear to be complied with. There is also opportunity to improve the rules to remove inconsistencies between zones and improve their effectiveness. Introducing additional rules to prevent upward light spill and to control the illumination of signage should be put in place as plan changes take place.

Coordination

Where warranted, the creation of a successful night time image of an area can be achieved with the co-ordinated operation of both public and private lighting. In a CBD or main-street situation the responsibility for operating lighting will rest with a wide group of building owners, operators and local authorities. It becomes clear that if a coherent night time image is to be achieved, a form of centralised control system is desirable. The resulting quality of lighting will be high and the individual installation will operate in unison.

Implementation

- 5.1 Ensure all Council installations meet Council standards, specifications and the best practice guidelines set out in this strategy.
- 5.2 Produce a “Good Neighbour Guide to Outdoor Lighting”
- 5.3 Implement an annual award for good private lighting.
- 5.4 Review and amend the District Plan rules to remove inconsistencies and introduce standards for upward light spill and sign illumination.
- 5.5 Consider opportunities for integrated lighting coordination in special sites such as Buckingham Street, Arrowtown.
- 5.6 Assist Transit New Zealand in the conversion of conventional highway lights to full – cut of lanterns

Strategy Six: Celebrating What's Special

The night time image of our townships is an important element in our visual experience of the district. In particular our relationship with the surrounding natural elements of mountains and water, together with a stunning night sky are features which are becoming increasingly unique.

We also have a number of cultural icons and architectural features which can benefit from careful and considered lighting.

By following the design guidelines outlined in this strategy we can avoid overwhelming special features worth celebrating with public street lighting. This gives the Council and private owners the opportunity to celebrate and highlight the special things in our towns.

Temporary lighting displays create short term impact and should be used for special events and festivals. In contrast permanent decorative lighting is most effective when it is used as an accent within a considered application of surrounding light.

Lighting Master Plans

To achieve the above, lighting master plans should be prepared for key areas where there are heritage, cultural and natural features to consider as well as normal street lighting requirements. These master plans should seek to avoid a "Disneyland" effect with lighting and focus on subtle lighting of outstanding features within the overall townscape. This low key approach is consistent with other objectives of energy conservation and reducing "sky glow".

The use of primary and saturated colour for the lighting of public and private buildings and structures should therefore be limited. Any such lighting should be operated only during very special and or festive occasions as:

- Intense or saturated colour draws the eye and eclipses other aspects of what would otherwise be a well balanced and perhaps subtle rendering of the building or structure.

- The use of coloured light overwhelms the natural colour of the materials used in the architecture of the building and imposes a very different set of visual values from those originated by the architect.
- The permanent presence of colour soon tires the eye of the beholder. The surprise factor wears thin. There is no other alternative to offer during times of celebration.
- The maintenance of colour filters and lamps adds a further burden to general lighting maintenance regimes. Also any missing or damaged filters become extremely apparent.

Festive Lighting

Festive lighting is the subject of either:

1. Permanently installed lighting that is switched on only during festive periods; and/or
2. Temporarily installed lighting that is specifically designed for a particular occasion.

There are many opportunities to light elements for festivities or make changes to permanent installations to highlight a festival or season. Examples include the lighting of;

- bridges
- significant building facades
- trees
- artworks
- memorials
- projections and visual effects on surfaces

The festive lighting design should be based upon the provision of a permanently available, civically funded, base level infrastructure (i.e. cabling and controls) that is supplemented by the creative initiative (and funding) associated with each major celebratory event. Repetitive festive lighting themes will quickly fade from prominence and Council should therefore precipitate new design on a regular basis.

Permanent Decorative Lighting

There are a few permanent public decorative lighting installations present. Some include temporary installations which have become permanent. These include:

- Wellingtonia Trees corner of Stanley and Ballarat Streets
- bud lighting in some trees in Earnslaw Park and Arrowtown
- highlights on street poles in Wanaka.
- bud and fairy lights on Earnslaw Park.
- Queenstown Gardens Pond
- tree lighting in Brian Smith Park

In particular, bud and fairy lighting is maintenance intensive and expensive to run. Permanent installations can damage foliage and prevent effective maintenance of trees. The overall impact of such lighting is often lost as general lighting improves. Fairy lighting can also provide a high glare source which conflicts with other lighting objectives.

Previously there has been decorative lighting of trees in the Queenstown Gardens and Wanaka Lakefront. These sites should be reconsidered for properly designed and installed lighting along with other key sites.

Implementation

- 6.1 Prepare lighting master plans for the Arrowtown Heritage Precinct and Queenstown town centre.
- 6.2 Encourage decorative displays that are limited in scale or duration
- 6.3 Install infrastructure for temporary event based lighting in major public spaces.
- 6.4 Limit the use of up-lighting on tree canopies to selected special specimen trees and public spaces and switch off up-lighting after 1am.
- 6.5 Phase-out bud lighting of trees as they reach the end of their economic life and limit existing operative systems to run only between June and October.
- 6.6 Operate fairy lighting and pole highlights in relation to festivals and special events only.
- 6.7 Identify specific features/project areas for permanent decorative lighting and implement as funding allows. These should include:
 - Marine Parade from the War Memorial to the Bridge
 - Earnslaw Park including the Town Pier and Eichardt's Hotel
 - Queenstown Gardens
 - Roy's Bay and Bullock Creek
 - Wanaka Station Park
 - Wanaka War Memorial
 - Horne Creek Bridges

Strategy Seven: A Safe Place

Good lighting contributes to our perception of safety from crime. It is important to note however, that the provision of lighting alone will not reduce crime and in some instance lighting areas with other safety issues may indeed create a perception of safety where one should not exist.

Unlike other major cities in New Zealand, the Queenstown Lakes District does not have a serious crime problem. Most crime is of a petty nature and often alcohol related. While below the national average, dishonesty related crime accounts for most crime reported in Queenstown. Drug and anti-social offences however are above the national average with the majority of incidents reported occur either within, or very close to, the Queenstown CBD.

In most large cities and districts typically an increase in crime is associated with increasing populations and developments, and it should therefore be acknowledged that crime may increase over time as the district develops. It is therefore prudent to ensure that the lighting develops in a cohesive manner to ensure a high standard of illumination is provided along streets in popular restaurant and bar districts and the CBD areas.

In lighting for safety the following should be considered:

- is there sufficient light to enable the users to traverse this crime node and feel comfortable and safe in doing so?
- is there sufficient vertical illuminance for any potential assailant to see on approach their attacker?
- do light levels give users adequate visual comprehension of the surrounding physical environment?
- is the lighting sufficient for its intended purpose, e.g. does it provide the right environment to encourage people into, and remain in, the CBD areas?
- And where relevant, is the lighting suitable for the security cameras (in terms of height, colour rendering and glare?)

Careful consideration needs to be given to the lighting of public spaces with priority given to areas of high crime risk and high public use at night time. Public spaces in which night time use should be avoided should not be lit and alternative routes provided instead.

Lighting is most likely to be of assistance in reducing crime in the town centres where there are moderate to high numbers of pedestrians using the streets, car-parks, parks and walkways at night.

Priority should be placed on:

- Providing a good level of quality lighting within town centre streets including lanes and access ways
- Lighting off-street public car parks and the walking routes to and from car parks
- Defining safe routes into town by lighting selected walking routes (through streets, parks and access ways) from activity generators, visitor attractions and major accommodation venues into town
- Lighting parks and public spaces within the town centre that can be passively observed by capable guardians
- Lighting public amenities such as toilets and bus shelters and access routes to these

Implementation

- 7.1 Initiate a programme of safety related lighting upgrades as identified in [Appendix 1](#).

Strategy Eight: Set the Standards

Much of the districts recent lighting infrastructure has been developer or supplier led. Light fittings appear to have been often selected for their daytime appearance rather than their night time performance.

Often developers have sought to brand and differentiate their subdivision with a style of lantern different to the immediate neighbour. This has resulted in a disjointed appearance and has created a maintenance issue for the Council in terms of replacement parts. Different lighting designs in every neighbourhood would detract from the unity of the public lighting system. The identity of each neighbourhood derives from the layout of its streets and the character of its buildings and vegetation. It should not depend on idiosyncratic street furniture.

Lighting should generally be a background element in the streetscape. Standard designs assist this role and help to focus attention on the surrounding architecture and landscape.

The Council has moved in recent times to set standards for the performance of lanterns being vested in the Council and has gone further to identify a preferred carriage way lantern for use in street and subdivision lighting.

There is a role for a decorative lantern and for other lighting elements such as poles, lamps, in-ground lights and bollard lights. The Council should also therefore establish preferred products for these elements.

Current approved products are included in [Appendix 3](#).

Bollard lighting

There is often a desire to specify bollard lighting in residential subdivisions and in “sensitive” environments. This is often based on a perception that low height lighting is good lighting. The reality is that more environmentally sound and comfortable lighting can often be provided with well selected fittings in well designed overhead lighting schemes.

There have been a number of subdivisions where bollards have been installed. These have included a wide range of brands and models and all have proven to be prone to damage and ineffective or uncomfortable light

sources. It is therefore considered that bollard lighting is not appropriate for application in residential streets and in vandal prone areas.

New technologies such as LED and Flat Beam™ optics offer potential advantages for bollard and other low height lighting which could be useful in our district so bollard lighting should not be completely discarded.

Implementation

- 8.1 Establish and specify a small family of preferred products that help create a more coherent streetscape.
- 8.2 Regularly review preferred products to make advantage of technological improvements.
- 8.3 Restrict the use of bollard lighting to special situations where they are not susceptible to accidental damage and vandalism.

Strategy Nine: A spectrum of Light

Lighting should be used to define and express the distinct difference between our town centres, heritage precincts, suburban neighbourhoods, parks and gardens and rural areas.

A hierarchy is suggested based firstly on urban form and secondly on intensity of use. Both intensity of lighting and the colour of light will be used to define and express these differences so that one can experience a spectrum of light from moonlight in rural areas to relatively intensive illumination in town centres.

Urban form is most strongly influenced by district plan zoning and these zones are largely used to establish the hierarchy.

Lighting design for new subdivisions and improvement projects is generally prepared in accordance with the relevant New Zealand Standards. The standards provide for a range of relative light levels that are selected by the designer based on an assessment of the attributes of the site (road type, town centre, transport interchange etc) and the activity, risk of crime and “need to enhance prestige”.

The prescribed lighting categories are relative only and do not take into account ambient light levels and community expectations. The appropriate lighting category will be determined by a number of factors and it is therefore necessary for the Council to provide guidance to lighting designers and roading authorities on the appropriate lighting category for our community.

Control of lighting ‘brightness’ values

In planning the night - time image it is important to seek to control the levels of luminance or ‘brightness’ through carrying out the lighting design process in a discriminating and detailed fashion, that takes full account of the nature, colour and reflection factor of the surfaces that are to be lit.

In planning or designing external lighting the question of luminance values becomes critical. It is easy to create excessive levels of lighting through poor design and the indiscriminate selection and placement of lighting equipment. Excessive levels of lighting have been shown to proliferate and many cities

exhibit the problem of escalating lighting levels as lighting schemes seek to compete with each other in terms of brightness. Such escalation is undesirable from several viewpoints.

The logical outcome of excessive lighting is a saturation level where it is no longer possible to distinguish buildings from each other and their surroundings.

Excessive lighting invariably leads to environmentally destructive light pollution and the obscuration of the night sky. Unnecessarily high lighting levels cause equally unnecessarily high levels of energy consumption.

Lighting brightness values can be controlled in part by applying the hierarchy of light levels established in the New Zealand standards.

To assist in the interpretation of this standard for the Queenstown Lakes District the Council has summarised Table 2.1 – 2.5 of the standard to reflect our local needs based on the District Plan zones.

Lighting Categories for Road Reserves in Local Areas (category P)

Area or Activity	District Plan Zone	Lighting Subcategory	Average horizontal illuminance (lux) ¹
Collector Roads or non arterial roads which collect traffic in an area, as well as serving abutting properties	All	P4	0.85
Local Roads or streets used primarily for access to abutting properties including residential properties	Town Centre, High Density Residential, Industrial and Business zones	P4	0.85
	Township, Residential Zones, Rural Zones ² , Special Zones	P5	0.5
Pathways (including cycle ways, footpaths along roads, walkways and park paths) where these have been specifically identified for lighting	Town centres – designated safe route	P3	1.75
	Town centres – other pathways	P4	0.85
	Pathways outside of Town centres	P4	0.85
Town Centre and Township pedestrian activity areas (malls, open arcades, town squares, civic centres)	Town Centre and Township	P8	7
Transport terminals and service areas with mixed pedestrian and vehicle movements during hours of darkness	All	P8	7

Category P (Pedestrian) lighting will be the main lighting standard used as it provides standards applicable to the majority of roads managed by the Council.

¹ The relevant table in AS/NZS 1158.3.1:2005 shall be referred to for full technical parameters as only the average horizontal illuminance has been shown in order to provide direct comparison between lighting subcategories.

² Where street lighting on new rural subdivisions is deemed necessary by the Council

Lighting Categories for Off-Street Outdoor Car Parks (including roof top car parks)

Area or Activity	Night time occupancy rates	Lighting Subcategory	Average horizontal illuminance (lux) ³
Off street Outdoor Car parks (including roof top car parks)	>75%	P11a	14
	≥ 25%, ≤ 75%	P11b	7
	<25%	P11c	3.5

Category V Lighting and Typical Applications

There are very few situations where the Council as the road controlling authority would have application for Category V lighting. It is more likely however that Transit New Zealand will apply category V lighting to the State Highway network in the District.

A careful assessment of the appropriate category for this District must be made given ambient light levels, community expectations and relatively low traffic volumes. It is considered that the highest sub-category appropriate for use in the District at this time will be V3 with most designs utilising the lower V4 standard.

“Flag lighting” of Isolated intersections

On occasion, isolated rural intersections have been lit by either the Council or Transit New Zealand to draw attention of approaching motorists to the presence of an intersection. Section 3.5 of AS/NZS 1158.1.1:2005 and Section 4.6.4 of AS/NZS 1158.1.3:1997 is relevant and should be complied with.

³ The relevant table in AS/NZS 1158.3.1:2005 shall be referred to for full technical parameters as only the average horizontal illuminance has been shown in order to provide direct comparison between lighting subcategories.

It is recommended that the lighting of isolated rural intersections be only considered as a last resort and alternative strategies such as retro-reflective signage be used first.

Light Colour

Different light sources produce illumination with distinct colours. In simple terms, different lamps can produce white, blue-white or yellow light. The choice is important because the colour of artificial light influences people's impressions of their surroundings.

At present around 35% of the district's street lighting is blue/white (mercury vapour), 60% is yellow (high pressure sodium) and 5% white (metal halide or fluorescent).

High Pressure Sodium Lamps (HPS) are commonly used for streetlights. They typically have a “warm” appearance and produce a characteristic yellow or orange illumination. They typically have a Correlated Colour Temperature of 2000K or less and a colour rendering index as low as 25. HPS lamps are energy efficient and have a long operating life. However the yellow light is less useable by the eye and can change and distort natural colour and the appearance of objects.

Metal Halide Lamps (CMH) are an energy efficient source of white and blue-white light. These lamps typically have a Correlated Colour Temperature of 3000-4000K and a colour rendering index of 85. Metal halide lamps have a shorter operating life than HPS lamps. Both lamp life and color temperature range is improving as metal halide technology develops. Metal halide lamps can produce a typically warm-white appearance (3000K) or a cool white appearance (4000K). The lamps are also more compact which assists in optical performance and lantern design.

Metal halide lamps produce a more useful light, in that generally less illumination is needed, if white light replaces yellow. White light reveals the natural colours of surfaces, and it provides a more accurate sense of the size and shape of objects. The standard lantern and control equipment selected by QLDC is capable of accommodating both Metal Halide and HPS lamps without modification or additional expense.

This strategy recommends using white light and warm white light in our townships and parks to get the benefits of improved colour rendition. Because of the quantity of existing HPS lamps in our residential neighbourhoods, industrial areas and rural areas, it is recommended to move to a consistent yellow light in these places at this time.

In late 2006 metal halide lighting was introduced into Kingston. It is intended that feedback from this community should be used to consider further applications of metal halide lighting in residential settings.

The retention and expansion of HPS (yellow light) should be regularly reviewed as lamp technologies develop and community feedback gained.

Queenstown Town Centre

The town centre will be defined by an elegant and visually cool-white main road surrounded by its historic and warm glowing facades and side streets.

The existing cool white light in Shotover Street will be continued in Stanley Street to define the main arterial.

Surrounding streets will be inviting and easy to navigate in with lower intensity warm - white light

These areas will be seen at night as a softly glowing and warmly lit backdrop to the surrounding environment. Building owners and occupiers should be encouraged to provide lighting of their facades and the first layer, or ground floor, of occupied space. Lit elements and facades will aid in the feeling of a visually cohesive haven.

Footpaths should be well illuminated and where possible keep the lanterns heights and poles low and in direct relation to human scale. Because these areas are lit in warmer colour temperatures than the surrounding environment, these will appear immediately to be enclosed and inviting environments.

At night building lighting will help to create a perception that the street expands to include the ground floor interiors of retail outlets.

The lighting of public spaces will require particular attention to add interest to the streetscape.

Defined safe routes will ensure pedestrians can move between the central business district and accommodation areas safely.

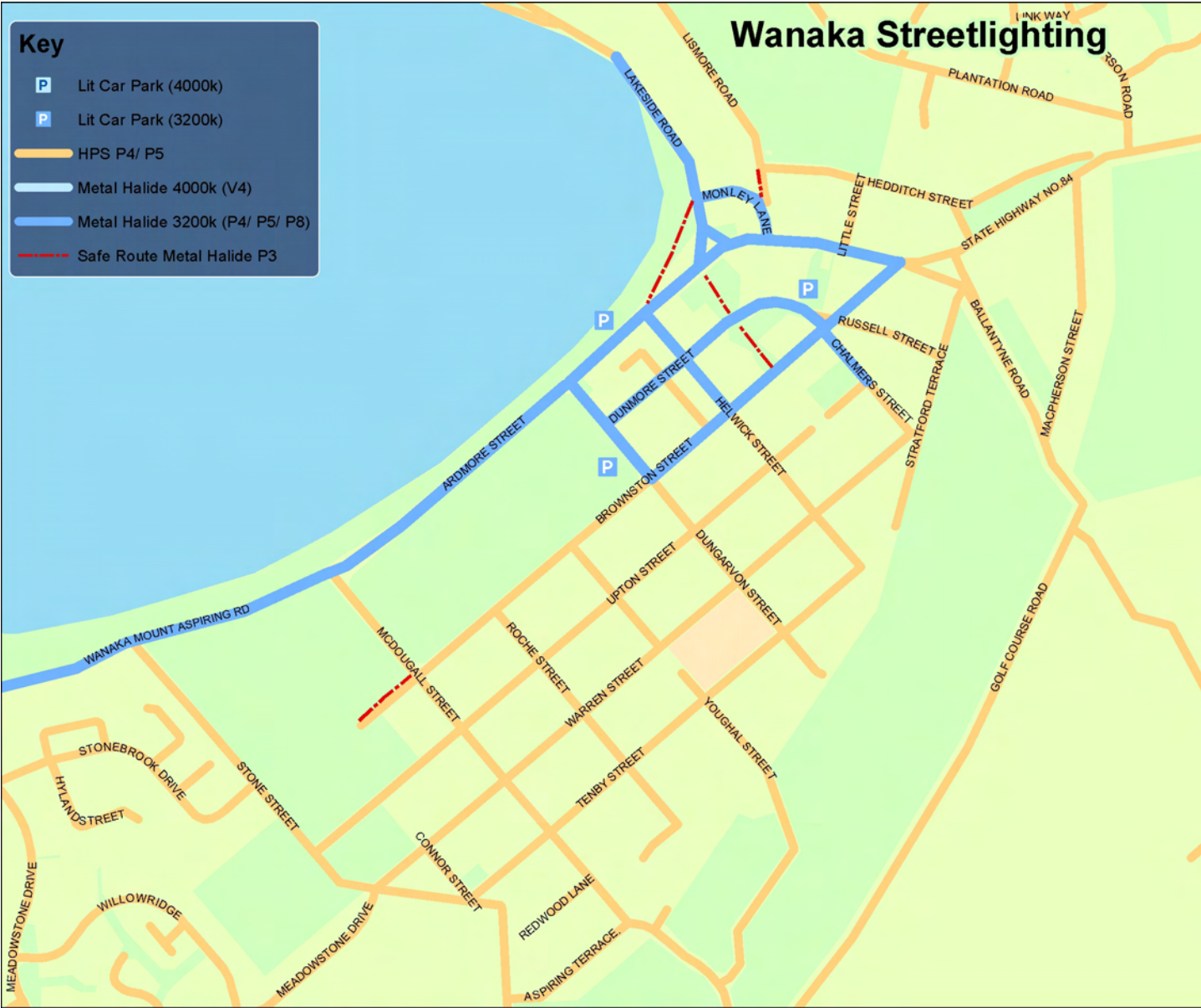
Wanaka Town Centre

The town centre will be defined by the use of warm white lighting in contrast to the HPS sources used in the surrounding residential areas.

The form of Roys Bay and foreshore reserve should be accentuated by the continuation of warm white lighting from the Roys Bay Boat Ramp to Wanaka Station Park. The overly dominant lighting in Pembroke Park should be addressed as resources and priorities permit.

The lighting of public spaces will require particular attention as these areas (such as the lakefront and Bullock Creek) a popular with pedestrians both day and night.

Given the poor level of lighting in the Wanaka Town Centre the preparation of a lighting master plan is considered a priority for 2007.



Arrowtown Town Centre

Due to the heritage nature of the street a specific lighting master plan is required. This will need to include building owners as well as the Council to deliver an effective and subtle lighting scheme that enhances the night time experience of visitors while avoiding a “Disneyland” effect.

Existing Residential Areas and Urban Townships

The night time vision for these areas is that they are lit to a minimum level to provide for safe pedestrian and vehicle movement.

Lighting is carefully controlled to avoid obtrusive and nuisance light through the use of quality full-cut of lanterns and dimming technology.

Residents should be able to enjoy comfortable and safe movement in the streets and key access-ways while enjoying the night sky and mountain vistas.

All roads will be lit with High Pressure Sodium lamps with pedestrian street to street walkways lit in warm metal halide.

Where lighting is provided by existing overhead lines, lanterns will typically be spaced at intersections and at every second pole to provide lighting to P4 or P5.

Consideration should be given to the use of 6 metre columns in low-rise residential areas. Lighting mounting heights for lanterns located to the rear of low rise residential buildings should be lower yet, at some 5 metres.

Rural Living Areas and Rural Townships

The night time vision for these areas is that they are lit to a minimum level to provide for safe pedestrian and vehicle movement.

Lighting is carefully controlled to avoid obtrusive and nuisance light through the use of quality full-cut of lanterns and dimming technology.

Residents should be able to enjoy comfortable and safe movement in the streets and key access-ways while enjoying the night sky and mountain vistas. Lighting in these areas will be designed primarily for the purpose of orientation and way finding (visual guidance) rather than with the higher illuminance levels generally perceived for safety and security.

All roads will be lit with High Pressure Sodium lamps with pedestrian street to street walkways lit in warm metal halide.

Where lighting is provided by existing overhead lines, lanterns will typically be spaced at intersections and at every third pole to provide lighting to P5 standard.

For new residential developments lighting will be carefully designed to minimise the visual effect of the development when viewed from vantage points and main roads. Avoid high contrast between light and dark surfaces and limit the levels of brightness (glare) to ensure that visibility is maintained when looking beyond the luminaire. Consideration needs to be given to ambient light levels in the surrounding landscape to avoid subdivisions being over-lit. Lighting to P5 is appropriate.

Consideration should be given to restrict the use of lighting within rural areas to that which is only essential in terms of traffic safety at road junctions and visual guidance and orientation for pedestrians elsewhere. Lighting mounting heights should be 6 – 7.5 metres for street lights. In special circumstances bollard lights (complete with appropriate glare and light control) and/or ground wash lighting could be used for the remaining rural areas where lighting is considered necessary.

Industrial and business areas

The night time vision for these areas is that adequate lighting is provided in the streets for safe pedestrian and vehicle movement.

All roads will be lit with High Pressure Sodium lamps typically to P4 standard.

Opportunities will be explored for dimming control to reduce energy use during off-peak times.

As almost all buildings within the district are of the low rise type it is recommended that the road and street lighting be provided from columns of 6 to 9 metre height at appropriate centres. Where wide road widths dictate the continued use of 10 and 12 metre columns is advocated.

Parks and gardens

The feeling of safety at night is a crucial element to local inhabitants, tourists and pedestrians who may live near, use, or need to walk through or around the perimeters of these parks. Lighting plays a critical role in this feeling of safety and helps to develop feelings of neighbourhood identity and ease of use.

Park lighting will be generally limited to those sites which either:

- contain a night time activity (such as a BBQ, public toilet, occupied car park, clubhouse or lit playing field)
- contain established walking routes between activity centres and can be lit in accordance with CPTED principles
- provide a significant visitor attraction (e.g. Queenstown Gardens, St Omer Park, Roy's Bay)

Otherwise parks will generally be only lit as part of the street lighting network providing perimeter lighting to describe the boundaries of parkland

Where park lighting is implemented, large areas of park land will not be illuminated. Instead, focal points, paths, bridges, will be lit with regard to crime prevention principles. Some significant natural or architectural elements within key parks may be lit so that they can be seen from major circulation routes or distant vantage points.

The sensitive lighting of sporting fields will encourage greater use and link them visually with the night time environment.

Natural reserves, areas used for regeneration or natural habitats and breeding grounds of any fauna should not be lit. Similarly, any area in which it is not required or advisable for the public to enter at night should not be lit.

Neighbour and local parks will not be typically lit unless they form part of a recognised safe walking route or have a night time activity generator located in the park.

Lighting will be metal halide generally in the warm-white range of 3000K. The use of high-pressure sodium light sources is to be avoided as these will render, as a brown colour, the green and blue/green colours of foliage, grass and other forms of planting.

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

Avoid all forms of glare.

Ensure that footpath lighting columns are maintained at centre to centre spacing that avoid glare being created by using lanterns that are designed to spread light over a considerable area at low mounting heights. Provide good illumination levels to the most popular walking routes. Ensure these pathways are interconnected with each other and surrounding streets.

Do not light pathways that are seldom used or have no through route (dead ends).

People are guided by light at night and if a space is lit there is perceived to be safe. This can lead people into areas of entrapment. The principles and guidelines of Crime Prevention through Environmental Design (CPTED) should be followed.

Use saturated colour with care.

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

Use vertical surfaces such as walls and areas of dense vertical foliage to reflect light and to create a sense of boundary. This technique also provides the ability to see in silhouette any person between the observer and the vertical surface.

Lighting for the Queenstown Gardens, St Omer Park, Roy's Bay and Wanaka Station Park should also consider the macro vista of elements within the parks when viewed from across the lake from the respective areas.

Implementation

- 9.1 All new lighting design applications shall comply with AS/NZS 1158:2005; Lighting for roads and public spaces, Part 1.1: Vehicular Traffic (Category V) lighting and Part 3.1 Pedestrian Area (Category P) lighting
- 9.2 All new lighting design applications shall have regard to the interpretation provided in this strategy of the applicable lighting category for the relevant District Plan zone to avoid over lighting.
- 9.3 Progressively implement the introduction of warm - white light sources in town centres and parks
- 9.4 Progressively replace Mercury Vapour lamps with High Pressure Sodium lamps in residential and rural areas.
- 9.5 Implement some trial applications of warm – white light sources in residential areas and evaluate community response and costs.
- 9.6 Prepare lighting master plans for Queenstown, Wanaka and Arrowtown Town Centres.

Appendices

Appendix 1: Priority Safety Improvements

The following areas have been assessed for safety improvements in accordance with the lighting strategy. These programmes will be funded via specific town centre improvement projects and the town Centre lighting budgets.

Over the next three years, \$178,000 is available in the Wakatipu ward and \$252,000 in the Wanaka ward for implementation of these improvements. The first step in initiating this work should be the preparation of a detailed implementation plans for Queenstown and Wanaka including costs.

Queenstown

Area	Location	Current Condition	Recommended Action/Priority
Town Centre Streets	Shotover Street	Excellent	None
	Camp Street	Poor	High
Town Centre Car Parks	Athol Street	Poor	High
	Ballarat Street	Poor	High (Subject to Remarkables Centre)
	Recreation Ground Sth	Average	High
	Gorge Road	Average	High
Key safe walking routes	Gorge Road Deviation	Poor	Low
	Gondola		
	Skyline to Brecon Street	Poor	High
	St Omer Park	Average	High
	Hotops Rise	Average	Moderate
	Hay Street	Poor	High
	Marine Parade to Park Street	Average	Moderate
	Man Street	Poor	Moderate
	Brunswick Street	poor	Moderate
	Malaghan Road	Poor	Low
Robins Road	Poor	Low	
Fernhill Road	Poor	High	

Wanaka

Area	Location	Recommended Action / Priority
Town Centre Streets	Ardmore Street	High
	Upper Helwick Street	High
	Dunmore Street	
Town Centre Car Parks	Waterfront (Dungarvon to Lakeside)	High
	Pembroke Park	High
	Ardmore Street	High
	Durham Street	Low
Key safe walking routes	Bullock Creek	High
	Monley Lane	High
	Lakeside Ave	High
	Brownston Street	High

Arrowtown

Area	Location	Recommended Action / Priority
Town Centre Streets	Buckingham Street	Low
	Arrow Lane	High
Town Centre Car Parks	Hansen Place	High
	River Car Parks	Low
	Ramshaw Lane	Medium
Key safe walking routes	Buckingham Street to Camp Ground	Medium
	Hertford/Wiltshire to Town	Medium

Frankton

Area	Location	Recommended Action / Priority
Town Centre Car Parks	Grey Street to Toilets/Bus Shelter	High
Key safe walking routes	Buckingham Street to Camp Ground	High

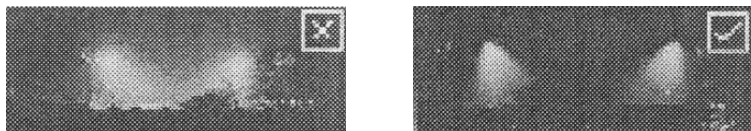
Appendix 2: Good Practice Lighting Guide

Preventing Light Pollution - Three Point Plan

Since urban sky glow (light pollution) arises from a combination of artificial light emitted directly into the sky from light fittings and light reflected up into the sky from buildings and the ground, the BAA Campaign for Dark Skies currently recommends that:

1. Wherever possible lights should be installed in full cut-off or ultra low-profile housings to prevent the emission of light above the horizontal.
2. 'Over-lighting' must be avoided. Using only the correct amount of light for the task, according to accepted standards, will reduce the amount of reflected light contributing to sky glow.
3. Unnecessary night-time lighting, particularly decorative floodlighting, merchandising and advertising lighting and sports floodlighting, should be switched off at 11pm or midnight to reduce the total sky glow in the early morning, pre-dawn hours.

Minimising Light Pollution



All Living things adjust their behaviour according to natural light. Artificial light has done much to safeguard and enhance our night-time environment but, if not properly controlled, obtrusive light can present serious physiological and ecological problems.

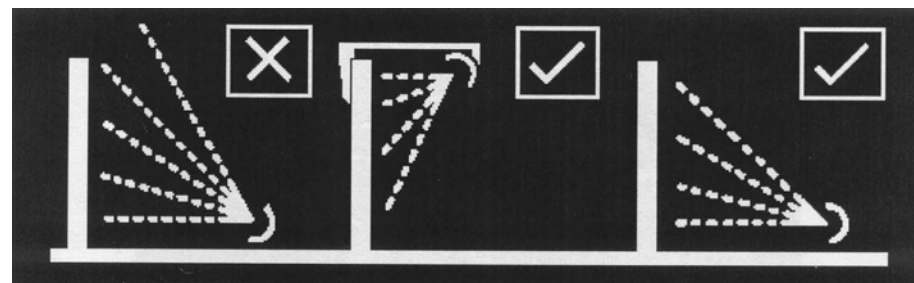
Light pollution, whether it keeps you awake through a bedroom window or impedes your view of the night sky, is a form of pollution and without too much trouble can be substantially reduced without detriment to the lighting task in both urban and rural areas.

Sky glow is one form of light pollution. Glare is the uncomfortable brightness of a light source when viewed against a dark background, and light trespass; the spilling of light beyond the boundary of the property on which the source is located; are other forms of light pollution. In residential areas street lighting columns should be of a height that is sympathetic to the scale of adjacent buildings but should not, under any circumstance, be higher than the height of such buildings.

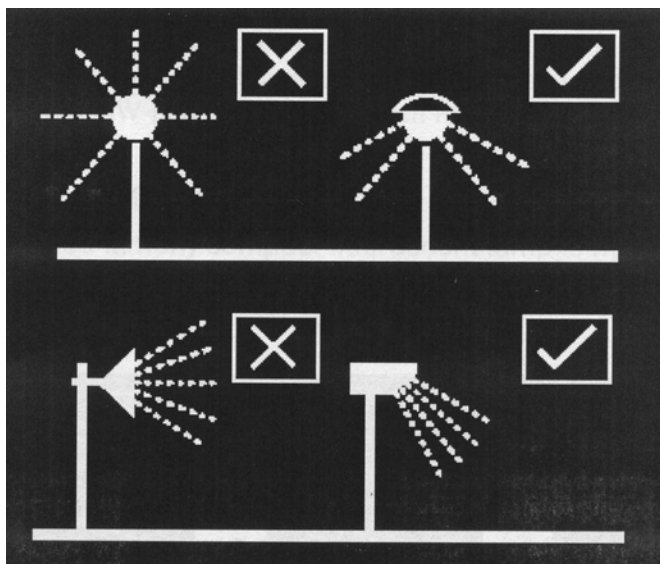
Listed below are some key ways to reduce the problems of unnecessary, obtrusive light:

Switch off lights when not required for safety, security or enhancement of the night-time scene. In this respect one can introduce the concept of a curfew with further limitations on lighting levels between agreed hours e.g. advertising and decorative floodlighting – off between 23.00hrs and dawn.

Direct light downwards wherever possible to illuminate a target, not upwards. If there is no alternative to up-lighting, then the use of shields and baffles will help to reduce spill light to a minimum.

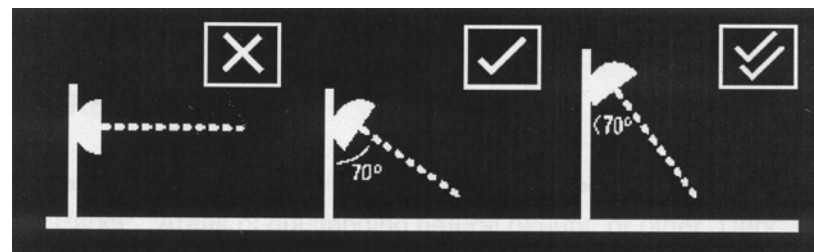
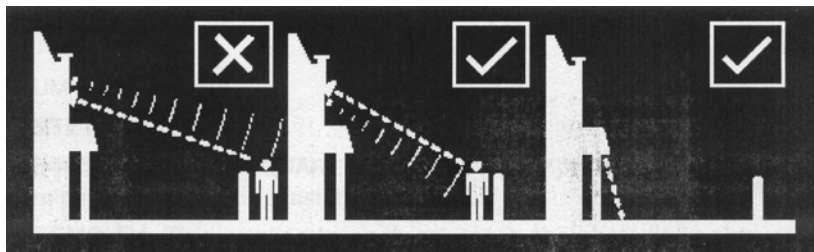


Use specifically designed lighting equipment that once installed minimizes the spread of light near to, or above the horizontal plane.

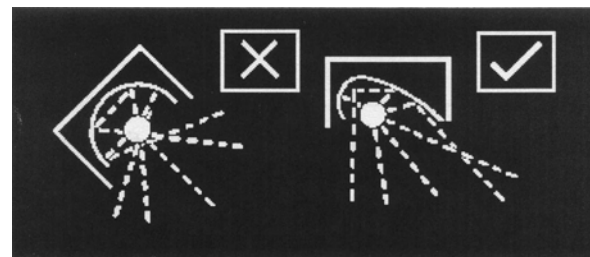


Do not 'over' light. It is a cause of light pollution and a waste of money.

Keep glare to a minimum, by ensuring that the main beam angle of all lights directed towards any potential observer is kept below 70 deg. It should be noted that the higher the mounting height, the lower the main beam angle. In places with low ambient light, glare can be very obtrusive and extra care should be taken in positioning and aiming.



Only use floodlights with asymmetrical beams that permit the front glazing to be kept at or near parallel to the surface being lit.



For domestic and small-scale lighting, there are two solutions:

1. Passive infrared detectors can be used to good effect, if correctly aligned and installed. A 150W (2000 lumen) tungsten halogen lamp is more than adequate. 300/500W lamps create too much light, more glare and darker shadows.
2. All-night lighting at low brightness is equally acceptable. For a porch light a 9W (600 lumen) compact fluorescent lamp is more than adequate in most locations.

Appendix 3: Specification for Lanterns Vested in QLDC

Introduction

The purpose of this standard is to ensure that lighting infrastructure being vested in Queenstown Lakes District Council (QLDC) meets accepted best practice and QLDC asset management and strategic objectives with regard to lighting in our district. These standards supersede any previous draft standards distributed by Council, or Council's contractors including DELTA, Civic Corp and Imtech.

Format

The standard is comprised of a performance based specification for light fixtures, lamps and poles. Applicants wishing to vest lighting assets in QLDC will need to demonstrate that the lighting design and asset selection meets or exceeds the minimum standards set out below.

Administration

Applicants are required to submit lighting design details to Civic Corp. Civic Corp will undertake liaison with the Council General Manager of Utilities, the Director of Parks and QLDC Engineering as required.

Warranty

All equipment shall have a minimum general warranty of 12 months from the date of handover to QLDC and the service life should be stated with the submission.

Carriage Way Lighting

In order to maintain continuity of aesthetic values in the area the proposed style of lantern and column shall be submitted to QLDC at the above address, for approval prior to progressing with the detailed lighting design.

The carriageway lighting shall meet the following criteria:

1. Be capable of accommodating all of the following lamp sources within a "family" of housings:
 - High pressure sodium
 - Metal halide
2. Accommodate wattages ranging from 50 watt up to 250 watt.
3. Have a minimum laboratory tested and approved ingress protection rating of IP54 for lamp housing and IP44 for gear housing that will last throughout the rated service life of the equipment. All gaskets should be solid (not foam) and silicon or proven equivalent with permanent shape memory (restored to original shape after accessing the equipment throughout the service life).
4. Where accessible to the public it shall not be possible to access components without the use of special tools. For street lanterns, access for lamp replacement shall be achievable without the use of any special tools.
5. Sealed optical assembly / chamber.
6. Control gear mounted on an easily removable plate.
7. Hinge or similar to retain the cover during maintenance.
8. Be provided with internal fuse protection.
9. Be capable of side entry, top entry or post top entry.
10. Control gear and lamp isolation when opened.
11. Have minimum power factor of 0.9 lag.
12. Have adjustable lamp position.
13. Have maximum energy loss of 10% and comply with NZ Minimum Energy Performance Standards (MEPS).
14. Have a minimum total light output ratio of 65%.
15. Comply with the requirements of applicable New Zealand and/or international standards. The complying standard shall be documented in the application
16. Have a zero upward wasted light output ratio (UWLOR). Consideration will be given to special circumstances where the use of luminaries with a UWLOR above 0% is considered necessary. This should be discussed with QLDC prior to lodging an application.

17. Be capable of the following configurations where appropriate:
- Flat glass (aeroscreen) lens
 - Drop glass lens
 - Tear Drop lens
 - Other (please state type and reason)

Pedestrian (above ground) Lighting

1. Be equipped with one of the following sources:
 - Compact fluorescent
 - LED
 - High pressure sodium
 - Metal halide
 - Fluorescent
2. Accommodate wattages ranging from low watt LED's up to 150w discharge lamps.
3. Have a minimum laboratory tested and approved ingress protection rating of IP54 that will last throughout the rated service life of the equipment. All gaskets should be solid (not foam) and silicon or proven equivalent with permanent shape memory (restored to original shape after accessing the equipment throughout the service life).
4. Be provided with internal fuse protection.
5. Be capable of side entry, top entry or post top entry.
6. Have minimum power factor of 0.9 lag.
7. Have maximum energy loss of 10% and comply with NZ Minimum Energy Performance Standards (MEPS).
8. Have a minimum total light output ratio of 65%.
9. Have a zero upward wasted light output ratio (UWLOR), but no greater than 4% with prior approval obtained from QLDC for specific circumstances.
10. Sealed optical chambers
11. Comply with the requirements of applicable New Zealand and/or international standards. The complying standard shall be documented in the application.

In- Ground Lighting

1. Be equipped with one of the following sources within a "family" of housings:
 - Compact fluorescent
 - L.E.D
 - Halogen
 - Metal halide
2. Accommodate wattages to suit LED's ranging to 150w metal halide.
3. Have a minimum laboratory tested and approved ingress protection rating of IP65 that will last throughout the rated service life of the equipment. All gaskets should be solid (not foam) and silicon or proven equivalent with permanent shape memory (restored to original shape after accessing the equipment throughout the service life).
4. Have maximum touch temperature of 70°C when installed. Note consideration is to be given to the climatic conditions experienced in the Queenstown Lakes District.
5. Be capable of providing very narrow, narrow, medium and wide beam patterns by way of reflector optics within the same "family" of housings.
6. Have a maximum energy loss of 10% and comply with NZ Minimum Energy Performance Standards (MEPS).
7. Have a minimum total light output ratio of 65%.
8. Be supplied with a separate pre-installation blackout and factory fitted sealed cable for connection to external supply. The factory sealed cable shall be terminated in a IP65 socket with a minimum of 1m of flexible cable. The supply cable shall be fitted with a matching IP65 plug to enable the safe and ready removal of the luminaire from the blackout.
9. Be provided with internal fuse protection and/or over voltage protection.
10. Comply with the requirements of applicable New Zealand and/or international standards. The complying standard shall be documented in the application
11. Minimum drive over load rating of 4,000kg in traffic areas and 1,000kg in soft landscaping.

12. Be capable of accommodating the following accessories where appropriate:
- Recessed housing or pre-installation kit
 - Glare shield
 - Filters
 - Lens' e.g sculpture etc
 - Guards
 - Tilt optic or tilt lens (state maximum angle)

Feature Lighting

1. Be equipped with one of the following sources within a "family" of housings:
 - Compact fluorescent
 - LED
 - Halogen
 - Metal halide
 - Fluorescent
2. Accommodate wattages ranging from low wattage LED's up to 1kW discharge lamps.
3. Have a minimum laboratory tested and approved ingress protection rating of IP44 that will last throughout the rated service life of the equipment. Where no protection is provided from the weather the minimum rating shall be IP65. All gaskets should be solid (not foam) and silicon or proven equivalent with permanent shape memory (restored to original shape after accessing the equipment throughout the service life).
4. Provide very narrow, narrow, medium and wide beam patterns by way of reflector optics within the "family" of housings.
5. Have a maximum energy loss of 10% and comply with NZ Minimum Energy Performance Standards (MEPS)
6. Have a minimum total light output ratio of 65%.
7. Be provided with internal fuse protection and/or over voltage protection.
8. Be capable of swivel and tilt where appropriate.
9. Be aesthetic but of rugged construction suitable for use in a public area susceptible to vandalism.
10. Comply with the requirements of applicable New Zealand and/or international standards. The complying standard shall be documented in the application

11. Be capable of accommodating the following accessories where appropriate:
- Pre-installation kit
 - Glare shield
 - Filters
 - Lens (sculpture, etc)
 - Guards
 - Snoots
 - Gobo's
 - Leaf Guards all, but only where appropriate to suit the site conditions

Lamps

1. Metal halide lamps shall have a minimum CRI of 80 and preferably of the ceramic type. Lamps will have a colour temperature of 3200k unless otherwise specified by the Council.
2. High pressure sodium lamps should be of the high output type e.g. 16,000 minimum initial lumens at 150 watt.

Appendix 4: Approved Equipment – As at July 2006

Carriageway lantern

Thorn Civic 1 (Flat Glass, Electronic Gear, 34mm side entry spiot)
HPS-T/CDM-TT 70W CIV1FGZ70.4/SE

Thorn Civic 1 (Flat Glass, Electronic Gear, 34mm side entry spiot with photocell)
CIV1FGZC70.4/SE

Decorative lantern

We-ef ASP504-E-70/H[K] Pendant luminaire

Lamps

High Pressure Sodium	Philips SON-T Plus 70W
Ceramic Metal Halide	General Electric or equivalent CMH70/UVC/C/U/830/E27 3000K 6000 lumens 70W

Columns

Unpainted octagonal street lighting poles

Residential applications specify Mounting height 6m to 7.5m
Curved outreach from 0.9m to 2m

42mm spigot
Combined effect of outreach tilt and spigot angle (including deflection) must provide for a 0° tilt providing for a true horizontal mounting of lantern.

Appendix 5: Residential Lantern Replacement Programme

Strategy one recommends the replacement of all DELTA leased lanterns with QLDC lanterns.

Strategy four recommends the replacement of all lanterns running MV lamps with lanterns running HPS lamps (and in some cases Metal Halide lamps).

There are cost savings to Council in lease charges from the replacement of DELTA lanterns and energy savings in lamp conversion. While a programme of individual lantern replacements could take place it is recommended that a replacement programme be implemented on a suburb by suburb to provide a consistent look and achieve other benefits from moving to full-cut off lanterns. Marginal cost savings will also be made given the efficiency of have a crew systematically work over one area.

Ideally priority should be placed on upgrading communities that have a high number of MV lamps and a high number of leased lanterns which will achieve modest cost savings on energy and lease charges for the Council. Table X shows the relative priorities when assessed on this basis.

However there have been a number of communities that have highlighted valid concerns with lighting and given the annual savings from one area to another are minor it is recommended that the first years programme focus on the communities of Kingston, Fernhill/Sunshine bay and Kelvin Peninsula where there has been a long record of community concern. Table 5.1 and 5.2 show the programme of works possible within existing capital budgets to 2009. In line with the aim of completing replacement of leased lanterns and conversion of MV to HPS lamps the balance of work is proposed for the 2010/2011 annual plan.

After 2011, the focus can move to further supplementing the lighting network, repairs and maintenance and replacement of the remaining QLDC owned lanterns with full cut off lanterns.

To undertake a bulk replacement the remaining QLDC owned lantern stock with new lanterns meeting current specifications would require around \$200,000 in the Wakatipu and x in the Wanaka Ward. In line with strategy 2.2 it is proposed to replace the remaining QLDC lantern stock as lanterns reach the end of their economic life rather than undertake a bulk replacement.

Potential Costs and Savings from conversion of MV lamps to HPS lamps and from Leased lanterns to Owned lanterns.

Area	Leased from DELTA		Owned by QLDC		Annual Saving		Replacement	Cost/ Benefit
	HPS	MV	HPS	MV	Lease	Energy	Cost (1)	Ratio (2)
Arrowtown	17	50	100	34	\$ 2,974	\$2,100	\$ 50,500	10.0
Queenstown Hill	34	19	115	16	\$ 2,353	\$875	\$ 34,500	10.7
Frankton	27	20	92	22	\$ 2,086	\$1,050	\$ 34,500	11.0
Arthur's Point	9	0	56	0	\$ 399	\$0	\$ 4,500	11.3
Kelvin Peninsula	9	6	11	33	\$ 666	\$975	\$ 24,000	14.6
Fernhill	6	4	55	77	\$ 444	\$2,025	\$ 43,500	17.6
Kingston	0	0	27	10	-	\$250	\$ 5,000	20.0
Quail Rise	0	0	3	52	-	\$1,300	\$ 26,000	20.0

- (1) Replacement cost is the estimated cost of replacing all leased lanterns (both HPS and MV) and all QLDC owned MV lanterns.
- (2) Cost Benefit ratio is the total cost/annual lease and energy savings to give a relative priority score. i.e. the lower the score the higher the gains.

Table 5.1 : Programme for residential upgrades, Wakatipu.

Project	2006/07	2007/08	2008/09	2009/2010
Extra Lights (1)	\$15			
Fernhill	\$39			
Kelvin Peninsula	\$22			
Kingston	\$5			
Extra Lights		\$6		
Arrowtown		\$45		
Extra Lights			\$15	
Queenstown Hill			\$31	
Extra Lights				\$15
Frankton				\$31
Quail Rise				\$23
Glenorchy				\$16
Total Cost	\$80	\$51	\$46	\$ 85
Total Budget	\$80	\$51	\$53	-

(1) "Extra lights" includes additional/infill lights and replacement of broken HPS lanterns owned by QLDC

Table 5.2 : Programme for residential upgrades, Wanaka.

	2006/07	2007/08	2008/09	2009/2010(2)
Extra Lights (1)	\$17	\$12	\$27	
Wanaka	\$125			
Lake Hawea		\$31		
Hawea		\$1		
Albert Town			\$23	
Makarora		\$1		
Luggate		\$5		
Total Cost	\$142	\$50	\$ 50	\$ -
Total Budget	\$142	\$50	\$ 50	\$ -

(2) Budget to be set according to priorities for extra lights or conversion to full cut-off

Queenstown Lakes District Council District Plan Rules

The following table has been compiled from the Queenstown Lakes District Council – Partially operative District Plan March 2004. The current version of the plan should always be referred to before proceeding with a lighting project.

Rural Areas	All fixed exterior lighting shall be directed away from adjacent sites and roads.
Airport Mixed Use	<ul style="list-style-type: none"> a. All exterior lighting installed on sites or buildings within the zone shall be directed away from adjacent sites, roads and public places b. No activity shall result in a greater than 10 lux spill (horizontal or vertical) of light onto any adjoining property within the zone, measured 2m inside the boundary of any adjoining property. c. No activity shall result in a greater than 3 lux spill (horizontal or vertical) onto any adjoining property which is zoned for residential purposes.
Residential, Rural Living Areas, Townships,	<ul style="list-style-type: none"> a. All fixed exterior lighting shall be directed away from adjacent sites and roads, and b. No activity on any site shall result in a greater than 3 lux spill (horizontal or vertical) onto any other site measured at any point inside the boundary of the other site.
Town Centres	<ul style="list-style-type: none"> a. All exterior lighting installed on sites or buildings within the zone shall be directed away from adjacent sites, roads and public places, except footpath or pedestrian link amenity lighting. b. No activity shall result in a greater than 10 lux spill (horizontal or vertical) of light onto any property within the zone, measured at any point inside the boundary of any adjoining property. c. No activity on any site shall result in a greater than 3 lux spill (horizontal or vertical) onto any adjoining property which is zoned high density residential measured at any point more than 2m inside the boundary of the adjoining property.
Business Areas, Industrial Areas	<ul style="list-style-type: none"> a. Exterior lighting installed on sites or buildings shall be directed away from adjacent sites, roads and public places. b. No activity shall result in a greater than 10 lux spill (horizontal or vertical) of light onto any adjoining property within the zone, measured 2m inside the boundary of any adjoining property. c. No activity shall result in a greater than 3 lux spill (horizontal or vertical) of light onto any adjoining zone measured at any point more than 2m inside the boundary of the adjoining property.
Resort Zones, Rural Visitor Zone	<ul style="list-style-type: none"> a. All fixed lighting shall be directed away from adjacent roads and properties b. No activity on any site shall result in a greater than 3 lux spill, horizontal and vertical, of light onto any property located outside of the zone, measured at any point inside the boundary of the adjoining property.
Bendemeer Special Zone	<ul style="list-style-type: none"> a. All lighting to accessways and roading within the zone shall be kept to a minimum, and directed downwards, so as to avoid light spill. b. All exterior lighting shall be no higher than 4m above finished ground levels.
Remarkables Park Zone	<ul style="list-style-type: none"> a. All fixed lighting shall be directed away from adjacent sites and roads; and b. No activity on any site shall result in a greater than 3 lux spill, horizontal and vertical, of light onto any other site measured at any point inside the boundary of the other site, provided that this rule shall not apply where it can be demonstrated that the design of adjacent buildings adequately mitigates such effects.

Quail Rise Zone	<ul style="list-style-type: none"> a. All fixed lighting shall be directed away from adjacent roads and properties b. No activity shall result in a greater than 3 lux spill (horizontal or vertical) of light onto any property outside of the zone, measured at any point inside the boundary of the adjoining property. c. No exterior lighting within the R2 Activity area shall be visible from State Highway 6.
Frankton Flats	<ul style="list-style-type: none"> a. All exterior lighting installed on sites or buildings within the zone shall be directed away from adjacent sites, roads and public places, except footpath or pedestrian link amenity lighting. b. No activity shall result in a greater than 10 lux spill (horizontal or vertical) of light onto any property adjoining the zone, measured at any point inside the boundary of any adjoining property. c. No activity on any site shall result in a greater than 3 lux spill (horizontal or vertical) onto any adjoining property where the primary use is a residential activity measured at any point more than 2m inside the boundary of the adjoining property.
Meadow Park	<ul style="list-style-type: none"> a. All fixed lighting shall be directed away from adjacent roads and properties b. No activity on any site shall result in a greater than 3 lux spill, horizontal and vertical, of light onto any property located outside of the zone, measured at any point inside the boundary of the other site.
Relocated buildings, temporary buildings and temporary activities	<ul style="list-style-type: none"> a. All fixed lighting shall be directed away from adjacent sites and roads.
Recreation Reserves	<ul style="list-style-type: none"> a. All fixed lighting shall be directed away from adjacent sites and roads; and b. No activity shall result in greater than a 2.5 lux spill, horizontal and vertical, of light onto any adjoining property in Residential or Rural- Residential Zone, measured 2 metres inside the boundary of the adjoining property.
Motor Parks and Golf Clubs	<ul style="list-style-type: none"> a. All exterior lighting shall be directed away from adjacent properties and roads. b. No activity shall result in greater than a 2.5 lux spill, horizontal and vertical, of light onto any adjoining property in Residential or Rural- Residential Zone, measured 2 metres inside the boundary of the adjoining property.
Site Standards Parking and Loading	<ul style="list-style-type: none"> vix. All parking and loading areas, excluding those for residential use which are designed to accommodate 5 or more vehicles and which are used at night, shall be illuminated to a minimum maintained level of 3 lux, with high uniformity, during hours of operation.

Glossary of Lighting Technology

Blue-White Light	Blue-white light is a "cool" white light, produced from lamps with a Correlated Colour Temperature of at least 4000K. It has a minimum Colour Rendering Index (CRI) of 80. The <i>Lighting Strategy</i> requires sources of blue-white to be energy efficient, and to be housed within full-cut off lanterns. With present technology, blue-white light is produced from Metal Halide lamps.
Colour Rendering	Colour Rendering describes the degree to which natural colours can be perceived under different kinds of artificial light. It is measured on a Colour Rendering Index (CRI). A CRI of 100 indicates that colours are depicted accurately. A CRI less than 30 indicates that colours are distorted and difficult to recognise. A CRI of 80 or above provides an acceptable standard for outdoor lighting.
Colour Temperature	Correlated Colour Temperature (CCT) describes the colour of a light source, and is measured in degrees Kelvin (K). Blue-white lamps have a high colour temperature, eg. 4000K. Yellow lamps have a low colour temperature, eg. 2000K.
Down-Lighting	Down-lighting refers to feature lighting that is directed down onto buildings or landscape elements from elevated sources. Down-lighting is less likely to contribute to skyglow than up-lighting. However, unless it is carefully targeted, down-lighting can create glare for pedestrians and the occupants of neighbouring buildings. Effective down-lighting also depends on the availability of suitable locations for elevated lamps.
Feature Lighting	Feature lighting is a form of decorative or promotional lighting. In this strategy, the term refers to night illumination of landscape features or building exteriors. Feature lighting includes "accent" lighting of small details as well as extensive installations that illuminate entire structures.
Floodlighting	Floodlighting is a crude form of feature lighting. It refers to indiscriminate, high intensity illumination of whole building facades or landscape elements.
Full Cut-Off Lanterns	Full cut-off lanterns conceal a light source from most viewing angles. They do this by housing lamps completely inside the light fitting.
Glare	Glare refers to an acute contrast between light and dark. In simple terms, glare results when bright spots are viewed against a dark background. Under these conditions, a reflex action fixes attention on the bright source. Glare can impair visibility and cause discomfort. As a result, background surfaces often appear darker if they are viewed alongside areas of much higher illumination.
High Pressure Sodium Lamps	High Pressure Sodium (HPS) lamps are commonly used for streetlights. They typically have a Correlated Colour Temperature of 1900K, and produce characteristic yellow or orange illumination. On some surfaces, this can produce a "warm" colour. HPS lamps are also energy efficient, and they have a long operating life. However, under typical night lighting conditions, the human eye is less sensitive to yellow light than it is to white or blue-white light. This means that HPS lamps are less effective than white or blue-white lamps. Furthermore, yellow or orange light distorts colours and can change the appearance of objects. The Colour Rendering Index for HPS lamps may be as low as 25. (see also comments on "Yellow Light").
Illumination	Illumination refers to the amount of light falling on a given surface. Where street lighting is concerned, illumination is usually measured on the ground. However, it is also important to know how much light reaches vertical surfaces. The correct technical term for illumination is "illuminance". It is measured in units called "lux".
Lamp	A lamp is a light source. In everyday language, a lamp is often referred to as a "light bulb".
Lantern	A lantern is a light fitting that houses a lamp. In technical language, a lantern is referred to as a "luminaire".
Lux	A unit of measurement for the amount of light that reaches a given location.

Metal Halide Lamps	Metal Halide Lamps are an energy efficient source of white and blue-white light. These lamps typically have a Correlated Colour Temperature of 3000-4000K and a Colour Rendering Index of 85. Metal halide lamps are more compact than high pressure sodium (HPS) lamps. For this reason, metal halide lamps perform better optically. They can easily be housed inside light fittings. Therefore the distribution of illumination can be precisely controlled. Metal halide lamps are energy efficient. However, they have a shorter operating life than HPS lamps.
Obtrusive Light	Obtrusive light refers to light that has the potential to cause negative environmental impacts, including nuisance to pedestrians and the occupants of nearby properties. These effects may result from the intensity or direction of the illumination.
Semi Cut-Off Fittings	Semi cut-off fittings allow lamps to protrude partially from the lantern. As a result, the light source is clearly visible, and frequently becomes a source of glare. Semi cut-off fittings allow little control over the distribution of illumination. Because the lamp protrudes from its housing, light falls over a very broad area. This spread allows streetlights to be placed further apart. However, it also results in as much as a third of the light generated being wasted, and emitted in a skyward direction.
Skyglow	Skyglow refers to the unnaturally bright night sky that occurs over cities & towns. Skyglow is caused by the component of artificial light that radiates upwards, and scatters in the atmosphere. It obscures the stars, planets and other celestial phenomena. It hinders the work of astronomers, and it diminishes everyone's awareness of features in the sky. In extreme cases, it may also disturb birds and other wildlife.
Spill	Spill refers to light that misses its target. It represents waste light and energy. Light spill contributes to skyglow, and may cause a nuisance to observers. Light spill is sometimes referred to as "stray" light.
Up-Lighting	Up-lighting refers to feature lighting that is directed up onto buildings or landscape elements from low-level sources. Unless it is carefully targeted, up-lighting can contribute to skyglow, and create a nuisance for the occupants of adjacent buildings. However, provided the light sources are concealed from view, up-lighting is unlikely to create glare for pedestrians at ground level. Effective up-lighting depends on the availability of suitable locations for low-level lamps.
White Light	In this strategy, white light refers to illumination produced from lamps with a Correlated Colour Temperature of at least 3700K in major streets and public places, or 3000K on minor streets or spaces. White light is also understood to have a minimum Colour Rendering Index of 80. The <i>Lighting Strategy</i> requires sources of white to be energy efficient, and to be housed within full cut-off lanterns. With present technology, a typical source of white light is the metal halide lamp.
Yellow Light	In this strategy, yellow light refers to illumination produced from lamps with a Correlated Colour Temperature of 2000K or less, and maximum Colour Rendering Index of Ra25. The <i>Lighting Strategy</i> requires sources of yellow light to be energy efficient. With present technology, a typical source of yellow light is the High Pressure Sodium (HPS) lamp.

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