

Cambridge Lighting Ordinance Task Force

9-16-15 Meeting



Comments by Task Force Member Carol Lynn Alpert
Resident & Director, Strategic Projects, Museum of Science
Co-Director, Center for Integrated Quantum Materials
at Harvard, MIT, Howard, and MOS

Thank you. I would like to begin by saying that designing lighting codes for a city is a serious matter, and deserves study, attention, and discussion. We are all trying to come up with a solution that promotes safety, energy savings, and enhances our city environment, as well as protects us from unwanted light trespass and glare, and we all would like an ordinance that is easy to understand, easy to apply, and easy to enforce, and that is fair to long-time residents, city agencies, and developers. I want to welcome Lisa Hemmerle, the city's relatively new Director of Economic Development to this process, and to note that she has a great reputation for guiding negotiations through to conclusion. Lisa has been very responsive in answering questions prior to this meeting with great thoughtfulness, and I know she is under considerable pressure to bring this much delayed process to a conclusion. I just hope that she and the rest of the folks here have the fortitude to stay with us through some additional adjustments that I think are required to make this Draft Ordinance worthy of guiding a city of Cambridge's prestige, excellence, intelligence, quality of life, multicultural vivacity, innovation and productivity through what promises to be a new decade of massive

Draft Lighting Ordinance mark-up

Edits/comments by C.L. Alpert 9/21/15

Chapter 15.22 Outdoor Lighting Ordinance

Section 15.22.010 Short Title. This Ordinance may be cited as the "Outdoor Lighting Ordinance" of the City of Cambridge (the "City").

Section 15.22.020 Purpose. The purpose of this Outdoor Lighting Ordinance is to regulate outdoor lighting, as defined in this Ordinance, in the City, the intent being to permit an amount of outdoor lighting that is appropriate to allow for the safe use and enjoyment of outdoor areas, while also mitigating potential nuisance in the form of light trespass and glare to abutters and the public at large, reducing light pollution, and promoting energy conservation.

Section 15.22.030 Definitions.

- A. **Architectural lighting.** Lighting designed to reveal architectural beauty, shape and/or form and for which lighting for any other purpose is ~~incidental~~secondary/ancillary.
- B. **Color rendering index** means a measure of the degree of color shift objects undergo when illuminated by the light source as compared to those same objects when illuminated by a reference source of comparable color temperature.
- C. **Correlated color temperature (CCT)** ~~means the absolute temperature of a blackbody radiator whose chromaticity most nearly resembles that of the light source.~~ A specification of the color appearance of the light emitted by a lamp, relating its color to the color of light from a reference source when heated to a particular temperature, measured in degrees Kelvin (K).
[RPI Color Research Center]

I have also prepared a detailed mark-up of the ordinance, with suggestions and commentary, that I will submit to Lisa and the rest of the Task Force for review. (I'm sure they can't wait to look at it.....!)

Some curious inconsistencies in the current
Draft Lighting Ordinance (DLO) ...

There are some curious inconsistencies in this ordinance. For instance,

DLO Alternative Performance Standards, pg. 6-7.

LEED Light Pollution Reduction Credit



1.) In the DLO's Alternative Performance Standards section, a developer or property owner can choose to submit a plan in alignment with the LEED Light Pollution Credit guidelines - which are very clear and precise - OR, they can submit a plan that indicates

Alternative Performance Standards, pg. 6-7:


“The maximum allowable vertical illuminance value shall be (8) lux at the perimeter of the lot.”

that there will be no more than 8 Lux emitted at the property line at 5 vertical feet and above. Now the reason this is an inconsistency - and a big one - - is that this 8 Lux figure is derived not from the LEED LPC standard which it is supposed to stand in for, but from the Model Lighting Ordinance's...

In the Model Lighting Ordinance, this table applies only to non-residential areas.

Table F Maximum Vertical Illuminance at any point in the plane of the property line

Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
0.05 FC or 0.5 LUX	0.1 FC or 1.0 LUX	0.3 FC or 3.0 LUX	0.8 FC or 8.0 LUX	1.5 FC or 15.0 LUX



Model Lighting Ordinance, pg. 32.

Table F. But in the Model Lighting Ordinance, this table only applies to non-residential, commercial areas, or what we are calling in the Cambridge Draft Ordinance,

DLO Alternative Performance Standards, pg. 6-7

According to the Model Lighting Ordinance,
8 lux should apply only to non-residential
LZ 3 areas - the yellow ones on the map.



Proposed Lighting Zones, Cambridge

Lighting Zone 3, which are the yellow areas on this map.
So it is an error that this Draft Ordinance has 8 lux as the Alternate
Performance alternate lux limit for the entire city, including the
residential and mixed residential areas of LZ 2.

DLO Alternative Performance Standards, pg. 6-7

In the Model Lighting Ordinance, 3 lux would apply to the LZ 2 areas, the white areas.




Proposed Lighting Zones, Cambridge

In the Model Lighting Ordinance, there is a limit of 3 lux at the property line for all Zone 2 areas – the white areas - that make up the majority of our city.

In the Model Lighting Ordinance, 3 lux would apply to the LZ 2 mixed residential areas.

Table F Maximum Vertical Illuminance at any point in the plane of the property line

Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
0.05 FC or 0.5 LUX	0.1 FC or 1.0 LUX	0.3 FC or 3.0 LUX	0.8 FC or 8.0 LUX	1.5 FC or 15.0 LUX



You can see that here.

DLO Alternative Performance Standards, pg. 6-7

The appropriate corresponding LEED light trespass standard is 2 lux for Zone 3 (yellow) and 1 lux for Zone 2 (white)



Proposed Lighting Zones, Cambridge

In truth, the more APPROPRIATE alternative light trespass standard for the Alternative Performance Standards - since it is substituting for the LEED Light Pollution Credit standard, should be the LEED Light Pollution Credit standard for trespass at the property boundaries – NOT the Model Lighting Ordinance. And the LEED LPC figure maximum is 2 lux for Zone 3 and 1 lux for Zone 2.

LEED Zone 3 light trespass text

LZ3: Medium (such as commercial/ industrial, and high-density residential):

Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.20 horizontal and vertical footcandles (2.0 horizontal and vertical lux) at the LEED project boundary and no greater than 0.01 horizontal footcandles (0.1 horizontal lux) 15 feet (4.5 meters) beyond the site.

From LEED Light Pollution Credit ss8

<http://www.usgbc.org/credits/ss8>

Here is the LEED trespass standard for Zone 3 – saying 2 LUX is the maximum

LEED Zone 2 light trespass text

LZ2: Low (primarily residential zones, neighborhood business districts, light industrial areas with limited nighttime use and residential mixed-use areas)

Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.10 horizontal and vertical footcandles (1.0 horizontal and vertical lux) at the LEED project boundary and no greater than 0.01 horizontal footcandles (0.1 horizontal lux) 15 feet (4.5 meters) beyond the site.

From LEED Light Pollution Credit ss8

<http://www.usgbc.org/credits/ss8>

And, here is the standard for Zone 2 – saying 1 LUX maximum.

DLO Prescriptive Standards, pg. 5

This kind of confusing mishmash of standards also occurs in the Draft Ordinance's Prescriptive Standards.

DLO Prescriptive Standards, pg. 5

E.E. Prescriptive Standards. Exterior lighting that meets the standards set forth in the table below shall be permitted in the City. Any lighting that does not meet the standards set forth in the table below may be permitted in the City only if it meets the Alternative Performance Standards set forth in this Ordinance.

Outdoor Lighting Category	Maximum Initial Lumens Per Light Fixture	Maximum Height	Shielding and Direction
Unshielded or partly shielded light fixture (general)	390 —315	12 feet above the surface of the area to be illuminated	Not applicable
Unshielded or partly shielded light fixture located in a front yard between the building and street	630	12 feet above the surface of the area to be illuminated	Not applicable
Fully shielded or shielded directional light fixture for entries, walkways, open spaces or buildings	1,050	12 feet above the surface of the area to be illuminated	Must be fully shielded or directed away from all properties that are abutting or located directly across a street
Fully shielded or shielded directional light fixture for automobile surface parking areas, driveways or outdoor loading bays	1,260	14 feet above the surface of the parking area, driveway or loading bay	Must be fully shielded or directed away from all properties that are abutting or located directly across a street

Table E shown on page 5 of the Draft Ordinance is derived largely from

Model Lighting Ordinance prescriptive standards for residential properties only.

Table G - Residential Lighting Limits

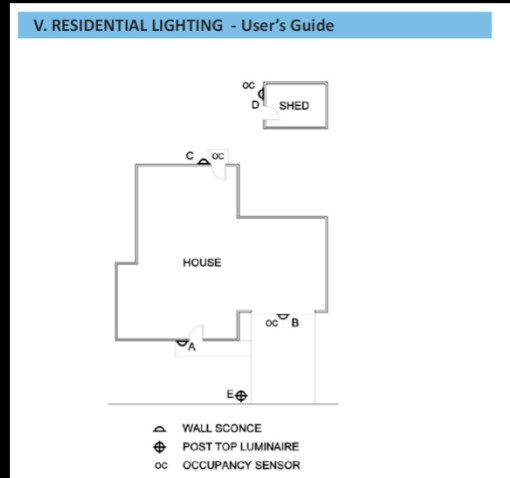
Lighting Application	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Row 1 Maximum Allowed Luminaire Lumens* for Unshielded Luminaires at one entry only	Not allowed	420 lumens	630 lumens	630 lumens	630 lumens
Row 2 Maximum Allowed Luminaire Lumens* for each Fully Shielded Luminaire	630 lumens	1,260 lumens	1,260 lumens	1,260 lumens	1,260 lumens
Row 3 Maximum Allowed Luminaire Lumens* for each Unshielded Luminaire excluding main entry	Not allowed	315 lumens	315 lumens	315 lumens	315 lumens
Row 4 Maximum Allowed Luminaire Lumens* for each Landscape Lighting	Not allowed	Not allowed	1,050 lumens	2,100 lumens	2,100 lumens
Row 5 Maximum Allowed Luminaire Lumens* for each Shielded Directional Flood Lighting	Not allowed	Not allowed	1,260 lumens	2,100 lumens	2,100 lumens
Row 6 Maximum Allowed Luminaire Lumens* for each Low Voltage Landscape Lighting	Not allowed	Not allowed	525 lumens	525 lumens	525 lumens

* Luminaire lumens equals Initial Lamp Lumens for a lamp, multiplied by the number of lamps in the luminaire

Model Lighting Ordinance, pg. 33.

the Model Lighting Ordinance's Table G - Prescriptive Standards for Residential – not commercial - areas.

MLO assumes just one fixture at entries and exits.



Model Lighting Ordinance Residential Guidance, p. 20

...there is the implicit assumption that there will be just ONE of each of these kinds of fixtures at the various entries and exits of a house....

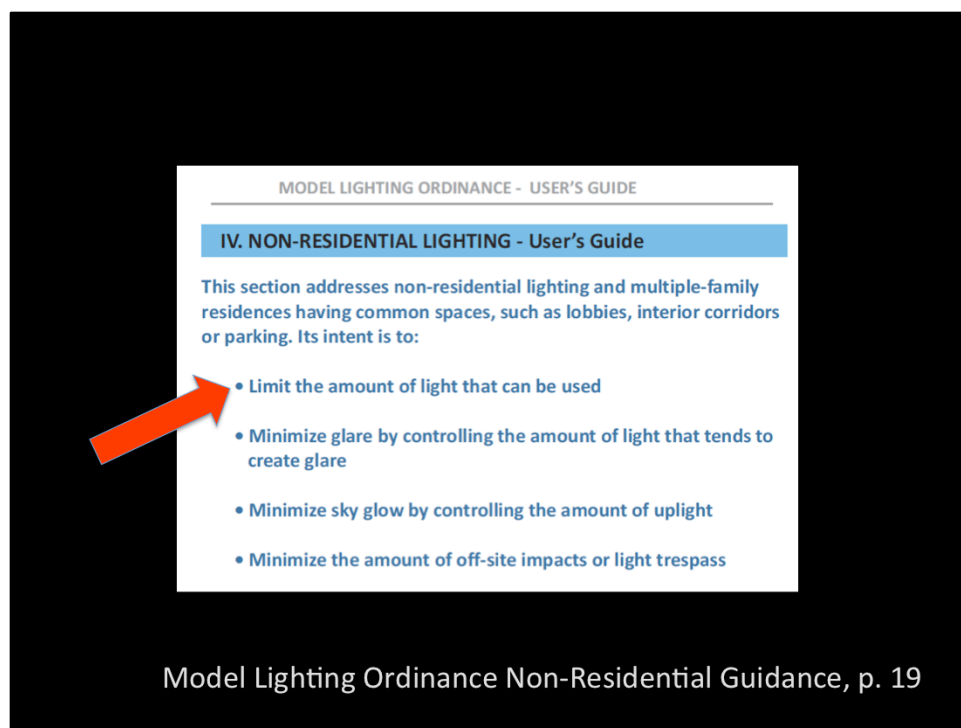
MLO assumes just one fixture at entries and exits,
and clearly specifies an upper lumen
limit and a prohibition on trespass.

1. One partly shielded or unshielded luminaire at the main entry, not exceeding the allowed lumen output in Table G row 1.
2. Any other partly shielded or unshielded luminaires not exceeding the allowed lumen output in Table G row 3.
3. Low voltage landscape lighting aimed away from adjacent properties and not exceeding the allowed lumen output in Table G row 4.
4. Shielded directional flood lighting aimed so that direct glare is not visible from adjacent properties and not exceeding the allowed lumen output in Table G row 5.

Model Lighting Ordinance Residential Guidance, p. 19

...and the section has additional language ensuring the principle of no light trespass on neighboring properties.

But the larger problem, is that the Model Lighting Ordinance - and most other municipal lighting ordinances I've looked at - make a distinction between residential and commercial properties in their prescriptive standards.



They require commercial properties to first limit the total amount of flux - or illumination – that can be used on the entire property - using a formula like total lumens per square foot.

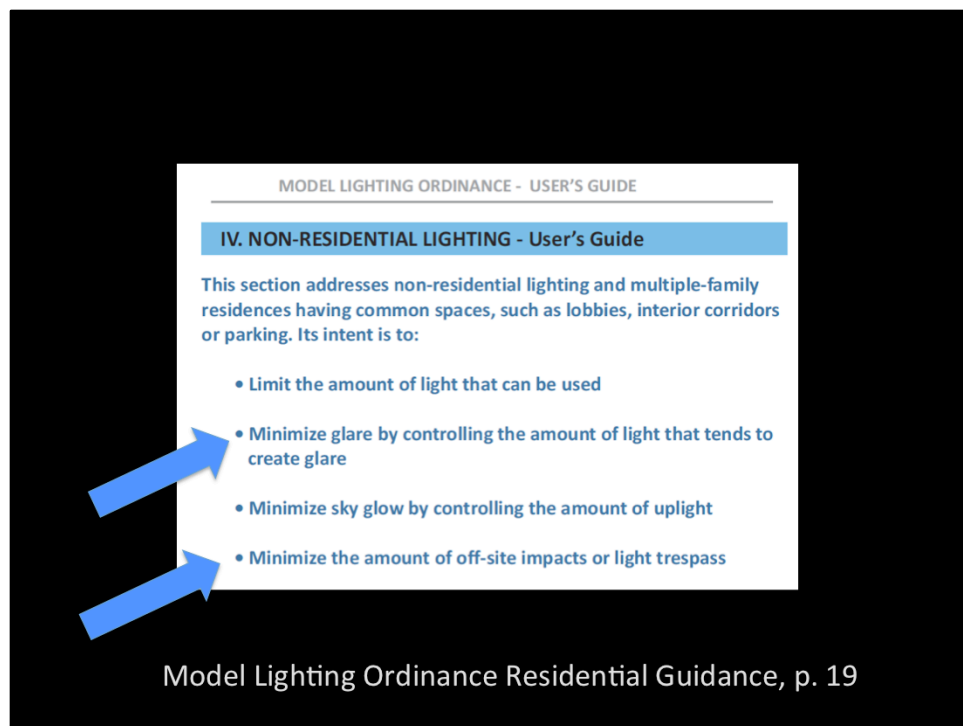
IV. NON-RESIDENTIAL LIGHTING - User's Guide

This section addresses non-residential lighting and multiple-family residences having common spaces, such as lobbies, interior corridors or parking. Its intent is to:

- Limit the amount of light that can be used
- Minimize glare by controlling the amount of light that tends to create glare
- Minimize sky glow by controlling the amount of uplight
- Minimize the amount of off-site impacts or light trespass

Model Lighting Ordinance Residential Guidance, p. 19

They also not only require that properties limit light spill above the horizontal line of the fixture, but that they also...



...limit glare and light trespass by limiting lumen emitted at the upper side angles -

The three components of BUG ratings are based on IES TM-15-07 (revised):

Backlight, which creates light trespass onto adjacent sites. The B rating takes into account the amount of light in the BL, BM, BH and BVH zones, which are in the direction of the luminaire OPPOSITE from the area intended to be lighted.

Uplight, which causes artificial sky glow. Lower uplight (zone UL) causes the most sky

IV
This residential ordinance

- Minimize glare by controlling the amount of light that tends to create glare
- Minimize sky glow by controlling the amount of uplight
- Minimize the amount of off-site impacts or light trespass

Sky glow (uplight)

Trespass and Glare

Model Lighting Ordinance Residential Guidance, p. 19

- This is the colorful BUG rating system that Jeff Berg showed us last time we were here -

DLO Prescriptive Standards, pg. 5

E.E. Prescriptive Standards. Exterior lighting that meets the standards set forth in the table below shall be permitted in the City. Any lighting that does not meet the standards set forth in the table below may be permitted in the City only if it meets the Alternative Performance Standards set forth in this Ordinance.

Outdoor Lighting Category	Maximum Initial Lumens Per Light Fixture	Maximum Height	Shielding and Direction
Unshielded or partly shielded light fixture (general)	390-315	12 feet above the surface of the area to be illuminated	Not applicable
Unshielded or partly shielded light fixture located in a front yard between the building and street	630	12 feet above the surface of the area to be illuminated	Not applicable
Fully shielded or shielded directional light fixture for entries, walkways, open spaces or buildings	1,050	12 feet above the surface of the area to be illuminated	Must be fully shielded or directed away from all properties that are abutting or located directly across a street
Fully shielded or shielded directional light fixture for automobile surface parking areas, driveways or outdoor loading bays	1,260	14 feet above the surface of the parking area, driveway or loading bay	Must be fully shielded or directed away from all properties that are abutting or located directly across a street

So, the issue with the Draft Lighting Ordinance Prescriptive table (that Peter Calkins and several others have pointed out) – is that – for the higher lumen values -
 ...it allows unlimited numbers of lights at 1050 lumens for walkways, open spaces, or buildings at up to 12 feet high...

DLO Prescriptive Standards, pg. 5

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as long as they are shielded from upglow – because that it how “fully shielded” is so far defined in this ordinance. However, they aren’t required to specifically be shielded against glare or trespass, just “directed away,” which is a fairly vague term.

Model Lighting Ordinance prescriptive standards for residential properties only.

Table G - Residential Lighting Limits

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Row 1 Maximum Allowed Luminaire Lumens* for Unshielded Luminaires at one entry only	Not allowed	420 lumens	630 lumens	630 lumens	630 lumens
Row 2 Maximum Allowed Luminaire Lumens* for each Fully Shielded Luminaire	630 lumens	1,260 lumens	1,260 lumens	1,260 lumens	1,600 lumens
Row 3 Maximum Allowed Luminaire Lumens* for each Unshielded Luminaire excluding main entry	Not allowed	315 lumens	315 lumens	315 lumens	315 lumens
Row 4 Maximum Allowed Luminaire Lumens* for each Landscape Lighting	Not allowed	Not allowed	1,050 lumens	2,100 lumens	2,100 lumens
Row 5 Maximum Allowed Luminaire Lumens* for each Shielded Directional Flood Lighting	Not allowed	Not allowed	1,260 lumens	2,100 lumens	2,000 lumens
Row 6 Maximum Allowed Luminaire Lumens* for each Low Voltage Landscape Lighting	Not allowed	Not allowed	525 lumens	525 lumens	525 lumens

* Luminaire lumens equals Initial Lamp Lumens for a lamp, multiplied by the number of lamps in the luminaire

Model Lighting Ordinance, pg. 33.

In the Model Lighting Ordinance table, you can see that these lower rows are still dedicated to household lighting, NOT to commercial lighting, such as parking areas and stores.

DLO Prescriptive Standards, pg. 5

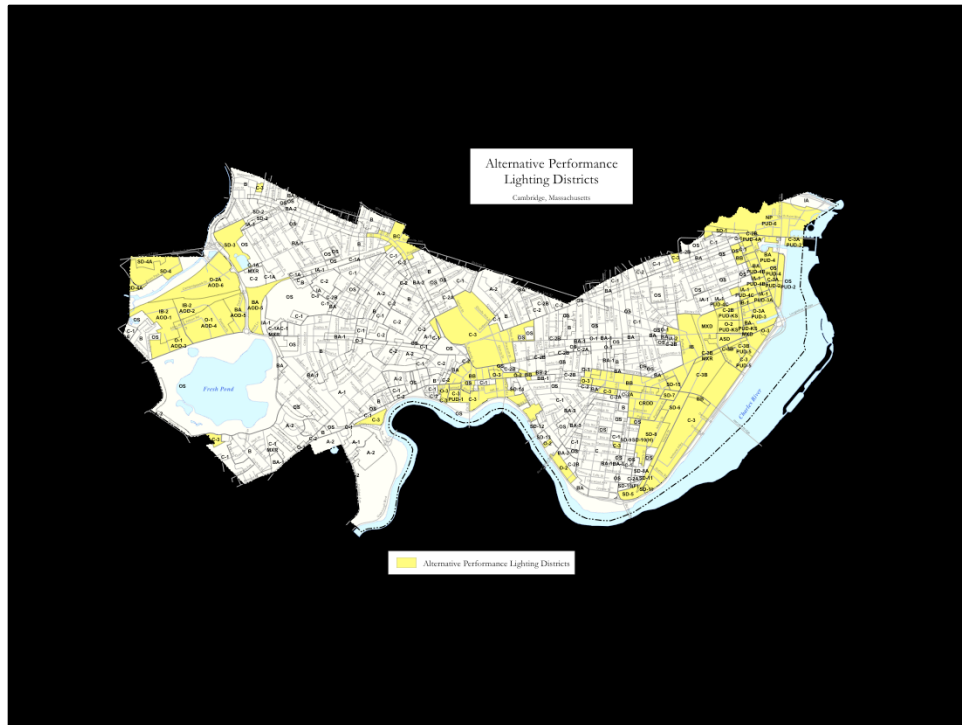
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However, in the Cambridge Draft Ordinance, when you move down to the bottom row in this Table, it seems to be providing a new set of standards for parking areas and loading bays – as if these areas were going to be deleted from the Zoning Ordinance, where they are currently regulated, including a proscription against light trespass, in Articles 6.41, 6.46, and 6.93 – which is not present in the language in the right column.

So this is a real mixing up of the the Model Lighting Ordinance’s intent that these particular prescriptive standards apply only to residential properties. And I think this is one of the things Charlie Teague was talking about when he said that the Draft Lighting Ordinance could actually undercut the protections we already have in the Zoning Ordinance.

The basic issue with this Draft Lighting Ordinance Prescriptive table (and Peter Calkins and several others have pointed this out) – is that – for the higher lumen values - it allows unlimited numbers of light fixtures at 12 or 14 feet for walkways, open spaces, or buildings, parking areas driveways, loading bays for all residences and commercial and industrial properties, as long as they are shielded from uplighting ABOVE the fixture...



..no matter where they are in the city, Zone 2 or Zone 3.

So how do we fix these problems and inconsistencies? I have several ideas:

First of all, you can get rid of a lot of technical jargon and a lot of specifications if the prescriptive standards specify three things very clearly:

.

Core strategy (from LEED and US Pattern Light Code):

1. Limit total lumens as well as individual fixtures.
2. Limit uplight (with a few special exceptions)
3. Limit light trespass and glare on abutting properties and public ways.



Core strategy

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2. Limit upright (with a few special exceptions)
3. Limit light trespass and glare on abutting properties and public ways.

It's sort of like saying...

Hey, keep your noise, smoke, toxic waste, garbage, and glare to yourself. I don't want it on my property where it is a nuisance and a health issue, or in public ways where it can blind me to other dangers.

And, I care enough about our city's environment and energy conservation, that I don't think it makes sense to try to light the night sky above us.

It's sort of like saying...

Hey, keep your noise, smoke, toxic waste, garbage, and glare to yourself. I don't want it on my property where it is a nuisance and a health issue, or in public ways where it can blind me to other dangers.

And, I care enough about our city's environment and energy conservation, that I don't think it makes sense to try to light the night sky above us

Here's how one municipal ordinance does it:

- (A) All nonexempt outdoor lighting fixtures shall be fully shielded.
- (B) All nonexempt outdoor lighting fixtures shall be placed so as to not cause light trespass of glare beyond the property boundary.
- (C) Any lamp installed on a residential property must be shielded such that glare from the lamp is not directly visible from any other residential property.
- (D) All nonexempt outdoor lighting fixtures shall be of a type and placed so as to not allow any light above the horizontal, as measured at the luminaire.
- (E) Flood or spot lamps must be fully shielded and aimed no higher than 45 degrees above straight down (half-way between straight down and horizontal) when the source is visible from any off-site residential property or public roadway. (over....)

(Madison, Mississippi)

Maybe this is too simple for Cambridge, but this is how several municipalities did it:

- (A) All nonexempt outdoor lighting fixtures shall be fully shielded.
- (B) All nonexempt outdoor lighting fixtures shall be placed so as to not cause light trespass of glare beyond the property boundary.
- (C) Any lamp installed on a residential property must be shielded such that glare from the lamp is not directly visible from any other residential property.
- (D) All nonexempt outdoor lighting fixtures shall be of a type and placed so as to not allow any light above the horizontal, as measured at the luminaire.
- (E) Flood or spot lamps must be fully shielded and aimed no higher than 45 degrees above straight down (half-way between straight down and horizontal) when the source is visible from any off-site residential

Here's how one municipal ordinance does it, cont'd):

(F) All lighting for commercial, industrial and any other non-residential activities, shall be extinguished between 11:00 p.m. (or when the business closes, whichever is later) and sunrise. Security lighting for these establishments shall conform with the other provisions of this ordinance.

(G) Commercial/industrial or business uses shall not exceed 70,000 lumens per acre.

(H) All light fixtures that are required to be shielded shall be installed and maintained in such a manner that shielding is effective as described herein for fully-shielded fixtures.

(I) Beyond the shielding requirements of this Ordinance, all light fixtures shall be located, aimed or shielded so as to minimize stray light trespassing across property boundaries.

(J) Multi-use lighting must conform to the shielding and timing restrictions, if any, that apply to most restrictive included use.

(F) All lighting for commercial, industrial and any other non-residential activities, shall be extinguished between 11:00 p.m. (or when the business closes, whichever is later) and sunrise. Security lighting for these establishments shall conform with the other provisions of this ordinance.

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(J) Multi-use lighting must conform to the shielding and timing restrictions, if any, that apply to most restrictive included use.

Now, this may not work for our city, BUT



Now that solution may not be the right one for Cambridge, but the point is that we want to focus on getting residents and developers to chose

Not only fully-shielded fixtures,...



...which prevent uplight and skyglow... but also fixtures that limit glare and trespass through directionality, total lumen limits, and additional shielding, such as cowls or hoods, or recessed lamp placement. You light what you need to light and let your neighbor deal with their own lighting. This is the simple protection most of the people who have testified at this meetings have asked for.

Discussion of Proposed Draft Ordinance Amendments



Image may be subject to copyright
http://farm6.staticflickr.com/5176/5497092533_051b7ee6f2_b.jpg

Next I would like to present some ideas about fixing the Draft Ordinance.

[These are in document “Discussed Favorably at the 9-16-15 Lighting Task Force Meeting” and in “Outdoor Lighting Ordinance DRAFT_2015_09_16-cl-edits.”]