

A white line-art illustration of a street lamp is positioned on the left side of the cover. The lamp has a tall, slender pole with a decorative base, a horizontal arm extending to the right, and a dome-shaped light fixture. The background behind the lamp is a dark blue sky filled with numerous white, multi-pointed stars of varying sizes, representing a starry night sky.

# Technical and regulatory guide for outdoor lighting - 2006

Light pollution abatement projet

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## 1. INTRODUCTION

As part of the light pollution abatement project, the action plan is being implemented in three components, which are awareness, regulations and lighting fixture conversion, in order to create one of the largest reserves of dark sky in the world and to ensure the sustainability of astronomy research in Quebec and Canada. This project has always been managed so as to reconcile a maximum number of objectives, thereby creating strong regional – and even national – cohesion. Light pollution abatement is a sustainable development project. The two main elements that influenced the development of this technical and regulatory guide were saving the night sky and increasing energy efficiency.

This technical and regulatory guide is intended for a wide range of stakeholders (municipalities, electricians, engineers, urban planners, inspectors, architects, lighting product distributors, etc.) to help them develop their lighting knowledge and understanding of the standards that are being proposed in the municipalities of the Granit and Haut-Saint-François regional counties, and in the City of Sherbrooke.

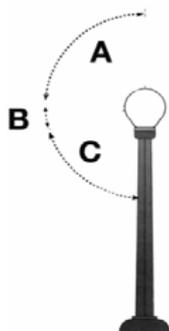
This guide starts by providing some background information by describing the problems created by light pollution, which include sky glow, light trespass, glare and wasted energy. Each section then discusses the elements covered by the regulations (light sources, luminaires, illumination level and operating hours) and concludes with a table that summarizes the proposed standard for this aspect. Detailed regulations are contained in Appendix A of the document, covering the MRC du Granit draft regulations. Appendices B and C contain examples of standard photometric reports for luminaires and a typical application situation.

We hope that this guide will contribute significantly to saving the dark sky in the Mont-Mégantic region, and that it will also serve as a reference tool that will contribute to the development of responsible management of outdoor lighting across Quebec and Canada.

## 2. LIGHT POLLUTION: DEFINITIONS AND CONSEQUENCES

Lighting that is poorly designed, poorly directed or improperly used is responsible for **sky glow**, creates **glare** and generates **light trespass**. This poor use of night lighting is defined as light pollution. Streets, parking lots, parks, public buildings, businesses, industries and private residences are often lit throughout the night. By illuminating the sky this way, all these sources of light hinder star observation and celestial research, disturb nature lovers, harm the balance of ecosystems and translate into a large **loss of energy**.

In North America, it is estimated that the light energy lost to the sky equals about \$1 billion annually. In addition, this excess use of energy contributes to increasing greenhouse gas emissions. Although hydroelectric energy use in Quebec does not generate greenhouse gases, many provinces and countries use coal-fired or gas-fired power plants to produce electricity, which emit greenhouse gases into the air. Promoting energy efficiency is beneficial to the environment because it helps to slow the construction of new electric power plants in Quebec and elsewhere.



### Useful light from a luminaire

Zone A – Sky glow: Light emitted above the horizontal is a total loss. It blocks star observation and wastes energy.

Zone B – Glare and light trespass: Light emitted less than 10° below the horizontal causes glare and risks generating more light trespass on neighbouring properties.

Zone C – Useful light.

Source: FAAQ, Dark Sky Committee

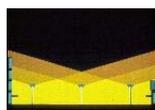
Sky free of light pollution    Sky masked by light pollution



### 2.1 Sky glow

When light is emitted into the sky, it encounters particles in the air and is reflected back to Earth, thereby increasing the brilliance of the night sky. The more the sky background is lit up, the less the stars are visible. For astronomers, the darkness of the sky is essential for studying celestial objects with faint light intensity.

***Sky glow is caused by light emitted directly above the horizontal, by light reflected off the ground and by white light.<sup>1</sup>***



Source: International Dark Sky Association

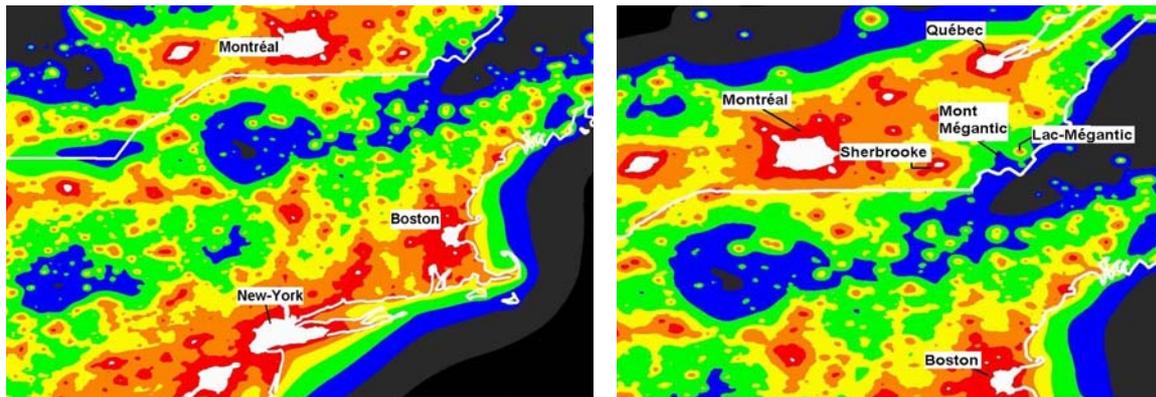
<sup>1</sup> See section on light sources.

In 1997, at the request of astronomers, specific observations designed for the study of light pollution were carried out (Cinzano, Falchi & Elvidge 2001; Isobe, Hamamra & Elvidge 2001) by the US Air Force Defense Meteorological Satellite Program (DMSP), resulting in the first World Atlas of Artificial Sky Brightness. These satellite images made it possible to analyze the quality of the sky compared with the amount of light emitted from the Earth. Below is the situation for eastern North America.

**Bortle's scale** makes it possible to rate the night sky according to the light emitted from the Earth.

Color	Description
Black	Natural night sky
Dark Blue	The Milky Way is visible
Blue	Faint light along the horizon over distant cities
Green	Impact on sky observation
Yellow	Major impact on sky observation and the work of astronomers
Orange	The Milky Way is not visible
Red	Less than 100 stars visible to the naked eye, much greater dome of light over cities
Dark Red	Less than 20 stars visible to the naked eye, the sky is yellow or green

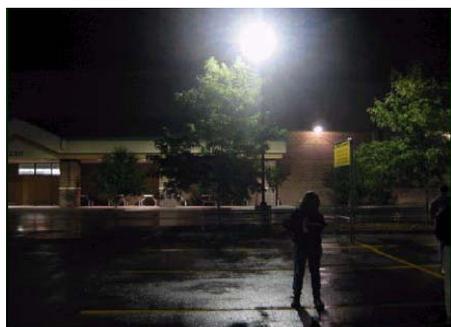
**Satellite images of light pollution in eastern North America**



**Dome of light produced by Sherbrooke as seen from the summit of Mont Mégantic (75 km)**



## 2.2 Glare and visibility



Glare can be blinding and can limit our ability to discern obstacles, or it can simply be visually uncomfortable. In both cases, glare is created by poor use of lighting and increases the risk of accidents. The photo on the right clearly illustrates that powerful, poorly directed lighting that is not uniform is blinding and hinders visibility: the pedestrian can barely be seen!

Glare or poor visibility are caused by a set of factors such as:

- Light emitted at less than 10° below the horizontal;<sup>2</sup>
- Too much illuminance;
- Excessive power from the light source;
- Poor lighting uniformity;
- Inadequate luminaire installation.

## 2.3 Light trespass

Light trespass is the light that shines into our homes – the light that falls beyond property limits.

Light trespass deprives us of peace inside our homes, on our property and in our gardens, in addition to limiting our access to the beauty of a star-filled sky. No valid excuse justifies lighting neighbouring properties. This is excessive use of light and, therefore, of energy.

Furthermore, recent studies have shown how important it is for **human health** to get a good night's sleep in the darkest possible room. Many hormones and cells in the immune system



function only in total darkness, including cells that combat certain cancers.<sup>3</sup>

**What About Safety?**

Darkness is often associated with fear, threats or danger. Yet the majority of thefts take place during daytime. Furthermore, overly bright lighting is not safe because it blinds and reduces the depth of the field of vision, thereby making it difficult to discern night strollers. In the United States, the Dark Campus Program (adopted by a few schools in Texas, Oregon and California) has banned all lighting outside activity hours, and vandalism has dropped and even stopped in some institutions. As for road safety, there is no correlation between the number of traffic accidents and the level of lighting.

Night lighting thus creates a false sense of security and provokes excessive use of light. Moreover, besides the alleged reasons, overconsumption of light can also be explained by the low cost of energy, an absence of clearly defined practices, marketing strategies and a poor understanding of the phenomenon of light pollution.

<sup>2</sup> See the previous section, "Useful light from a luminaire".

<sup>3</sup> Ecology of the Night Symposium, Circadian Rhythm and Human Health, Dr. Joan E. Roberts, Ph.D.

## 2.4 Lost energy

From the satellite images of light pollution in section 2.1, it is also possible to estimate the amount of energy used to light the sky. These studies show that Quebec is one of the most illuminated areas in the world. By applying some basic principles – efficient lamps and luminaires, adequate lighting levels and controlled operating hours – it is estimated that the potential energy savings would amount to **several hundreds of GWh annually in Quebec**, or the equivalent of several dozen million dollars annually.



A flagrant case of the misuse of light energy is the **extremely common** use of security lighting that emits a large percentage of light and energy upward, and that is often used with mercury vapour light sources and remains on all night. We do not know how many security lighting fixtures in Quebec use mercury vapour lamps, but they are very common in residential neighbourhoods in rural and semi-rural areas, and in industrial and commercial areas.

Annual cost of typical dusk to dawn security lighting

Mercury vapour lighting ± \$100

Motion detector ± \$10

In 2003, in Quebec alone, 3,700 security lighting fixtures were sold, including 2,200 that were 400-watt mercury vapour lamps. A 400-watt mercury vapour lamp can be replaced by a 100-watt high-pressure sodium lamp that generates the same amount of light. Simply banning the use of mercury vapour lamps and replacing them with high-pressure sodium lamps would result in **savings of 60%**. In addition, since security lighting fixtures direct about 20% of their light upward, action should be taken not only on the type of source, but also to work with more efficient luminaires to reach maximum energy efficiency and minimum light pollution. Many architectural street luminaires still in use in Quebec direct almost as much light upward as they do downward. In the last 10 years, technologies have improved and these types of luminaires can now reach an efficiency of 60% downward and generate minimum loss upward (from 0 to 3%).

Thus, 150-watt luminaires in Lac-Mégantic could be replaced by more efficient 70-watt luminaires, representing a savings of 50% in addition to limiting light trespass as illustrated in the adjacent photo.

Many industries, businesses and residents light the sky, street and neighbouring properties by using luminaires that do not provide adequate control of the light.



It is sometimes possible to combine energy efficiency and reduced light pollution by changing only the luminaires, but reaching these objectives is meaningful only if it is linked to managing real needs. Using the right amount of light at the right place and right time of night is mandatory for ensuring efficient management of lighting needs. Calgary, which is overlit and has a level similar to that of Montreal,<sup>4</sup> expects to benefit from savings of \$2 million annually, or 20 million kWh/year, thanks to its public lighting conversion program.

<sup>4</sup> Cinzano, Falchi & Elvidge 2001; Isobe, Hamamra & Elvidge 2001.

***The more we light, the more we create a need, thus provoking overlighting.***

Other examples also illustrate lighting abuse. Parking lots, retail areas and many roads are illuminated an average of two to five times more than current standards recommend. For commercial reasons, businesses set their own standards. Believing that they are improving security, or simply due to a lack of information, electricians and engineers plan for more lighting than necessary.

The three photos below also illustrate this observation. This road, which is located in a rural environment, has about three times as much lighting as what is recommended for this type of traffic area. The section that is not lit thus seems very dark in contrast and if obstacles, pedestrians or animals are on the road outside the illuminated area, they cannot be seen. The pedestrian appears as he steps into the lit area, but otherwise he would not have been seen until the last minute! Much dimmer lighting providing a better transition between the lit and unlit areas would improve visibility.



Furthermore, considering that many installations do not require lighting to be on all night, the savings would be even greater. A drive along Highway 20 between Quebec City and Montreal alone shows the impressive number of lighting fixtures that are on to light up deserted areas.

Controlling hours of operation could be a very effective solution for reducing energy consumption while minimizing excess lighting during a large part of the night.

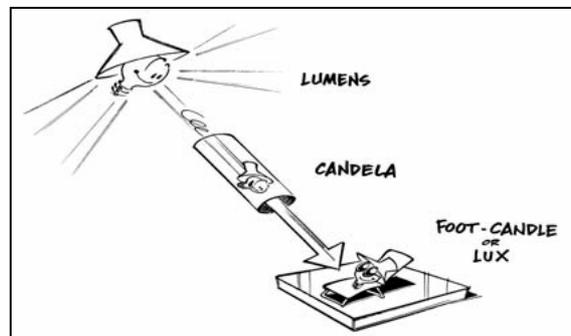
### 3. UNITS OF MEASURE



#### Luminous flux – lumen (lm)

Total amount of light emitted in all directions by a light source. Luminous flux is measured in **lumens (lm)**. One 100-watt incandescent bulb emits 1,500 lumens, while a 100-watt high-pressure sodium lamp emits 10,000 lumens.

*By analogy, the flow of water from a shower head.*



Source: Lumec

#### Luminous intensity – candela (cd)

Quantity of light emitted in a given direction, or vector quantity. Luminous intensity is measured in **candelas (cd)**. One candela is equal to the intensity of a candle. 1 cd = 1 lumen per sr (sr: steradian – unit of a solid angle in a sphere).

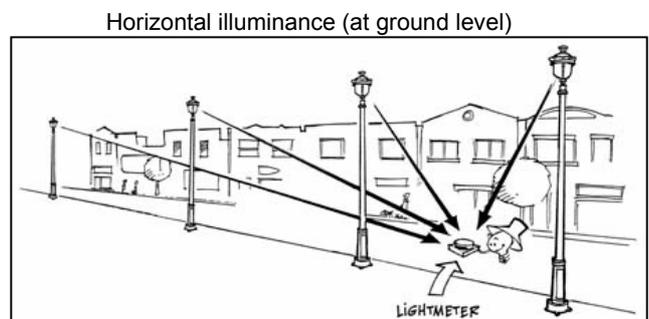
*By analogy, the water flowing through a hole in a shower head.*

#### Illuminance - lux (lumens/m<sup>2</sup>)

Average quantity of light that reaches a surface. Illuminance is measured in **lux** (lumens/m<sup>2</sup>) or **foot-candles** (lumens/ft<sup>2</sup>).

$$1 \text{ foot-candle} = 10.76 \text{ lux}$$

*Light meters are used to measure illuminance.*



Source: Lumec

## 4. PURPOSE OF REGULATIONS

Because of the problems caused by light pollution on the research capacity and scientific effectiveness of the Mont-Mégantic Observatory, the purpose of outdoor lighting standards is to determine means to control outdoor lighting so as not to create unreasonable obstruction to celestial observation and enjoyment of the night sky. The standards are intended to encourage the use of non-polluting outdoor lighting by regulating the wavelengths emitted by light sources, the percentage of uplight, and the amount of light permitted according to the activity, while also maintaining security and productivity levels, minimizing glare and light trespass, and promoting energy efficient outdoor lighting.

To achieve this, different regulations and recommendations were studied to develop a regulatory framework that encompasses as many objectives as possible. The table below summarizes the impact of the different standards proposed according to the objectives targeted by the regulations.

TABLE 1

The impact of the proposed standard on the targeted objective is... A: very significant B: significant C: somewhat or not significant	Proposed standards			
	Equipment		Quantity of light	Hours of operation
	Light source	Luminaire		
Targeted objectives				
Sky glow	A	A	A	A
Energy savings	A	B	A	A
Light trespass	C	A	B	A
Glare	B	A	B	C

**It is essential to stress the fact that the introduction and application of regulations do not result in an obligation to install lighting!**

### Assessing the need to light...

1. Is it necessary to provide light?
2. For which reasons?
3. How many hours per night?
4. What surface needs to be lit?
5. How much light is needed?

## 5. ENVIRONMENTAL ZONES

In 1997, the *International Commission on Illumination (CIE)*<sup>5</sup> defined four environmental zones as a working base for any new outdoor lighting regulations and the *Illuminating Engineering Society of North America (IESNA)*<sup>6</sup> recommends their use. The environmental zones were first established to protect natural sites such as conservation parks and observatories, but they are also used today to limit the use of night lighting and energy consumption, while improving visual comfort.

The amount of light required for any visual task often depends on the surrounding light. For some tasks, the eye does not need the same level of lighting in a dimly lit environment as it does in a downtown area. For instance, a sign in a rural area only needs a small amount of light to be seen, whereas in a downtown area, the same sign would require much more illuminance to be seen because its environment is already brightly lit. Visual perception is based on the notion of contrast.

The use of environmental zones thus makes it possible to establish different standards according to the nature of the activities related to certain regions, cities or villages. Zone E1, as defined by the CIE, was established to protect astronomy sites or natural environments. The Mont-Mégantic region is affected by a specific problem. The protection areas were defined according to light pollution studies conducted in the region. Because of a 50% contribution to light pollution, the 0-25 km zone is thus considered to be an E1 environmental zone. The other surrounding municipalities, those in the 25-50 km zone around the Observatory, are classified as E2, while the city of Sherbrooke is classified as E3.

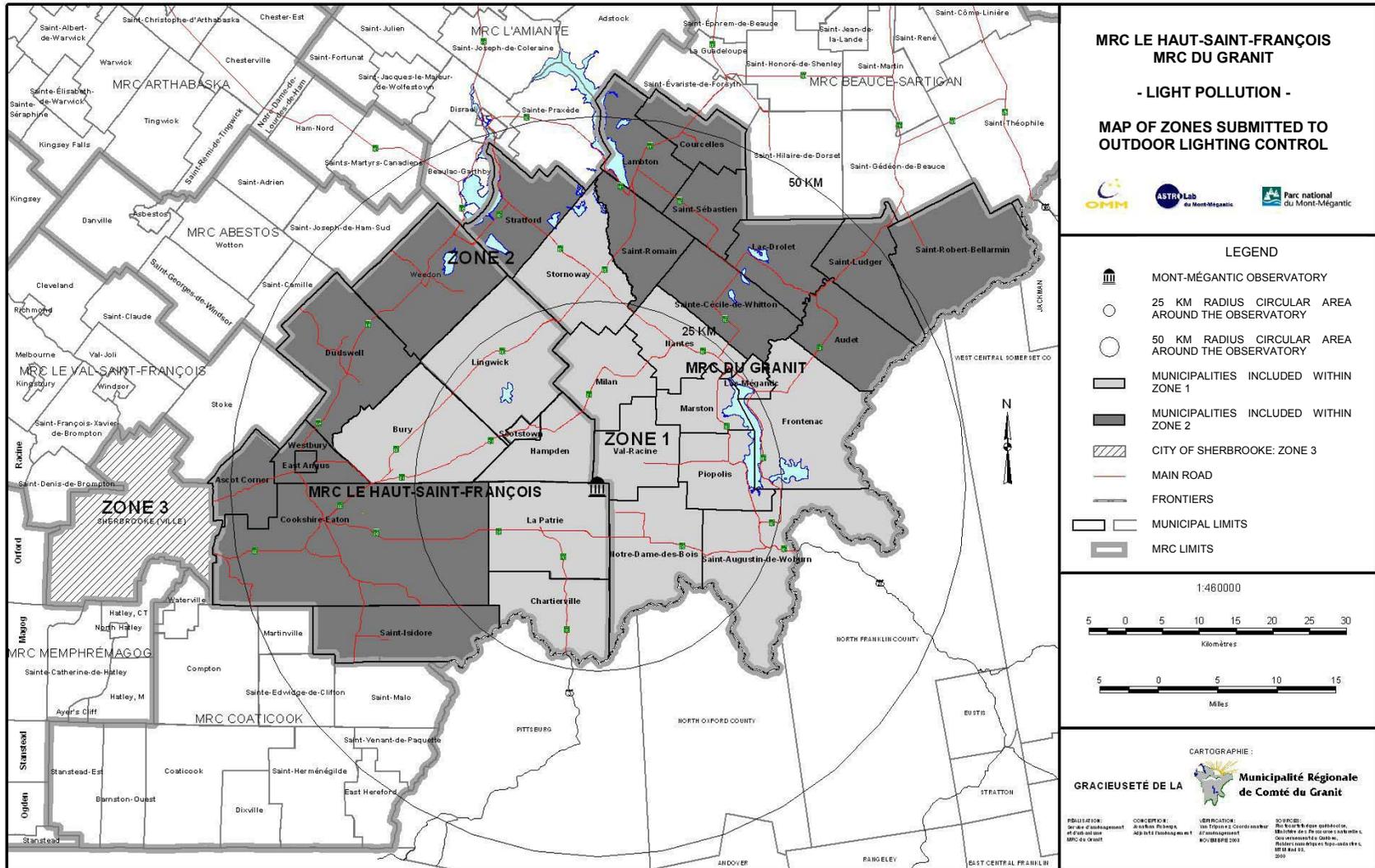
**TABLE 2**  
ENVIRONMENTAL ZONES

		CIE Description	Municipalities
<b>ENVIRONMENTAL ZONES</b>	1	Intrinsically dark areas Astronomical observatory and conservation parks protection areas Residential sectors where controlling light trespass is important	<u>0-25 km around the Observatory</u> Mont-Mégantic National Park Bury, Chartierville, Frontenac, Hampden, Lac-Mégantic, Marston, Milan, Nantes, Notre-Dame-des-Bois, La Patrie, Scotstown, Stornoway, Val-Racine, Piopolis, Woburn
	2	Moderate brightness areas Rural areas Residential sectors far from urban centres	<u>25-50 km around the Observatory</u> Ascot Corner, Audet, Cookshire-Eaton, Courcelles, Dudswell, East Angus, Lac-Drolet, Lambton, Saint-Isidore, Saint-Cécile-de-Whitton, Saint-Ludger, Saint-Romain, Saint-Sébastien, Stratford, Weedon, Westbury
	3	High brightness areas Commercial sectors Urban residential sectors	Sherbrooke

<sup>5</sup> CIE, "Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations", Report of committee TC5.12, Obtrusive light.

<sup>6</sup> RP-33-99, Lighting for Exterior Environments.

**MAP OF ENVIRONMENTAL ZONES AROUND THE OBSERVATORY**



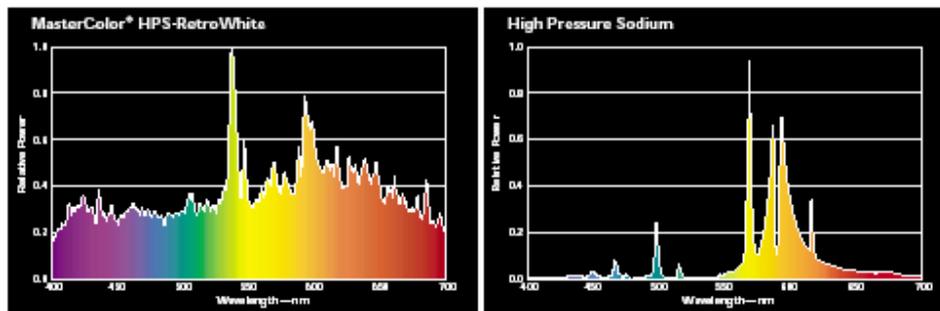
## 6. STANDARDS FOR REQUIRED EQUIPMENT

### 6.1 Light sources

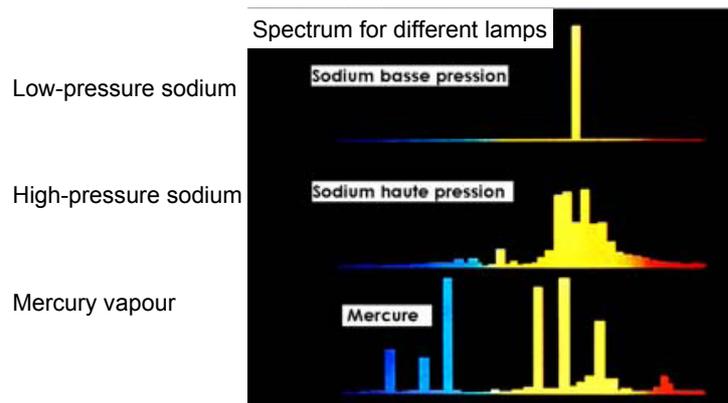
The visible spectrum of light emits wavelengths ranging from ultraviolet to infrared. The intensity of each of these wavelengths varies between light sources.

For instance, the visible spectrum for:

- Low-pressure sodium lighting is monochromatic. It emits a single wavelength in the yellow range.
- High-pressure sodium lighting emits primarily in the yellow range and very slightly in the blue and red ranges.
- Mercury, metal halide and fluorescent lighting emit all types of wavelengths.



Source: Philips



Source: International Dark Sky

## Why limit the use of white light sources?

### White light sources

Mercury vapour, metal halide, incandescent, halogen, compact fluorescent, fluorescent, induction

### Yellow light sources

Low-pressure sodium and high-pressure sodium

The most harmful light sources for observing stars (white lights) often have a higher energy cost and a greater impact on human health and the ecosystem, hence the benefit of adopting regulations to limit the use of certain ones. However, for some applications where the colour of objects is important for safety or esthetic reasons (sports fields, signs, hospital emergency areas, etc.), white lights do provide better colour rendering.<sup>7</sup>

### Astronomy aspect

A white light emits more blue wavelengths into the atmosphere than a so-called "yellow" light. Because blue wavelengths have an impact that is two to four times greater than yellow ones on the brilliance of the sky, they are more harmful for celestial observation. In addition, it is better to have monochromatic light sources (one wavelength), such as low-pressure sodium, close to an observatory since it is easier to filter them out during observations.

### Energy aspect

For a light source to appear white, it must contain all the colours in the visible spectrum. The human eye is much more sensitive to wavelengths associated with yellow than those associated with blue. Since the eye is less sensitive to blue, the light source must therefore produce a greater amount of blue to obtain the whiteness that is desired. Therefore, for the same quantity of light, several white light sources are less energy efficient than those that emit primarily yellow wavelengths. However, technologies to produce light are constantly improving and the general statement that white lights are less efficient is not always true. The arrival of compact fluorescent lamps and light emitting diodes (LED) are good examples of this.

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<sup>7</sup> See the definition for "colour rendering index".

The following table summarizes the main comparison elements for evaluating the advantages and disadvantages of each of the commonly used light sources.

TABLE 3

Comparison criteria	Light sources								
	Low-pressure sodium (LPS) <sup>8</sup>	High-pressure sodium (HPS) <sup>10</sup>	Metal halide (MH) <sup>10</sup>	Fluorescent <sup>10</sup>	Induction	Mercury vapour <sup>10</sup>	Incandescent	Halogen	Compact fluorescent
Efficiency (Lumen/watt)	100 to 200	57 to 135	43 to 135	42 to 92	47 to 65	15 to 60	13 to 18	15 to 25	50 to 80
Lifetime (hours)	10,000 to 18,000	12,000 to 24,000	10,000 to 15,000	10,000 to 24,000	100,000	12,000 to 24,000	1,000 to 2,000	1,000 to 4,000	6,000 to 20,000
Colour rendering index (CRI)	None 0	Poor 22	Good 65 to 80	Good 70 to 90	Good 80	Average 50	Good 100	Good	Good 80
Lumen depreciation (%)	0	10	25	15	20	50	10	-	15

High-pressure sodium



Low-pressure sodium



Incandescent



Compact fluorescent



The table shows that low and high-pressure sodium light sources are more energy efficient, they have a longer lifetime and low lumen depreciation over time. The standards for zones 1, 2 and 3 are proposed in order to preserve the quality of the night sky and to promote the use of more energy efficient light sources. The standards are thus intended to encourage the use of low or high-pressure sodium sources and to tolerate white light sources only for specific applications. In addition, it would be pertinent to limit (but not ban) the lumens emitted by halogen and incandescent sources because they are not very efficient and emit undesirable wavelengths. Nevertheless, since they are very common for small applications, their use cannot be avoided.

<sup>8</sup> Efficiency does not include loss in the ballast.

## RECOMMENDED STANDARDS FOR LIGHT SOURCES

TABLE 4

ENVIRONMENTAL ZONES	Yellow light sources		White light sources		
		High-pressure sodium, Standard low-pressure sodium, Amber diode	Metal halide, Induction, White diode, High-pressure sodium with corrected colour rendering	Fluorescent, Neon	Incandescent, Halogen (Quartz), Compact fluorescent
1	No restriction	Accepted only for: - outdoor sales areas - signs - sports fields	Banned	Accepted if $\leq 1,000$ lumens	Banned
2	No restriction	Accepted only for: - outdoor sales areas - signs - sports fields	Accepted only for illuminated signs	Accepted if $\leq 1,500$ lumens	Banned
3	No restriction	Accepted only for: - outdoor sales areas - signs - sports fields - building fronts	Accepted only for illuminated signs and building fronts	Accepted if $\leq 2,000$ lumens	Banned

## 6.2 Luminaires

Choosing the proper luminaire is an essential step in meeting the objectives of the regulations, which are to deal with sky glow, glare, light trespass and energy efficiency. Different types of luminaires are suitable for different applications. Primarily, there are functional or decorative luminaires for large areas (roadways, parking lots, etc.), wall packs and floodlights.

Functional, roadway



Decorative, large area



The luminaire's design, which is called the luminaire's photometry, determines its ability to direct the light produced by the light source to where it is desired.

The **photometric report**<sup>9</sup> is an analysis of the luminaire's luminous flux distribution and provides a variety of information. Among other things, a photometric report includes:

Wall pack



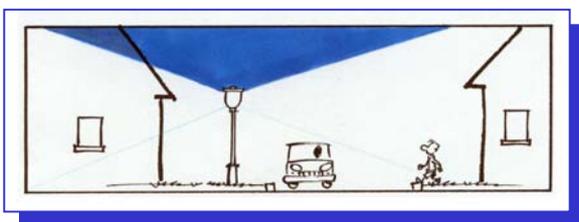
- The luminaire's efficiency (percentage of light emitted upward, downward, house side, street side);
- IESNA<sup>10</sup> classification on the type of light distribution pattern (Type I to V);
- IESNA cutoff classification (full cutoff, cutoff, semi-cutoff, non-cutoff).

The illustrations below show the resulting impact of two different luminaires, with two different photometries.



Source: Lumec

In this case, the luminous flux is well controlled and provides good visibility while minimizing the loss of light upward and towards houses.



Source: Lumec

The second case shows that the luminaire has very little control of the luminous flux as the light is emitted in all directions. In short, this is a situation to be avoided for energy reasons, to respect privacy and to preserve the night sky!

<sup>9</sup> See Appendix B for different standard photometric reports.

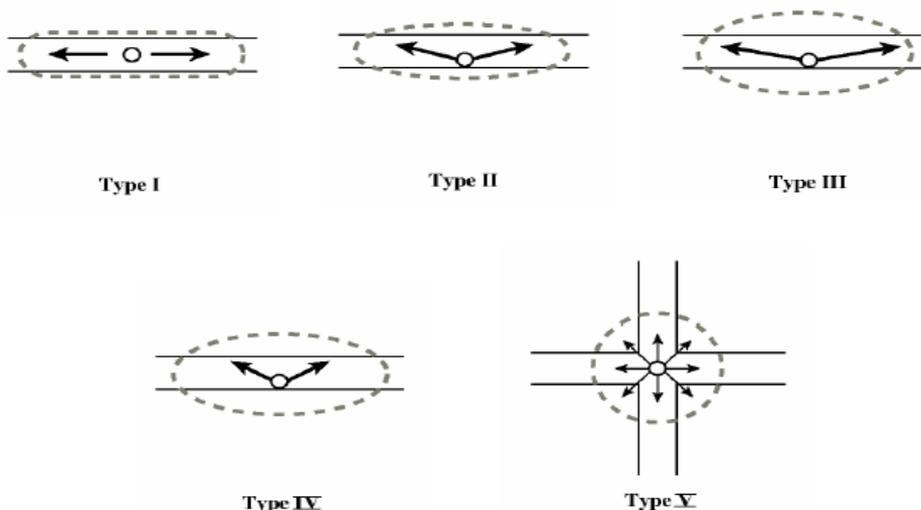
<sup>10</sup> Illuminating Engineering Society of North America.

## What is luminaire efficiency?

Luminaire efficiency indicates the percentage of lumens emitted by the luminaire compared with the initial lumens emitted by the light source. A light source of 6,000 lumens in a luminaire with a total efficiency of 60% means that 3,600 lumens are used for lighting. However, for this efficiency, a distinction must be made between the percentage of light directed downward and the percentage directed upward. Thus, a luminaire with a total efficiency of 60% that emits 15% of the lumens upward really only uses 45% of the lumens to light downward.

Many luminaires emit a large percentage of their light directly upward or beyond the surfaces concerned, thereby lighting more than is really needed. Directing light beyond the surfaces concerned and exceeding real lighting needs results in overlighting and increases the quantity of light reflected from the ground upward. Hence the advantage of choosing a luminaire that can control the light according to real needs. The IESNA proposes a classification according to the type of downward light distribution.

### IESNA classification of light distribution pattern for outdoor luminaires

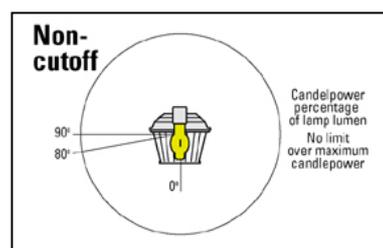


## What is the IESNA cutoff classification?

The IESNA proposes a classification for luminaires according to a maximum intensity (candelas) equivalent to a percentage of the luminous flux (lumens) emitted above the horizontal and in the glare zone. Contrary to popular belief, the primary goal of this classification is not to determine the quantity of light emitted above the horizontal, but to control glare.<sup>11</sup> Below are the four definitions for the cutoff classifications (non-cutoff, semi-cutoff, cutoff and full cutoff), and the percentage of lumens emitted above the horizontal for each of these classifications.

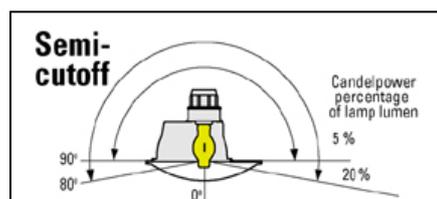
### Non-cutoff luminaires

- No restriction on the % of luminous flux emitted above the horizontal and in the glare zone.



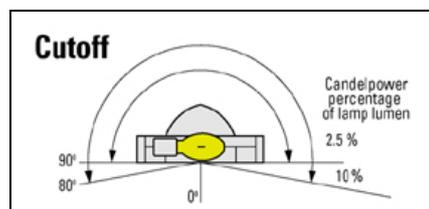
### Semi-cutoff luminaires

- **0% to 31% of luminous flux emitted upward.**
- Intensity (candela) <5% of luminous flux (lumen) emitted above the horizontal.
- Intensity (candela) <20% of luminous flux (lumen) emitted between 0° and 10° below the horizontal.



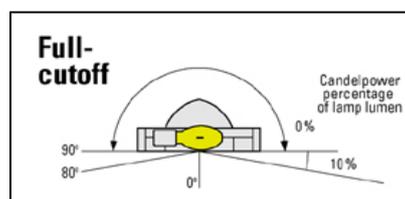
### Cutoff luminaires

- **0% to 16% of luminous flux emitted upward.**
- Intensity (candela) <2.5% of luminous flux (lumen) emitted above horizontal.
- Intensity (candela) <10% of luminous flux (lumen) emitted between 0° and 10° below horizontal.



### Full cutoff luminaires

- **No luminous flux emitted above the horizontal.**
- Intensity (candela) <10% of luminous flux emitted between 0° and 10° below the horizontal.



Thus, a luminaire can be classified as semi-cutoff and not emit any lumens above the horizontal. Conversely, a cutoff luminaire can emit up to 16% of its lumens above the horizontal.

<sup>11</sup> The percentage of lumens emitted above the horizontal is what should be considered. The data are usually provided in the photometric report, but some luminaire models do not provide this information.

Although many regulations favour the use of full cutoff luminaires only, it has nevertheless been shown that this is not always the best option for energy efficiency or the quality of lighting design. The standards proposed in the table below tolerate up to 2.5% of light being emitted above the horizontal to encourage the use of luminaires that offer both good control of luminous flux and good efficiency.

*It is thus better to control the percentage of light emitted upward using the luminaire's photometric report indicating the percentage of lumens emitted above the horizontal (% upward or uplight) than the IESNA classification.*

*Only the full cutoff classification gives exact information regarding the percentage of light emitted above horizontal, which is 0%!*

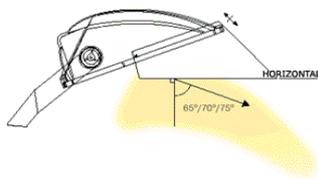
### Using floodlights

Floodlights are luminaires that can be adjusted to the desired angle. These lighting fixtures are often poorly used and direct a large quantity of light directly upward or beyond the areas to be lit.

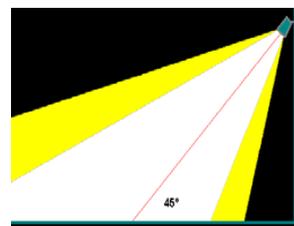
Whether floodlights are for lighting building fronts, signs, sports fields or other large areas, they should be used in such a way as to limit the needless loss of light. Consequently, the luminous flux must be projected downward either by pointing the floodlights adequately below the horizontal or by attaching internal or external shielding.

The luminous flux emitted by a floodlight can be concentrated into a beam that can vary from 10° to 100°. It is primarily for this reason that it is difficult to enforce a maximum tilt angle when the use of floodlights is required. To light large areas, manufacturers should be consulted to ensure that the floodlights comply with the standard for the percentage of light emitted above the horizontal by using the appropriate tilt.

Floodlight with shielding



Appropriate angle for floodlight

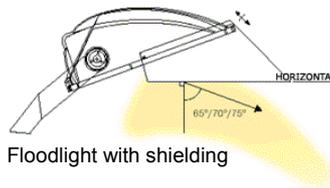


## RECOMMENDED STANDARDS FOR LUMINAIRES

### 1.0 All luminaire installations must:

- 1.1 In Zone 1: emit less than 1% of luminary flux above the horizon, as certified by the photometric report, and or;  
In Zones 2 and 3: emit less than 1% of luminary flux above the horizon or, if the luminaire is mounted lower than 5 m, emit less than 2.5% of luminary flux above the horizon, as certified by the photometric report, and/or;
- 1.2 Be classified as IESNA full cutoff, and/or;
- 1.3 Have a flat lens, and/or;
- 1.4 Have shielding that entirely shields the luminary source, and/or;
- 1.5 Be installed directly below overhanging areas (eaves, balconies, roof projections, etc.) of a building.

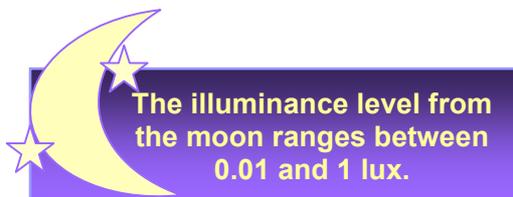
2.0 Floodlights must not be tilted at an angle that is greater than 15° above the horizon or, if the tilt is greater than that angle, they must have internal and external shielding to ensure they comply with the percentage of light emitted above the horizontal.



## 7. STANDARDS FOR LIGHT QUANTITY

### 7.1 Horizontal illuminance

Horizontal illuminance is the quantity of light that reaches the ground. The IESNA recommends minimum illuminance levels for certain applications, but since the IESNA standards are not included in any codes or regulations, the developers or designers of new facilities can do as they please when it comes to planning lighting.



In addition, illuminance levels are not always established according to the surrounding light environment, hence the advantage of defining them according to the environmental zone, like the *California Energy Commission* (CEC) does in the development of new outdoor lighting standards entitled "Title 24 Standard." Since the primary purpose of the new California standards is energy efficiency, they are based on a wattage limit per unit of surface ( $\text{watt}/\text{ft}^2$ ). The preliminary study entitled "Outdoor Lighting Research" made it possible to validate the impact of the  $\text{watt}/\text{ft}^2$  limits on the levels of illuminance obtained according to the different lighting applications encountered. This work also inspired the Modeling Lighting Ordinance (MLO), a major working group reporting to the *International Dark Sky Association* that includes the best lighting specialists in the United States.

According to these draft regulations, none of the lighting applications should exceed the prescribed average illuminance level. However, to simplify enforcement of the regulations, some of these applications can also be considered based on a  $\text{lumen}/\text{m}^2$  limit that is equivalent to the one prescribed by the California standards. Since the primary objective of the present guide is to limit light pollution and not just improve energy efficiency, the  $\text{watt}/\text{ft}^2$  limits were translated into the  $\text{lumens}/\text{m}^2$  limits contained in the MRC du Granit draft regulations found in Appendix A.

Limiting the quantity of light downward makes it possible to minimize energy costs and the quantity of light reflected upward from the ground to the sky or to our homes. However, it is important to note that for some applications, such as the lighting of footpaths or streets with many pedestrians, vertical illuminance and uniformity are just as important to ensure proper visibility. Lighting designers must pay attention to these technical aspects to ensure the resulting quality of the lighting.

*The "point-by-point" calculation method makes it possible to approve the compliance of proposed illuminance levels before the lighting is installed.*

*Once the lighting fixtures are in operation, a field check is done using a **light meter**.*

## What is a point-by-point calculation?

Point-by-point illuminance calculations evaluate the quantity of light that reaches a horizontal or vertical plane at different points on the lit surface. The calculations are completed and provided by the manufacturers, professional lighting specialists or manufacturers' agents upon request.

In addition to being a tool to verify the compliance of illuminance levels, the calculations make it possible to analyze the quality of the proposed lighting design by supplying other information such as uniformity, minimum and maximum illuminance points, etc.

*Illuminance calculations must be done taking only the surface to be lit into account.*

For instance, when calculating the illuminance for a footpath, the calculation surface is the path itself, and not the surrounding grassy areas. This does not mean that there can be no light beyond the path, but the levels are set taking the actual surface into account, which is the footpath in this case.

For the point-by-point method to be realistic, the **average maintained illuminance** must be considered in the calculations and not the initial illuminance. The average maintained illuminance is calculated by applying a **maintenance factor** or **light loss factor** (LLF) to the initial illuminance level that takes various significant elements into account, such as lumen depreciation, sealing of the luminaire, the dirt accumulation factor of internal and external parts, ballast quality, etc.

*As a general rule, a maintenance factor of 0.72 is used for metal halide sources, and 0.8 for high-pressure sodium sources.*

## Field inspection

Once the work has been completed, a field inspection is necessary to check the compliance of the illuminance calculations that were approved. For this task, a **light meter** is used to measure the initial illuminance level on the ground.

The process involves determining whether the points in the point-by-point calculation match the ones measured on the lit surface. However, the initial level measured in the field must be reduced by the established maintenance factor so that the field data can be compared with the data resulting from the maintained illuminance calculation.



### Example of a point-by-point calculation

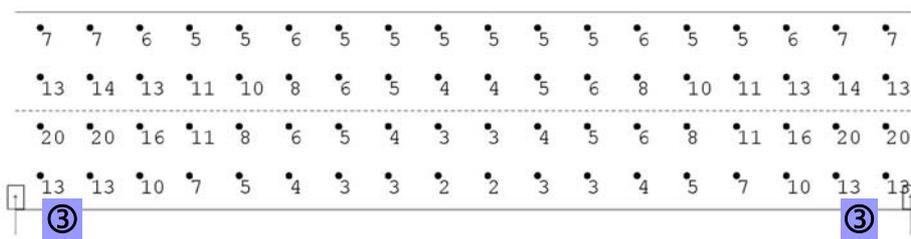
The following data should appear in a point-by-point calculation:

- Location of buildings and delimitation of lit surfaces;
- Average, minimum and maximum maintained illuminance level on the ground<sup>12</sup>  $E_{moy}$ ,  $E_{min}$ ,  $E_{max}$  ①;
- Uniformity of lighting (illuminance ratios)  $E_{moy} / E_{min}$  ②;
- Arrangement of luminaires ③;
- Length of luminaire arms, lumen, cutoff classification, light loss factor used, etc. ④;
- Spacing between luminaires, mounting height ⑤;
- Light source power ⑥.

#### Street Section

### Street - Horizontal illuminance

⑤ Street: 8 m  
Spacing : 36 m  
Height: 7.5 m



Luminaire Schedule								
Project: All Projects								
Symbol	Qty	Label	Lumens	LLF	Description	Arm	IES Class	Cutoff Class
	2	L1	6400	0.800	HÉLIOS-HBS-MC3-70-SHP	1.5	Type III	Cutoff

Numeric Summary						
Project: All Projects						
Units	Avg	Max	Min	Avg/Min	Max/Min	# Pts
Lux	8.00	20	2	4.00	10.00	72

<sup>12</sup> When necessary, the vertical illuminance may be requested as well.

## RECOMMENDED STANDARDS FOR ILLUMINANCE LEVELS

TABLE 5

<b>Maximum values for average maintained illuminance levels for the main applications<sup>13</sup> concerned</b>			
<b>Applications</b>	<b>Environmental Zones</b>		
	<b>1 Lux</b>	<b>2 Lux</b>	<b>3 Lux</b>
Outdoor sales area			
All outdoor sales areas (garden centre, materials, etc.)	30	40	60
Display row for automobile dealerships	50	75	100
Storage area	10	10	15
Unloading, handling or work area	30	40	50
Pedestrian, cyclist area	4	6	6
Building entrance	30	40	30 to 50 <sup>19</sup>
Street (for R <sub>2</sub> and R <sub>3</sub> reflecting surfaces) <sup>14</sup>			
All residential	4	6	6
Urban residential <sup>15</sup>	6	8	8
Village commercial <sup>16</sup>	8	10	12
Urban commercial	10	12	17
Industrial	6	6	9
<b>All streets located outside of the urban perimeter should not be lighted, except for crossroads</b>			
Outdoor parking	10	15	10 to 25 <sup>17</sup>
Service station			
Pumping area	30	50	100
Peripheral area (or other surface under a canopy)	15	20	30
Sports area (recreational and amateur use)			
Rink, soccer, football	75	75	NA
Tennis	100	100	NA
Other sports or professional use	IESNA base standard to a maximum of 150 lux	IESNA base standard	NA

<sup>13</sup> Other applications are covered only with respect to lumens per m<sup>2</sup> of surface, such as signs or landscape/decorative lighting. See Appendix A.

<sup>14</sup> The data for zone 3 for Sherbrooke are for information purposes only as the levels will be defined more precisely according to the use of the street and the type of traffic on it.

<sup>15</sup> Considered urban residential if the ratio of dwellings per hectare is greater than 40.

<sup>16</sup> Any agglomeration with less than 5,000 inhabitants is defined as "village."

<sup>17</sup> Defined according to usage and the frequency of night visits.

## 7.2 Controlling light trespass

Using adequate luminaires and illuminance levels indirectly controls light trespass. However, since it is useful to have criteria to evaluate and measure light trespass, the CIE issued a standard for admissible light trespass at property boundaries. Vertical illuminance is the light that reaches a vertical surface, and light trespass is the light that would shine through an imaginary window or wall at the boundary of a property.

Using a standard specifically for controlling light trespass gives citizens the opportunity to minimize undesirable light on their property and also forces lighting specialists and developers to pay special attention to this aspect when developing design criteria. However, this standard was not used for the regulations in Appendix A since it can sometimes be complex to apply, especially when it comes to determining the origin of the source of light trespass (commercial lighting, street, neighbours, etc.). Nevertheless, it can certainly be used as a reference to evaluate a given situation and could be required for the point-by-point calculations.

TABLE 6  
*Recommended Standards for Light Trespass*

ENVIRON- MENTAL ZONES	Maximum illuminance in lux measured vertically at a height of 1.5 m, at the boundary of a property*	
	During operating hours	After operating hours
	1	1
2	4	1
3	8	2

\* Except light from roadway lighting

## 8. STANDARDS FOR OPERATING HOURS

Regardless of the application, it is better when lighting fixtures are equipped with control systems to limit their hours of operation, thereby reducing electricity consumption and the level of light pollution for a large part of the night – when astronomers are the most active! There is no reason for a lighting fixture to remain on all night when it is not useful for anyone, hence the concept of a curfew (from *couvre-feu*, or "cover the fire").

### RECOMMENDED STANDARDS FOR OPERATING HOURS

1. *All lighting fixtures, including signs, shall be turned off at 10:00 p.m. (in zones 1 and 2) or 11:00 p.m. (in zone 3), or outside business or operating hours.*
2. *Any lighting fixtures used for security (lighting in storage areas, streets, public pedestrian areas or building entrances) are exempt from point 1.*
3. *Outdoor sales area, unloading, handling or work areas shall be illuminated at the level prescribed for storage areas outside business or operating hours, or shall reduce their lighting by 75%.*

## 9. DEFINITIONS

### **Average initial illuminance**

Average illuminance level obtained over an entire surface before applying the maintenance factor. Illuminance level obtained when lighting fixtures are first put into operation.

### **Average maintained illuminance**

Average illuminance level obtained when the maintenance factor is applied in the point-by-point calculation to evaluate the decrease in illuminance over time. Maintained illuminance thus provides a better approximation of the actual level that will be obtained a certain time after lighting fixtures are put into operation.

### **Colour rendering index (CRI)**

An index that makes it possible to evaluate a light source's ability to correctly render the colour of objects/surfaces it is lighting. A CRI of "0" means that the source is monochromatic (one wavelength) and that it does not render colour well: all the objects will have the same hue as the source. A CRI approaching "100" means that all the colours are rendered well: blue appears blue, yellow appears yellow, etc.

### **Floodlight**

A luminaire that can be aimed at a desired angle.

### **Horizontal illuminance**

Average quantity of light that reaches a horizontal surface, generally the ground.

### **Lumen depreciation**

The luminous flux (lumens) of a light source decreases over time. This value is generally provided by manufacturers at the mid-point in a lamp's lifetime.

### **Luminaire**

A lighting unit that includes a light source, with or without ballast, integrated into the various parts used to distribute the light, direct it and protect the light source, as well as provide the required electric power.

### **Light meter**

A device used to measure the illuminance level at a point, in lux or foot-candles, on a plane surface.

### **Light source (i.e. lamp)**

Source of artificial light, protected by a bulb that can be of various shapes, and powered by an electric current.

### **Maintenance factor**

The factor applied to a luminaire in illuminance calculations to evaluate the maintained illuminance. The maintenance factor takes various elements into account that have an impact on the quantity of light emitted: lumen depreciation over time, dustiness of the luminaire (depending on the luminaire's seal), ballast losses, etc.

**Maximum illuminance**

Maximum illuminance level at a point on a lit surface.

**Minimum illuminance**

Minimum illuminance level at a point on a lit surface.

**Point-by-point illuminance calculation**

Calculation method for determining the quantity of light, in lux or foot-candles, that reaches a horizontal or vertical plane at different points on the lit surface. The calculations are done by manufacturers, engineers or technicians specializing in lighting or manufacturers' agents, and are supplied on request.

**Photometric report**

A report issued by an independent photometric laboratory describing the luminous flux distribution (efficiency, percentage of lumens emitted upward, distribution of candelas in the horizontal and vertical planes) and other characteristics of the luminaire.

**Shield**

Screen affixed to the external or internal parts of a luminaire to limit the undesired loss of light.

**Shielding**

Top part of a luminaire designed to limit the emission of direct uplight. The shielding must be larger than the diameter of the light source it is covering and must partly cover it up..

**Vertical illuminance**

Average quantity of light that reaches a vertical surface, such as the light that reaches a wall or a pedestrian.

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# APPENDIX A

## Draft Regulations



## LIGHT POLLUTION ABATEMENT PROJECT FOR THE MONT-MÉGANTIC REGION

### Outdoor Lighting Draft Regulations

#### PROVISIONS FOR THE CONTROL OF OUTDOOR LIGHTING (LIGHT POLLUTION)

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Yan Triponez, Urban Planner, Land-use Planner, MRC du Granit

**February 2006**

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## PROVISIONS FOR THE CONTROL OF OUTDOOR LIGHTING (LIGHT POLLUTION)

### 1. Units of measure and definitions

#### 1.1. Units of measure

**Illuminance – lux (lumens/m<sup>2</sup>):** Average quantity of light that reaches a surface. Illuminance is measured in **lux** (lumens/m<sup>2</sup>) or **foot-candles** (lumens/ft<sup>2</sup>). 1 foot-candle = 10.76 lux.

**Luminous flux – Lumen (lm):** Total amount of light emitted in all directions by a light source. Luminous flux is measured in **lumens (lm)**. One 100-watt incandescent bulb emits 1,500 lumens. *By analogy, the flow of water from a shower head.*

#### 1.2. Definitions

**Building entrance:** The largest surface between either:  
- 2.5 m in front of the doors and 1 m on either side of the doors; or  
- the surface under the canopy.

**Commercial display area:** Outdoor surface where merchandise (automobiles, various materials, garden centre, etc.) intended for immediate sale is displayed for viewing by customers.

**Floodlight:** A luminaire that can be aimed at a desired angle.

**Horizontal illuminance:** Average quantity of light that reaches a horizontal surface, generally the ground.

Average initial illuminance: Average illuminance level obtained over a surface before applying the maintenance factor. Illuminance level obtained when lighting fixtures are first put into operation.

Average maintained luminance: Average illuminance level obtained on a surface and over time. Illuminance level obtained when the maintenance factor is applied in the point-by-point calculation to anticipate the decrease in illuminance over time. Maintained illuminance thus provides a better approximation of the actual level obtained a certain time after lighting fixtures are put into operation.

**Illuminated sign:** Sign designed to emit an artificial light through a translucent surface using a light source placed inside the sign and having one or more translucent walls.

**Light source** (i.e. lamp): Source of artificial light, protected by a bulb that can be of various shapes, and powered by an electric current.

**Loading/unloading, handling or work area:** Outdoor surface where manual tasks are performed regularly or where a large number of loading/unloading vehicles are constantly in operation. It includes, but is not limited to, access to garage doors, delivery areas, loading platforms, stacked storage of goods, and storage of hazardous materials.

**Lumen depreciation:** Luminous flux (lumens) reduction factor of a light source at the mid-point in a lamp's lifetime.

**Luminaire:** A lighting unit that includes a light source, with or without a voltage regulator (ballast), integrated into the various parts used to distribute the light, direct it and protect the light source, as well as provide the required electric power.

**Maintenance factor:** Factor applied to a luminaire in illuminance calculations to evaluate the maintained illuminance. The maintenance factor takes various elements into account that have an impact on the quantity of light emitted: lumen depreciation over time, dustiness of the luminaire, ballast losses, etc.

**Pedestrian area:** Sidewalks, public places, rest areas, staircases, ramps, footpaths, bicycle paths.

**Photometric report:** A report issued by an independent photometric laboratory describing the luminous flux distribution (efficiency, percentage of lumens emitted upward, distribution of candelas in the horizontal and vertical planes) and other characteristics of the luminaire.

**Point-by-point illuminance calculation:** Calculation method for determining the quantity of light, in lux or foot-candles, that reaches a horizontal or vertical plane at different points on the lit surface. The calculations are done by manufacturers, engineers or technicians specializing in lighting, or manufacturers' agents, and are supplied on request.

**Reflection-illuminated sign:** Sign that is entirely illuminated by a light source located outside the sign.

**R1, R2, R3, R4 reflective surface:** Property related to the ability of a surface to reflect light. R2 and R3 surfaces are normally used for roadway lighting calculations.

R1: Diffuse reflection: rough surface, concrete or cement surface.

R2: Diffuse and specular reflection: moderately smooth asphalt.

R3: Slightly specular reflection: typical highway asphalt.

R4: Specular reflection: asphalt with a very smooth surface.

**Service station pumping area:** Surface under the canopy, or if there is no canopy, a surface of 50 m<sup>2</sup> on either side of the gas pumps.

**Shielding:** Top part of a luminaire designed to limit the emission of direct uplight. The shielding must be larger than the diameter of the light source it is covering and must partly cover it up.

**Storage area:** Outdoor surface where various goods are stored, or manual tasks are occasionally performed, and/or where loading/unloading vehicles operate on occasion. Lighting in a storage area ensures the security of goods and equipment, while allowing pedestrians and vehicles to circulate freely. It includes, but is not limited to, handling decks, storage for goods not intended for immediate sale, peripheral lanes around the loading/unloading, and handling or work areas.

**Shield:** Screen affixed to the external or internal parts of a luminaire to limit the undesired loss of light.

## 2. Purpose of regulations

Because of the problems caused by light pollution on the research capacity and scientific effectiveness of the Mont-Mégantic Observatory, the purpose of outdoor lighting standards is to determine means to control outdoor lighting so as not to create unreasonable obstruction to celestial observation and enjoyment of the night sky. The standards are intended to encourage the use of non-polluting outdoor lighting by regulating the wavelengths emitted by light sources, the percentage of uplight, and the amount of light permitted according to the activity, while also maintaining security and productivity levels, minimizing glare and light trespass, and promoting energy efficient outdoor lighting.

Application of the standards is determined according to the proximity of lighting installations to the Mont-Mégantic Observatory. Three environmental zones are subject to the standards concerning outdoor lighting in order to create a night sky reserve in the Mont-Mégantic area.

## 3. Area of application

To apply these provisions, the environmental zones for the MRC du Haut-Saint-François area are made up of the following municipal areas:

Environmental zone 1: Bury, Chartierville, Eaton, Hampden, La Patrie, Lingwick, Scotstown.

Environmental zone 2: Ascot Corner, Cookshire, Dudswell, East Angus, Saint-Isidor, Weedon, Westbury.

## 4. Required lighting equipment

### 4.1. Light sources

All light sources used for outdoor lighting must meet the standards in Table 2.

**TABLE 2: Accepted light sources based on the visible spectrum emitted**

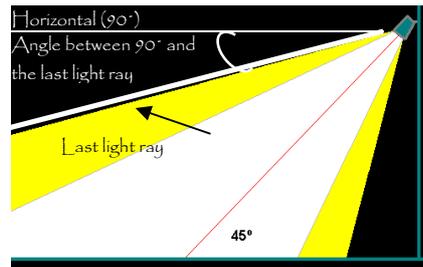
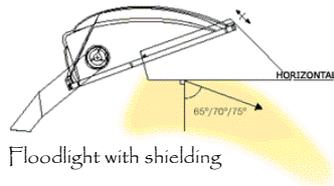
		<b>YELLOW LIGHT SOURCES</b> or emitting primarily yellow, orange or red wavelengths	<b>WHITE LIGHT SOURCES</b> or emitting a significant percentage of blue/green wavelengths				<b>OTHERS</b>	
		Standard high-pressure sodium (1), Low-pressure sodium, Amber, red or orange diodes	Metal halide, Induction, Diodes, High-pressure sodium with corrected colour rendering	Fluorescent	Neon	Incandescent, Halogen (Quartz), Compact fluorescent, white diodes (2)	Mercury vapour	Laser, Searchlight
<b>ENVIRONMENTAL ZONE</b>	1	No restriction	Accepted only for: – commercial display areas; – signs; – sports fields.	Banned	Accepted only for sign lettering	Accepted if $\leq 1,000$ lumens (3)  Equivalence: Inc. /Hal.: 60 watts Compact fluo.: 9 watts	Banned	Use of a laser light ray or any similar light for advertising or entertainment is banned when projected horizontally. Searchlight operation for advertising purposes is banned.
	2	No restriction	Accepted only for: – commercial display areas; – signs; – sports fields.	Accepted only for illuminated signs	Accepted only for illuminated signs	Accepted if $\leq 1,500$ lumens (3)  Equivalence: Inc. /Hal.: 100 watts Compact fluo.: 13 watts	Banned	Use of a laser light ray or any similar light for advertising or entertainment is banned when projected horizontally. Searchlight operation for advertising purposes is banned from 10:00 p.m. to sunrise.
<p>(1) High-pressure sodium with corrected colour rendering (tending to white) is not permitted because of the percentage of wavelengths emitted in the blue/green range.            (2) For small power, white diodes are acceptable.            (3) Lumen restriction does not apply to reflection-illuminated signs.</p>								

## 4.2. Luminaires

All luminaire installations must:

- in Zone 1: emit less than 1% of luminary flux above the horizon;
- in Zone 2: emit less than 1% of luminary flux above the horizon or, if the luminaire is mounted lower than 5 m, emit less than 2.5% of luminary flux above the horizon, as certified by the photometric report, and/or;
- be classified as IESNA full cutoff, and/or;
- have a flat lens, and/or;
- have shielding that entirely shields the luminary source, and/or;
- be installed directly below overhanging areas (eaves, balconies, roof projections) of a building.

Floodlights must not be tilted at an angle that is greater than 15° above the horizon or, if the tilt is greater than that angle, they must have internal and external shielding to ensure they comply with the percentage of light emitted above the horizontal.



## 5. Quantity of light permitted

### 5.1. Residential use

Any lighting installation designed for residential use must not exceed 15,000 lumens to light the property.

		Wattage											
		10	15	20	25	35	50	60	70	75	100	150	
L u m e n s	Small sources	Incandescent	50	100	100	200	-	500	800	-	1000	1500	2000
		Halogen	150	-	300	-	-	800	1000	-	1000	1500	2500
		Compact fluo	600	900	1200	1800	-	4300	-	-	-	-	-
	Large sources	HPS	-	-	-	-	2000	4000	-	6400	-	9600	16000
		MH	-	-	-	-	2000	3400	-	5800	-	8000	12000

If the maximum limit in lumens is insufficient for residences with four or more dwellings, standard 5.2 shall apply.

### 5.2. All uses and applications, except residential properties of four or more dwellings

#### 5.2.1. Maximum values of average maintained illuminance levels

Any lighting installation must be set up for a specific application or an equivalent task and must not exceed the standards for illuminance level, in lux, or the equivalent in lumens/m<sup>2</sup>, as stipulated in Table 3.

Any application in which the total quantity of light used exceeds 150,000 lumens must be considered according to the average maintained illuminance levels in lux.

Only the surface for a specific application that is to be lit must be considered, regardless of the standard used (lux or lumen/m<sup>2</sup>).

The limit for the "Miscellaneous use, lighting building fronts, landscaping, driveways, etc." application is established according to the total area in m<sup>2</sup> of the exterior walls of the buildings on the property, regardless of whether the fixture is attached to the building or not.

#### 5.2.2. Limit set in lux and point-by-point calculation requirement

When the standard for the quantity of light permitted is considered using an illuminance level in lux, a point-by-point calculation is required for the standard to be approved and it must contain the following information: the lit surface, the type, number, height and location of luminaires, the light sources used and their nominal wattage, the maintenance factor used, the average initial illuminance level, and the average maintained illuminance level.

### 5.2.3. Limit set in lumen/m<sup>2</sup>

For the standard to be approved when the standard for the quantity of light permitted is considered using a limit of lumens per square metre (lumen/m<sup>2</sup>), the lumens must represent the total lumens emitted by the light sources and the m<sup>2</sup> must represent the surface to be lit for the given application.

TABLE 3: Maximum values for average maintained illuminance levels in lux or the equivalent in lumens/m<sup>2</sup>

USE AND APPLICATIONS	ENVIRONMENTAL ZONES			
	1	2	1	2
	Lux (1)	Lux (1)	Lumen/m <sup>2</sup>	Lumen/m <sup>2</sup>
Commercial display area				
- All commercial areas (garden centre, materials, etc.)	30	40	100	150
- Display row for automobile dealerships	50	75	NA	NA
Storage area	10	10	30	30
Unloading, handling or work area	30	40	100	150
Pedestrian area	4	6	NA	NA
Building entrance	30	40	300	400
Illuminated sign	Banned	NA	Banned	NA
Reflection-illuminated sign	NA	NA	1,500	1,500
Street (for R2 and R3 reflective surfaces)				
- Village residential	4	6	NA	NA
- Village commercial (note 2)	8	10	NA	NA
- Urban commercial	10	12	NA	NA
- Industrial	6	6	NA	NA
<b>- All streets located outside of the urban perimeter should not be lighted, except for crossroads.</b>				
Outdoor parking	10	15	30	40
Service station				
- Pumping area	25	35	NA	NA
- Peripheral area (or other surface under a canopy)	10	15	NA	NA
Sports area (recreational and amateur use)				
- Rink, soccer, football	75	75	NA	NA
- Tennis	100	100	NA	NA
- Baseball: outfield	100	100	NA	NA
- Baseball: infield	150	150	NA	NA
- Other sports or professional use	IESNA base standard (4) to a maximum of 150 lux	IESNA base standard (4)	NA	NA
Miscellaneous use, lighting building fronts, landscaping, driveways, etc.	NA	NA	25 to a maximum of 15,000 lumens per building	
Notes				
NA: Not applicable				
(1) A margin of error of 15% is tolerated when a point-by-point calculation is done.				
(2) Any agglomeration with less than 5,000 inhabitants is defined as "village."				
(3) IESNA: Illuminating Engineering Society of North America, IESNA Lighting Handbook.				

#### 5.2.4. Illuminated signs

To limit glare and excess lighting, illuminated signs must be made of dark-coloured materials like the colours shown in the chart in Appendix A of these regulations. The lettering may be lighter and may not exceed 50% of the total area of the sign.

When the corporate logo is a colour that does not match any of the options on the colour chart, the sign must be reflection-illuminated.

Furthermore, signs must be lit with a minimum spacing of 30.48 cm (1 foot) between each fluorescent lamp.

## 6. **Hours of operation**

Any lighting fixtures used for non-residential applications, including signs, must be turned off at 10:00 p.m. or outside business or operating hours.

Any lighting used for security purposes (lighting for storage areas, streets, public pedestrian areas, building entrances) is exempt from the provisions in the preceding paragraph.

Commercial display and loading/unloading, handling or work areas must comply with the illuminance level set out for storage areas outside business or operating hours, or reduce the quantity of light used by 75%.

## 7. **Exemptions**

The situations below are exempt from these provisions. However, whenever possible, these regulations should be used as guidance for installations:

- The use of motion detectors;
- Light sources emitting less than 150 lumens;
- Temporary decorative lighting for the holiday season between November 15 and January 15;
- Lighting regulated by other provincial or federal regulations, such as lighting for communication towers, airports, etc.;
- Temporary lighting for special activities such as outdoor shows, village festivals, construction sites or other temporary work.

## 8. Minor exceptions (not applicable to the interim control regulations)

Any application or specific use where public safety may be compromised, such as hospital emergency areas, may be declared a minor exception as long as a study conducted by qualified professionals or lighting specialists shows that application of these regulations compromises the safety of property or individuals. These regulations must be used as guidance for installations.

Lighting to enhance building and landscape heritage that does not comply with the standards in these regulations may be declared a minor exception. However, the building must represent a heritage value or a specific architecture, and the landscape must be part of a tourist or cultural route. The enhancement concept must be completed by qualified professionals or lighting specialists and be guided by these regulations.

## 9. Acquired rights

All lighting fixtures existing before these provisions become effective shall have acquired rights. However, any lighting fixture modification, alteration, replacement or addition must comply with the provisions in these regulations.

## 10. Application for a certificate of authorization

### 10.1. Requirement for a certificate of authorization

Any installation of one or more lighting fixtures with a light source that emits more than 4,000 lumens or that reaches a total of 15,000 lumens in a single or several stages must be subject to an application for a certificate of authorization.

### 10.2. Application form

All applications for a certificate of authorization must be submitted in writing to the authority responsible for enforcing these provisions on a form provided by the municipality. The form must be duly completed and signed, and must be accompanied by the following information:

- A detailed description of the lighting fixtures and their locations;
- The nature of the lighting (i.e., use and application);
- The type of light source and nominal wattage;
- The type of luminaire;
- The point-by-point illumination calculation, if applicable;
- The photometric report for the luminaire issued by a certified laboratory, if applicable;
- Any other required or relevant information.

## APPENDIX B

### Extracts from Standard Photometric Reports

# Extract from Standard Photometric Report #1 Roadway Luminaire

**Page 1: General luminaire data**  
(Data concerning the percentage of luminous flux emitted upward are not included.)



IES ROAD REPORT  
PHOTOMETRIC FILENAME : S0104092.IES

## DESCRIPTIVE INFORMATION (From Photometric File)

IESNA LM-63-95  
[DATE] 9 April 2001  
[LABORATORY] Spectralux  
[TEST] S0104092.IES  
[MANUFAC] LUMEC  
[LUMCAT] 150HPS-RN20-THA3-PC  
[LUMINAIRE] Renaissance - Architectural Roadway  
[LAMP] (1) 150W Clear High Pressure Sodium Mogul ED23.5  
[LAMPDETAILS] ANSI S55, 100V, LCL=5.00"  
[BURNING] Tilted Down 15 Deg. (18,000 Lumens)  
[REFLECTOR] Semi-Specular Hydroformed  
[LENS] Prismatic Clear Polycarbonate Acorn  
[HOUSING] Die Cast Aluminum  
[SKTPOSITION] D3  
[DISTRIBUTION] Type III, Medium, SemiCutoff

## CHARACTERISTICS

IES Classification	Type III
Longitudinal Classification	Medium
Cutoff Classification	Semi-Cutoff
Total Rated Lamp Lumens	18000
Maximum Candela	9369
Maximum Candela Angle	70H 75V
Maximum Candela At 90 Degrees Vertical	161 (1.01% Lamp Lms)
Maximum Candela At 80 Degrees Vertical	2356 (14.73% Lamp Lms)
Downward Total Efficiency	62.0%

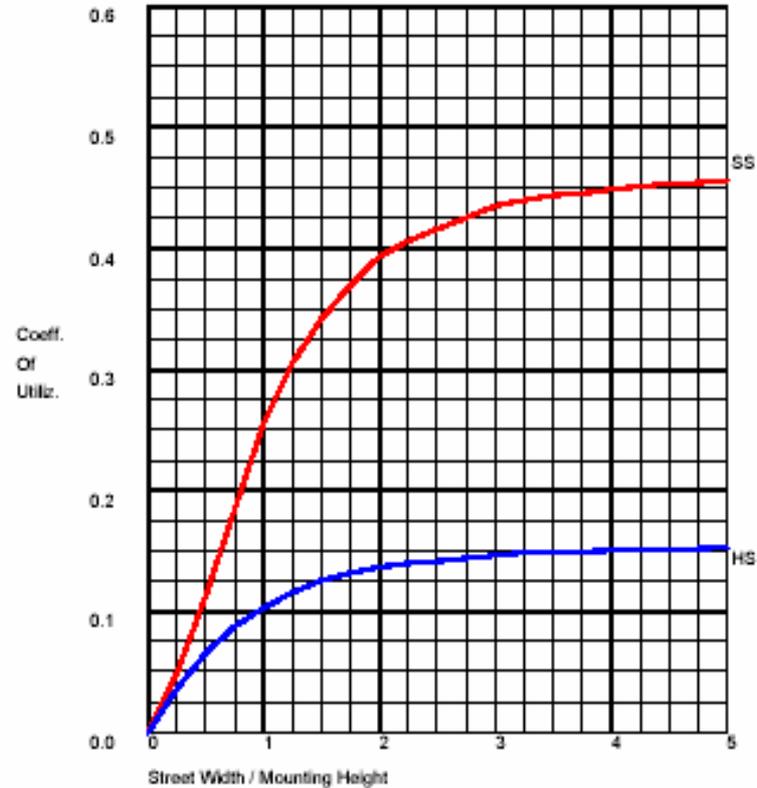


**Extract #1, Page 2, Standard Photometric Report**

**Luminous Flux Distribution**

IES ROAD REPORT  
PHOTOMETRIC FILENAME : S0104092.IES

COEFFICIENTS OF UTILIZATION



Total percentage of luminous flux emitted upward: 0.8% + 0.7% = 1.5%

FLUX DISTRIBUTION

	Lumens	Percent Of Lamp
Downward Street Side	7404.5	48.3
Downward House Side	2512.5	15.7
Downward Total	9917.0	62.0
Upward Street Side	129.4	0.8
Upward House Side	109.9	0.7
Upward Total	239.3	1.5
Total Flux	10156.3	63.5

The luminaire complies with the standard for the percentage of light emitted above the horizontal if it is mounted below 3.5 m in zone 1 and below 5 m in zone 2.

## Extract from Standard Photometric Report #2 Roadway Luminaire

**Page 1: General luminaire data**  
(Data concerning the percentage of luminous flux emitted upward are not included.)



**IES ROAD REPORT**  
**PHOTOMETRIC FILENAME : S0105303.IES**

### DESCRIPTIVE INFORMATION (From Photometric File)

IESNA LM-63-95  
[DATE] 30 May 2001  
[LABORATORY] Spectralux  
[TEST] S0105303.IES  
[MANUFAC] LUMEC  
[LUMCAT] 150HPS-DM850-8CB3M  
[LUMINAIRE] Domus - Bell Shaped Decorative Pendant Mount  
[LAMP] (1) 150W High Pressure Sodium Mogul ET23.5  
[LAMPDETAILS] ANSI 855, 85V, LCL=5.00"  
[BURNING] Vertical Base UP (16,000 Lumens)  
[REFLECTOR] Semi-Specular Hydroformed  
[LENS] Tempered Clear Bag Glass  
[HOUSING] Soun and Cast Aluminum  
[SKTPOSITION] D3  
[DISTRIBUTION] Type II, Short, Cutoff

### CHARACTERISTICS

IES Classification	Type II
Longitudinal Classification	Short
Cutoff Classification	Cutoff
Total Rated Lamp Lumens	16000
Maximum Candela	6641
Maximum Candela Angle	65H 67.5V
Maximum Candela At 90 Degrees Vertical	84 (0.52% Lamp Lms)
Maximum Candela At 80 Degrees Vertical	831 (5.19% Lamp Lms)
Downward Total Efficiency	63.4%

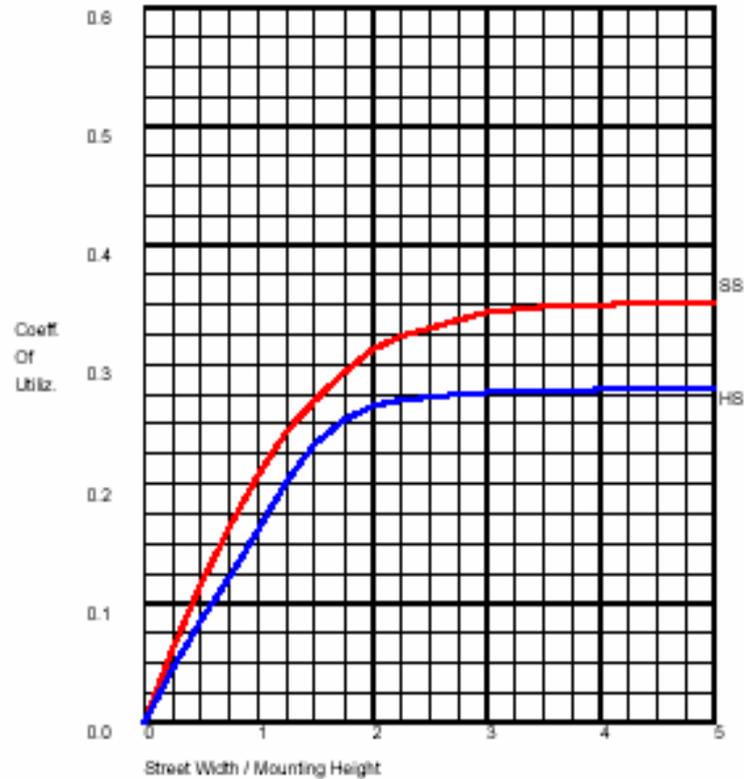


**Extract #2, Page 2, Standard Photometric Report**

**Luminous Flux Distribution**

IES ROAD REPORT  
PHOTOMETRIC FILENAME : S0105303.IES

**COEFFICIENTS OF UTILIZATION**



Total percentage of luminous flux emitted upward: 0.0% + 0.0% = 0%

Comment: Even though the IESNA classification on the previous page is cutoff and not full cutoff, the luminaire does not emit any light above the horizontal.

**FLUX DISTRIBUTION**

	Lumens	Percent Of Lamp
Downward Street Side	5642.8	35.3
Downward House Side	4499.1	28.1
Downward Total	10141.9	63.4
Upward Street Side	0.3	0.0
Upward House Side	4.2	0.0
Upward Total	4.5	0.0
Total Flux	10146.4	63.4

# Extract from Standard Photometric Report #3 Wall Pack



## Page 1: Summary of data and results

Total percentage of luminous flux emitted upward:  
8.8% + 0.9% = 9.7%

The luminaire does not comply with the standard for the percentage of light emitted above the horizontal.

TEST NO.: HP-09113  
CAT. NO.: PVL-150S-x2x

DATE: 10- 8-2002

### LUMINAIRE

SOCKET POS.: FIXED  
REFLECTOR: ALUMINUM  
SPECULAR  
ENCLOSURE: PRISMATIC POLYCARBONATE

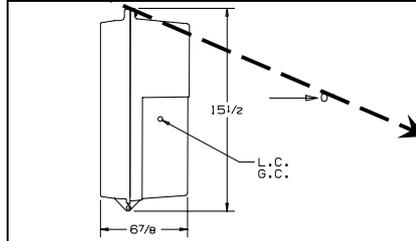
### LAMP

TYPE: 150 W. HPS  
ANSI: C150S55 I.D.: P-1  
ENVELOPE: ED23,5 L.C.L.: 5.0 INCHES  
1 LAMP(S) at LUMENS/LAMP: 16000

### CLASSIFICATION

DISTRIBUTION: SHORT  
TYPE: III  
CONTROL: NONCUTOFF  
GENERAL

TEST DISTANCE: 36 FEET



LIGHT FLUX VALUES		
	LUMENS	PERCENT OF LAMP
DOWNWARD STREETSIDE	6636	41.5
DOWNWARD HOUSESIDE	688	4.3
UPWARD STREETSIDE	1416	8.9
UPWARD HOUSESIDE	142	0.9
TOTAL	8882	55.5

To approximate performance for similar lamps with different Lumens, multiply Lumens, Lux and Footcandles by this ratio:

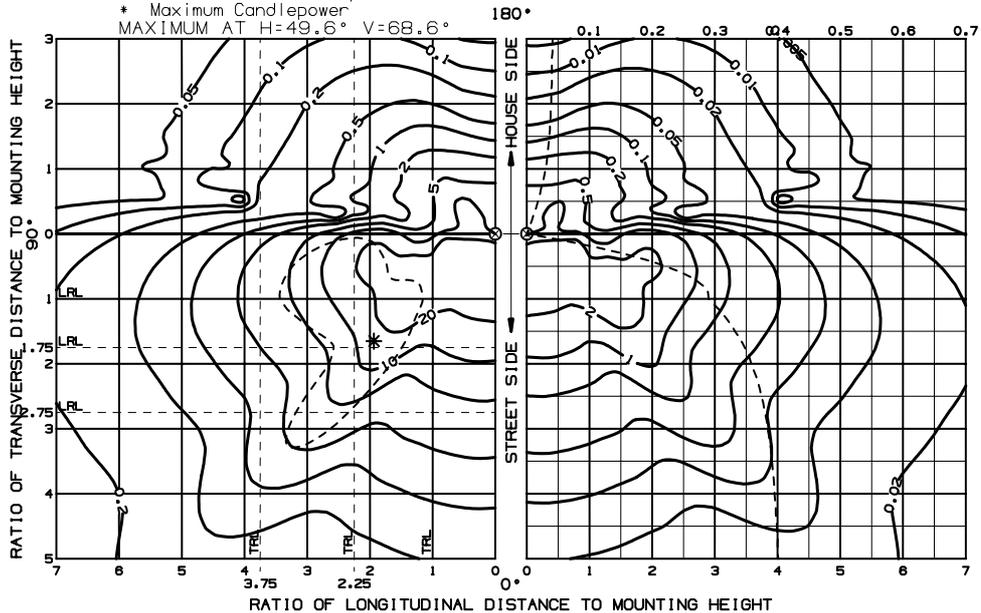
$$\text{RATIO} = \frac{\text{SELECTED LAMP LUMENS}}{16000}$$

### ISOLUX DIAGRAM

MOUNTING HEIGHT: 4.57 METERS  
----- Half Maximum Candlepower Trace  
\* Maximum Candlepower  
MAXIMUM AT H=49.6° V=68.6°

### ISOFOOTCANDLE DIAGRAM

MOUNTING HEIGHT: 15 FEET  
----- Coefficient of Utilization Curves



### MOUNTING HEIGHT CORRECTION FACTORS

Mounting Height - Feet	9	11	13	15	17	19	21
Mounting Height - Meters	2.74	3.35	3.96	4.57	5.18	5.79	6.40
Factor	2.78	1.86	1.33	1.00	0.78	0.62	0.51

TESTED TO CURRENT IES AND NEMA STANDARDS UNDER STABILIZED LABORATORY CONDITIONS. VARIOUS OPERATING FACTORS CAN CAUSE DIFFERENCES BETWEEN LAB DATA AND ACTUAL FIELD MEASUREMENTS.

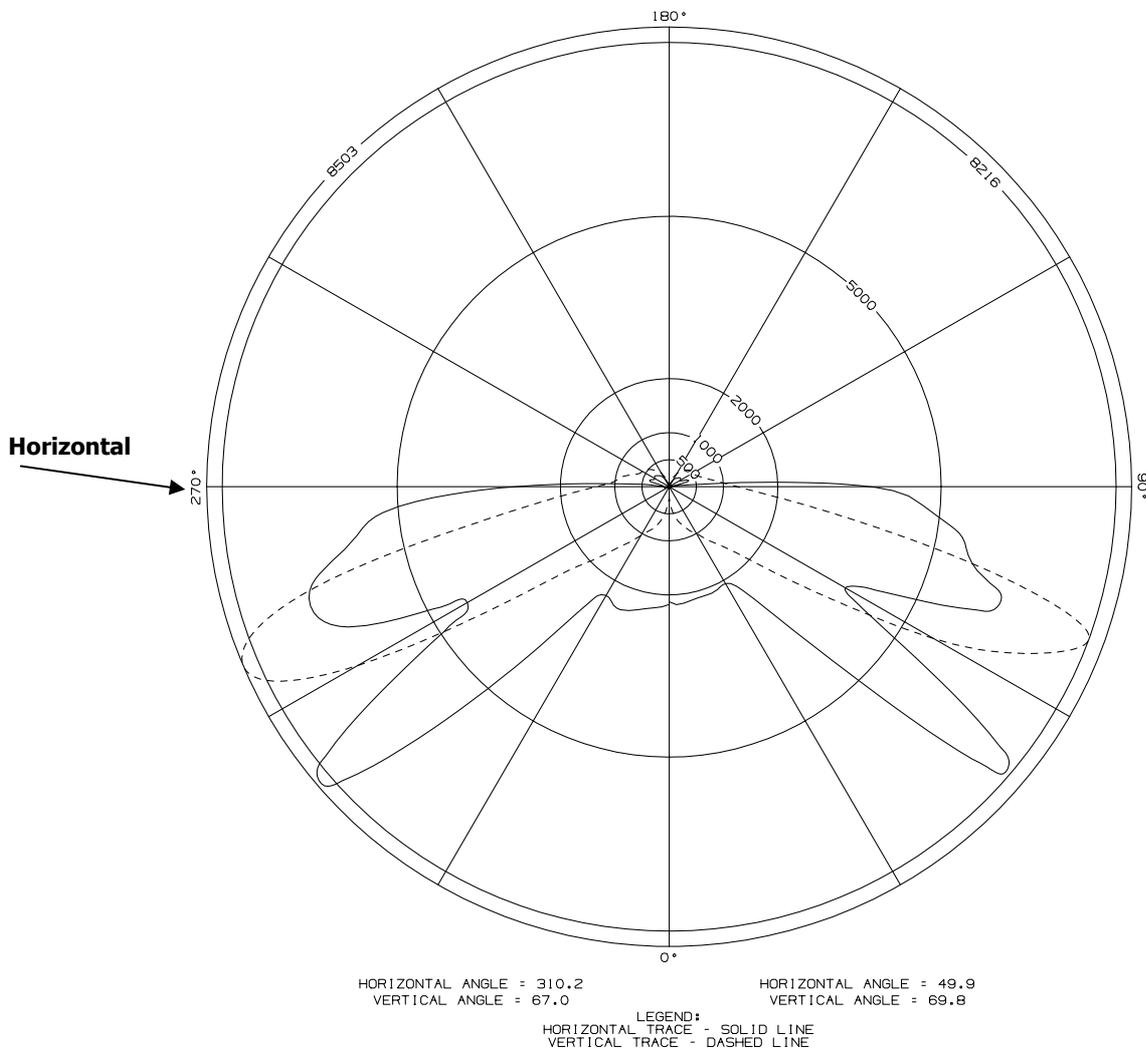
**Extract from Other Page, Photometric Report #3**  
**Plan view and elevation of the luminous flux distribution**

**Comment**

The dashed line shows the elevation. It shows that light is lost above the horizontal, but the percentage is unknown.

TEST NO. HP-09113  
CAT. NO. PVL-150S-x2x

10- 8-2002



**Extract from Last Page, Photometric Report #3**

**Luminous Flux Distribution**

REPORT NO. HP-09113  
DATE 10- 8-2002

CAT. NO. PVL-150S-x2x  
TESTED WITH LAMP TYPE C150S55 CONSTANTS

LAMP CONSTANT	136.307
NUMBER OF LAMPS	1
VENDOR LUMENS/LAMP	16000.
PER UNIT M.H.	15.0
TOTAL LUMENS	8882.
TOTAL EFFICIENCY	55.5

**Another extract from the same photometric report containing the photometric test results.**

**Total percentage of luminous flux emitted upward: 8.9% + 0.9 % = 9.8%**

LUMENS BY VERTICAL QUADRANTS

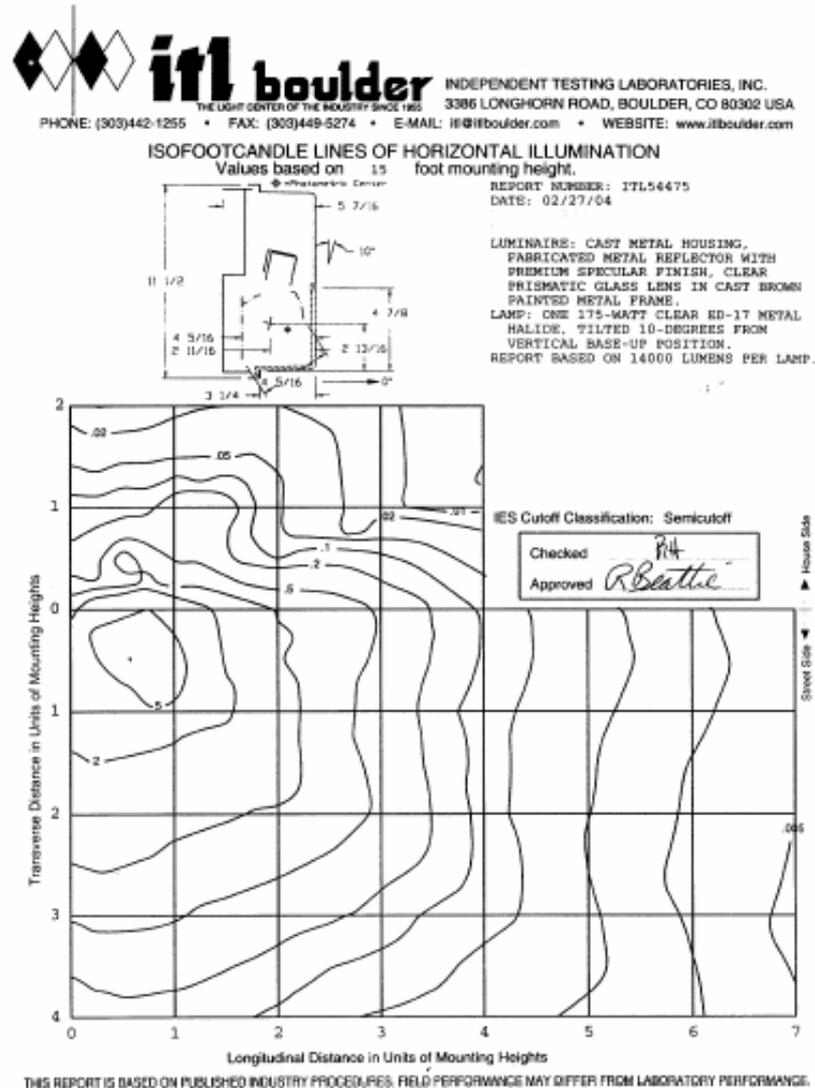
	STREET SIDE		HOUSE SIDE	
	LUMENS	PCT	LUMENS	PCT
DOWN	6636.	41.5	688.	4.3
UP	1416.	8.9	141.	0.9

NOTES:

- RESULTS OF THIS TEST WERE: III, SHORT, NONCUTOFF
- PHOTOMETER ARC VOLT RISE WAS 2.4 VOLTS.

## Extract from Standard Photometric Report #4 Wall Pack

**Page 1: Luminous flux distribution downward**  
(Data concerning the percentage of luminous flux emitted upward are not included.)



### Extract from Last Page, Photometric Report #4 Luminous Flux Distribution

Total percentage of luminous flux emitted upward: 6.24% + 0.78 % = 7.02%

The luminaire does not comply with the standard for the percentage of light emitted above the horizontal.

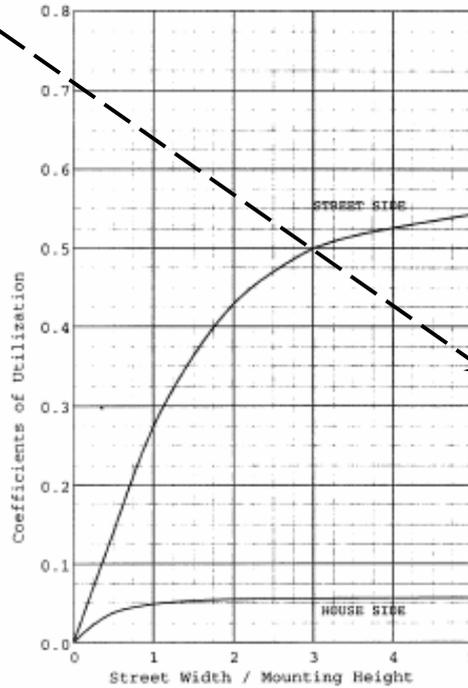


INDEPENDENT TESTING LABORATORIES, INC.  
3386 LONGHORN ROAD, BOULDER, CO 80302 USA  
PHONE: (303)442-1255 • FAX: (303)449-5274 • E-MAIL: [itl@itlboulder.com](mailto:itl@itlboulder.com) • WEBSITE: [www.itlboulder.com](http://www.itlboulder.com)

REPORT NUMBER: ITL54475

DATE: 02/27/04

COEFFICIENTS OF UTILIZATION AND FLUX DISTRIBUTION



	LUMENS	PERCENT OF LAMP
DOWNWARD STREET SIDE	7872	56.23
DOWNWARD HOUSE SIDE	807	5.76
DOWNWARD TOTAL	8679	61.99
UPWARD STREET SIDE	873	6.24
UPWARD HOUSE SIDE	109	0.78
UPWARD TOTAL	982	7.01
TOTAL FLUX	9661	69.01

ALL CANDELA, LUMENS AND COEFFICIENT OF UTILIZATION VALUES IN THIS REPORT ARE BASED ON RELATIVE PHOTOMETRY WHICH ASSUMES A BALLAST FACTOR OF 1.00. ANY CALCULATIONS PREPARED FROM THESE DATA SHOULD INCLUDE AN APPROPRIATE BALLAST FACTOR.

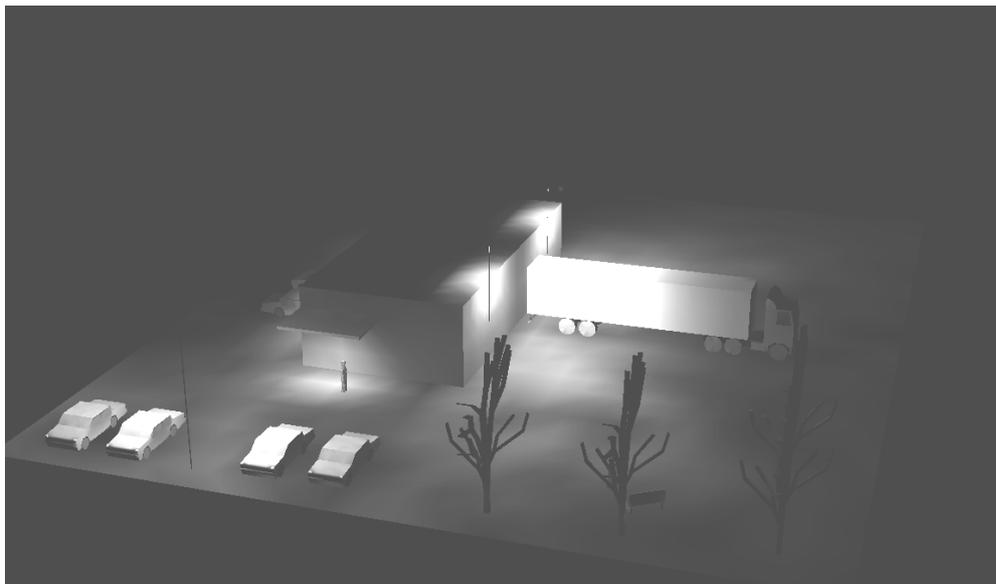
THIS REPORT IS BASED ON PUBLISHED INDUSTRY PROCEDURES. FIELD PERFORMANCE MAY DIFFER FROM LABORATORY PERFORMANCE.

## APPENDIX C

### Standard case

### Small industry, zone 1

Model permit application  
Site plan and application  
Lighting plan



Municipality of: STANDARD CASE, ZONE 1

Roll Number: \_\_\_\_\_

Permit Number: \_\_\_\_\_

**APPLICATION FOR A PERMIT TO INSTALL OUTDOOR LIGHTING FIXTURES  
NOT INTENDED FOR RESIDENTIAL USE**  
Outdoor Lighting Regulations

**BLOCK 1 GENERAL INFORMATION**

Owner: \_\_\_\_\_ Telephone: \_\_\_\_\_  
Address: \_\_\_\_\_ Postal code: \_\_\_\_\_

**Location of property where work is to take place**

Address (if different): \_\_\_\_\_  
Cadastral identification (lot, range, township cadastre): \_\_\_\_\_

Execution of Work

By: \_\_\_\_\_ Telephone: \_\_\_\_\_  
Address: \_\_\_\_\_ Postal code: \_\_\_\_\_  
RBQ licence: \_\_\_\_\_

Value of work: \_\_\_\_\_  
Photometric reports and/or data sheet of luminaires appended: \_\_\_\_\_  
Point-by-point illumination calculations appended: \_\_\_\_\_  
Date of start of work: \_\_\_\_\_ Planned duration: \_\_\_\_\_  
New work  Transformation/Modification  Repair

**BLOCK 2 INTENDED APPLICATIONS AND CALCULATION METHOD**

Current land use: INDUSTRIAL  
Construction date of main building: \_\_\_\_\_

**Intended lighting applications**

- Commercial display area
  - All commercial areas (garden centre, materials, etc.)
  - Display row for automobile dealerships
- Storage area
- Unloading, handling or work area
- Pedestrian area
- Building entrance
- Illuminated sign
- Reflection-illuminated sign
- Outdoor parking
- Service station
  - Pumping area
  - Peripheral area (or other surface under a canopy)
- Miscellaneous use (building fronts, landscaping)

**The application will be considered based on:**

Point-by-point calculation in lux	lumen/m <sup>2</sup>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	NA
<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	NA
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	NA
<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	NA
<input type="checkbox"/>	<input type="checkbox"/>

**BLOCK 3 TYPE OF LIGHT SOURCES**

**Intended application:**    PARKING 1   

Type of light source		Quantity	Wattage								
Compact fluorescent	<input type="checkbox"/>	_____	10 <input type="checkbox"/>	13 <input type="checkbox"/>	15 <input type="checkbox"/>	20 <input type="checkbox"/>					
Incandescent - Halogen	<input type="checkbox"/>	_____	50 <input type="checkbox"/>	60 <input type="checkbox"/>	75 <input type="checkbox"/>	100 <input type="checkbox"/>					
High-pressure sodium	<input checked="" type="checkbox"/>	<u>   1   </u>	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input checked="" type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Low-pressure sodium	<input type="checkbox"/>	_____	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Metal halide	<input type="checkbox"/>	_____	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Other	<input type="checkbox"/>	_____									

**Intended application:**    PARKING 2   

Type of light source		Quantity	Wattage								
Compact fluorescent	<input type="checkbox"/>	_____	10 <input type="checkbox"/>	13 <input type="checkbox"/>	15 <input type="checkbox"/>	20 <input type="checkbox"/>					
Incandescent - Halogen	<input type="checkbox"/>	_____	50 <input type="checkbox"/>	60 <input type="checkbox"/>	75 <input type="checkbox"/>	100 <input type="checkbox"/>					
High-pressure sodium	<input checked="" type="checkbox"/>	<u>   2   </u>	35 <input type="checkbox"/>	50 <input checked="" type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Low-pressure sodium	<input type="checkbox"/>	_____	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Metal halide	<input type="checkbox"/>	_____	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Other	<input type="checkbox"/>	_____									

**Intended application:**    ENTRANCE   

Type of light source		Quantity	Wattage								
Compact fluorescent	<input type="checkbox"/>	_____	10 <input type="checkbox"/>	13 <input type="checkbox"/>	15 <input type="checkbox"/>	20 <input type="checkbox"/>					
Incandescent - Halogen	<input type="checkbox"/>	_____	50 <input type="checkbox"/>	60 <input type="checkbox"/>	75 <input type="checkbox"/>	100 <input type="checkbox"/>					
High-pressure sodium	<input checked="" type="checkbox"/>	<u>   1   </u>	35 <input checked="" type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Low-pressure sodium	<input type="checkbox"/>	_____	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Metal halide	<input type="checkbox"/>	_____	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Other	<input type="checkbox"/>	_____									

**Intended application:**    UNLOADING AREA   

Type of light source		Quantity	Wattage								
Compact fluorescent	<input type="checkbox"/>	_____	10 <input type="checkbox"/>	13 <input type="checkbox"/>	15 <input type="checkbox"/>	20 <input type="checkbox"/>					
Incandescent - Halogen	<input type="checkbox"/>	_____	50 <input type="checkbox"/>	60 <input type="checkbox"/>	75 <input type="checkbox"/>	100 <input type="checkbox"/>					
High-pressure sodium	<input checked="" type="checkbox"/>	<u>   2   </u>	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input checked="" type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Low-pressure sodium	<input type="checkbox"/>	_____	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Metal halide	<input type="checkbox"/>	_____	35 <input type="checkbox"/>	50 <input type="checkbox"/>	70 <input type="checkbox"/>	100 <input type="checkbox"/>	150 <input type="checkbox"/>	250 <input type="checkbox"/>	400 <input type="checkbox"/>		
Other	<input type="checkbox"/>	_____									

**BLOCK 4**

**TYPE OF LUMINAIRES**

Intended application: \_\_\_\_\_ PARKING 1 \_\_\_\_\_

Type of luminaire: Wall pack  Bollard  Floodlight  Other   
 Model: LUMEC – DOMUS: DOS-SG3 full cutoff  
 Mounting height: 8.5 m

Percentage of light emitted upward according to the luminaire's photometric report:  
 Less than 1%  from 1% to 2.5%  Unknown

If unknown, does the luminaire have:  
 full cutoff classification? Yes  No   
 a flat lens? Yes  No   
 shielding that completely shields the luminary source? Yes  No

or  
 will it be mounted directly under overhanging areas of the building? Yes  No

Will the luminaire be tilted above the horizontal when mounted? Yes  No   
 If so, what is the tilt angle? \_\_\_\_\_

Intended application: \_\_\_\_\_ PARKING 2 \_\_\_\_\_

Type of luminaire: Wall pack  Bollard  Floodlight  Other   
 Model: GARDCO – WT101 full cutoff  
 Mounting height: 3 m

Percentage of light emitted upward according to the luminaire's photometric report:  
 Less than 1%  from 1% to 2.5%  Unknown

If unknown, does the luminaire have:  
 full cutoff classification? Yes  No   
 a flat lens? Yes  No   
 shielding that completely shields the luminary source? Yes  No

or  
 will it be mounted directly under overhanging areas of the building? Yes  No

Will the luminaire be tilted above the horizontal when mounted? Yes  No   
 If so, what is the tilt angle? \_\_\_\_\_

Intended application: \_\_\_\_\_ ENTRANCE \_\_\_\_\_

Type of luminaire: Wall pack  Bollard  Floodlight  Other   
 Model: GARDCO 220-P  
 Mounting height: UNDER THE CANOPY

Percentage of light emitted upward according to the luminaire's photometric report:  
 Less than 1%  from 1% to 2.5%  Unknown

If unknown, does the luminaire have:



**BLOCK 6**

**STATEMENT**

I certify that the information provided is accurate and complete and if a permit is granted, I will comply with the provisions of the Acts and Regulations in effect.

Signed at: \_\_\_\_\_

This: \_\_\_\_\_

Owner or authorized representative: \_\_\_\_\_

**BLOCK 7**

**ADMINISTRATION**

Application received: \_\_\_\_\_

Documents submitted: \_\_\_\_\_

Fee: \_\_\_\_\_ Paid  Inspections: \_\_\_\_\_

Approved  Application complies with Regulation No.: \_\_\_\_\_ Expiry: \_\_\_\_\_

Denied  Reasons: \_\_\_\_\_

Building inspector: \_\_\_\_\_ Date: \_\_\_\_\_

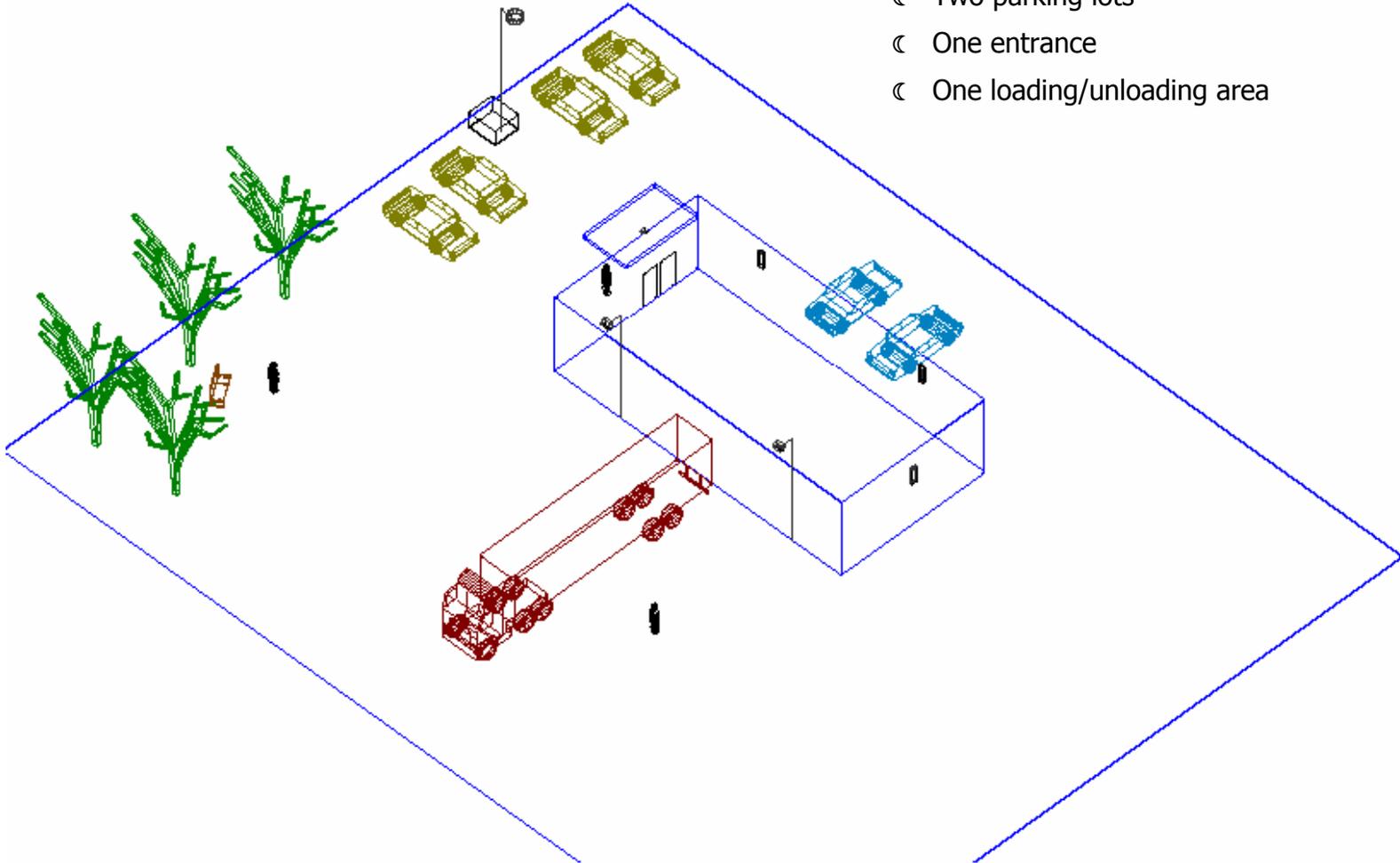
Work completed on: \_\_\_\_\_

Notes  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

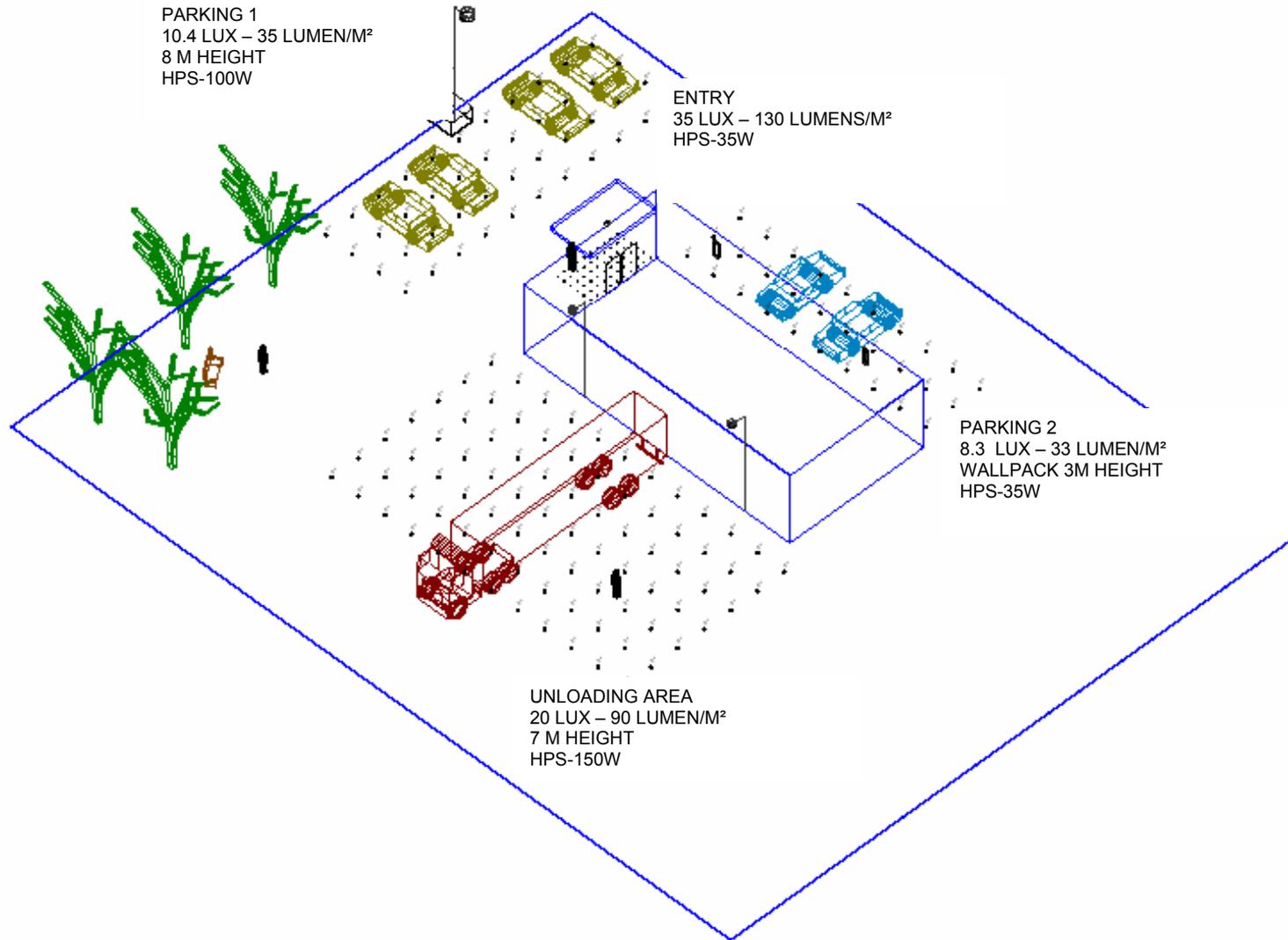
# Standard Case, Zone 1: Small Industrial Site

## Site plan and applications

- Ⓒ Two parking lots
- Ⓒ One entrance
- Ⓒ One loading/unloading area



# Lighting Plan – 3D View



## Photometric Study – Results

Luminaire Schedule							
Project: All Projects							
Symbol	Qty	Label	Lumens	LLF	Description	Arm	Cutoff Class
	1	100HPS-DOS-SG3	9500	0.800	Lumec - Domus - Parking 1	1	Full Cutoff
	2	EMCO-EC3V15HS	16000	0.800	EMCO - Ecolume - Unloading	1	Full Cutoff
	1	marquise220-P-35HP	2000	0.800	Gardco - 200-canopy - Entry	0	Full Cutoff
	2	101-WT-35HPS	2000	0.800	Gardco - 100 Sconces - Wall Pack -	0	Full Cutoff

Numeric Summary						
Project: All Projects						
Label	Avg	Max	Min	Avg/Min	Max/Min	Units
Unloading	19.98	35.7	6.4	3.12	5.58	Lux
Parking 2	8.31	21.0	1.2	6.93	17.50	Lux
Parking 1	10.26	15.8	5.6	1.83	2.82	Lux
Entry	32.47	47.0	19.1	1.70	2.46	Lux

