

Appendix A

Outdoor Lighting Bylaw for Pepperell, Massachusetts Pepperell LAN Committee

1. Authority

- 1.1. This Bylaw is adopted by the Town of Pepperell pursuant to its authority under M.G.L. Chapter 40, Section 21, as reasonable and necessary for the protection of the health and welfare of the citizens of the Town of Pepperell.

2. Purpose

The Town of Pepperell hereby finds and determines that the welfare and enjoyment of Pepperell is associated with its rural character, including its nighttime ambience. It is recognized that light pollution, as defined in this Bylaw, is a nuisance to the residents of Pepperell as it negatively impacts human health and contributes to the loss of our night-sky heritage. Preserving and protecting the night sky enhances the general well-being of residents, as well as the use and enjoyment of property, through the use of appropriate lighting practices. Current and future outdoor lighting systems should be designed, constructed, installed, and maintained to:

- 2.1. Minimize *light pollution* to the greatest extent possible, especially blue light, resulting from the use of outdoor lighting, as it causes negative effects on human health, road visibility, the well-being of nocturnal organisms such as turtles, fish, bats, pollinators and other insects and reduces agricultural yields;
- 2.2. Protect residents from unwanted light, *light trespass*, that negatively affects the enjoyment of property, disrupts the natural circadian rhythm of humans, wildlife and agriculture, as well as being a form of energy waste;
- 2.3. Control *glare* to ensure safe navigation for motorists and pedestrians, as well as increasing the safety and security of Pepperell;
- 2.4. Minimize *skyglow*, to preserve the residents of Pepperell's ability to see the Milky Way galaxy against a dark sky;
- 2.5. Provide adequate light for the safe performance of outdoor tasks at night;
- 2.6. Promote efficient and cost-effective lighting to conserve energy, thereby reducing carbon emissions and costs to the citizens of Pepperell.

3. Applicability

- 3.1. General applicability. All exterior lighting installed in Pepperell after the effective date of this Bylaw shall be in conformance with the requirements established by this Bylaw and any other applicable bylaws of the Town.
- 3.2. Existing lighting. All outdoor lighting fixtures that were lawfully installed prior to the effective date of this Bylaw, but that do not comply with the requirements of this Bylaw, are declared to be legal non-conforming luminaires. All legal non-conforming luminaires may continue to be used and maintained after the adoption of this Bylaw, but shall be subject to the *Nuisance* and *After hours operation* sections of this Bylaw and shall be brought into compliance with the requirements of the Bylaw upon the first to occur of any of the following:

- 3.2.1. A determination by the Building Inspector or Building Inspector's designee that the luminaire constitutes a hazard to public safety or otherwise constitutes a lighting nuisance;
- 3.2.2. More than fifty (50) percent of the total assessed value or square footage of a structure, as determined from the records of the Assessors and/or the Building Inspector, is repaired, altered, reconstructed or renovated;
- 3.2.3. A certificate of occupancy is requested for a property which has, prior thereto, not been used or occupied for at least six (6) months; or
- 3.2.4. The replacement of any nonconforming luminaire with new lighting equipment, except a replacement of only lamps or bulbs.

To the extent applicable, the luminaire shall be brought into compliance prior to issuance of a certificate of occupancy.

- 3.3. Lighting Plans. All applications for a building permit for construction that will include exterior lighting shall include lighting plans showing location, type, height, *Correlated Color Temperature (CCT)*, lumen output, (*BUG*) rating (if applicable), shielding description, and the number of all proposed luminaires. The applicant shall provide sufficient information to verify that lighting conforms to the provisions of this Bylaw. The Building Inspector shall have the authority to request additional information in order to confirm compliance with the provisions of this Bylaw.
- 3.4. Priority of Bylaw Provisions. In case of conflict between any of the provisions of this Bylaw, the most restrictive shall apply.

4. Performance Requirements

- 4.1. Shielding. Unless exempted elsewhere in this Bylaw, all exterior luminaires and/or lamps with initial lumens exceeding 450 lumens shall be *fully shielded*. *See Figures 1 and 2 for examples of fully shielded and unshielded luminaires.*
 - 4.1.1. Maximum allowed amounts of unshielded lighting. On no parcel of property shall the amount of allowed unshielded lighting exceed, in the aggregate, 1000 lumens.
- 4.2. Nuisance. No exterior luminaire installed within the Town of Pepperell shall create a lighting nuisance in the form of *light trespass, glare or skyglow*.
 - 4.2.1. Light trespass. The maximum illumination level at a property line shall not exceed 0.1-foot candle, as measured at grade, except where abutting non-residential, or other non-sensitive uses. For a non-residential use on property which abuts a public right-of-way, or another property the use of which is non-residential, outdoor lighting must be designed so that the illumination at the property boundary line does not exceed 1.0 foot-candles, as measured at grade. Sensitive uses include all residential uses, land subject to a conservation restriction under Massachusetts law, and land designated as part of the Wild and Scenic River System under the federal Wild and Scenic Rivers Act. When outdoor lighting is to be placed adjacent to a sensitive use, shielding or

- redirecting of the luminaire may be necessary to comply with this standard. The measurement for compliance may be made by the Building Inspector or the Building Inspector's designee.
- 4.2.2. Glare. Glare is declared to be a lighting nuisance when it constitutes a hazard to public safety along a public way or causes intense discomfort to occupants of adjacent properties. This determination will be made by the Building Inspector or Building Inspector's designee through a site visit and a visual inspection and/or night-time photograph.
- 4.2.3. Skyglow. No new permanent exterior lighting shall change the overall brightness or color of the night sky in the Town of Pepperell. The effect of the lighting in both on and off states may be verified with photographs or by use of a calibrated light meter.
- 4.3. After hours operation. For all non-residential buildings, all exterior lighting shall be extinguished by 11 P.M. or within one (1) hour of the end of scheduled or licensed business hours, whichever occurs later. Exceptions shall apply for:
- 4.3.1. Businesses whose normal and legal operating hours are twenty-four (24) hours per day;
- 4.3.2. Lighting the purpose of which is to facilitate safety and security along driveways, walkways, parking lots and building entrances. This includes lighting used to prevent accidents, as well as protect buildings and property stored outdoors. This exception shall be applied so as to not interfere with the essential functions of municipal and public works sites.
- 4.3.2.1. To preserve the natural nighttime environment and minimize energy waste, said lighting shall be turned off or dimmed when not in use for safety and security purposes. If lighting is controlled by a motion sensor, it must have an on-time of no more than 10 minutes per activation, and the motion detector shall be adjusted so that normal movement of vehicles and traffic along a street or public right of way shall not cause its activation.
- 4.4. Spectrum management. The emission of light by all new luminaires, lamps and bulbs shall be controlled for spectral output (color appearance) according to the following specifications found on the product or its packaging:
- 4.4.1. The correlated color temperature (CCT), measured in Kelvin (K), of the light shall not exceed 2700 K. The warmest possible color temperature (lowest Kelvin value) should be chosen. If a 2700 K or lower product is unavailable, a 3000 K product may be used except as otherwise required in this Bylaw.
- 4.5. Streetlights and other elevated lighting.
- 4.5.1. This section applies to Town-owned, Town-installed and any other non-residential lighting installed at least 12 feet above the intended area of illumination. Said lighting shall conform to the Lighting Fixture Height standards below and shall conform to the following requirements:
- 4.5.1.1. The illuminance shall not exceed the values contained in the current edition of the IESNA RP-8 handbook on best practices for roadway, walkway and parking lot lighting. The measurement shall be made with

a photometer placed horizontally on the ground at points within the area of illumination.

- 4.5.1.2. Using the BUG rating, as provided by the manufacturer, a luminaire should be selected with the lowest possible number, ideally 0 or 1. Values of 3 or above are expressly prohibited.
- 4.5.1.3. Effort should be made to source lighting with a CCT lower than the maximum permitted value of 2700 K.
- 4.5.1.4. If a municipal or utility company lighting project is proposed that involves the retrofit or replacement of streetlights or the addition of more than ten (10) elevated luminaires with at least 2000 initial *lumens*, then the Board of Selectmen or its designee must seek public comment prior to installation so as to help mitigate unforeseen negative impact. Specifically, for streetlights, as part of the public comment process the project proponent must provide a demonstration installation of at least three (3) luminaire options.

4.5.2. Lighting Fixture Height:

Fixture type:	Maximum height of luminaire or lamp from intended area of illumination (feet):
Streetlights and roadway	25
Parking area	16
Walls, building surfaces	12

- 4.6. Allowed illuminance values. *Illuminance* resulting from all non-residential lighting installations shall conform to the relevant edition of the recommended practices of the *IESNA* current at the time of installation.
- 4.7. Illuminated Signs. The following restrictions shall apply:
 - 4.7.1. Externally illuminated signs shall be lighted only from the top of the sign, with fully shielded luminaires designed and installed to prevent light from spilling beyond the physical edges of the sign.
 - 4.7.2. Internally illuminated signs shall be subject to all of the following requirements, except when operated by Town or state entities:
 - 4.7.2.1. Luminance levels. Luminance levels during permitted operating hours shall not exceed 100 *nits* (see definition of *Luminance*). For electronic displays, this figure is as measured under conditions of a full white display.
 - 4.7.2.2. Luminous surface. The luminous surface area of an individual sign shall not exceed 12 square feet.
- 4.8. Service Station Canopies. All luminaires mounted or recessed into the lower surface of motor vehicle service station canopies shall be fully shielded and utilize only flat lenses or windows. Shielding must be provided by the luminaire itself, and not by surrounding structures such as canopy edges. Illuminance values shall neither fall below IESNA-recommended minimum values, nor exceed the recommended maximum values.

- 4.9. Outdoor accent lighting. Lighting of landscaping, monuments, plaques, flagpoles and similar installations shall be fully shielded, and focused directly at the target so that the lamp is not visible from abutting streets or abutting lots.

5. Prohibitions

The use of the following types of outdoor lighting is prohibited, except as specifically exempted in this Bylaw:

- 5.1. Outdoor floodlights or spotlights pointed above the horizontal plane running through the lowest light-emitting portion of a luminaire with respect to grade.
- 5.2. Searchlight, sky beam, and similar lighting, except as required by public safety personnel during emergency conditions.
- 5.3. Any light that dynamically varies its output by intermittently fading, flashing, blinking, or rotating. This type of lighting includes strobe lighting.
- 5.4. Any luminaire involving the use of lasers, mercury vapor lamps, neon lamps, or quartz lamps.
- 5.5. Lighting on publicly-owned properties subject to a conservation restriction under Massachusetts law; or on publicly-owned properties within one thousand (1,000) feet of any property subject to such a conservation restriction.

6. Exemptions

The following are exempt from compliance with all provisions of this Bylaw, except as noted:

- 6.1. Residential holiday, string, festoon, and similar decorative lighting.
- 6.2. Lighting required by law to be installed on motor vehicles.
- 6.3. Emergency lighting, only for as long as emergency conditions so identified by public safety personnel continue to exist. This includes the activities of law enforcement, fire and other emergency services.
- 6.4. Lighting employed during repairs of roads, utilities and similar infrastructure, including unshielded lighting, provided that such lighting is deployed, positioned and aimed such that the resulting glare is not directed toward any roadway.
- 6.5. Any form of lighting whose use is mandated or otherwise governed by any legal jurisdiction superior to that of the Town of Pepperell.
- 6.6. Temporary lighting required to save life, limb or property from imminent peril, provided that use persists only during the hours of the peril.
- 6.7. Temporary lighting for events sponsored by the Town or for which a Town license or other approval has been issued, such as concerts, fairs, and festivals.
- 6.8. Athletic fields are exempt from Shielding, Lighting Fixture Height and Spectrum management requirements, but are subject to all other provisions of this Bylaw.

7. Enforcement

- 7.1. Administrative guidance. The Building Inspector is authorized to promulgate one or more interpretive documents to aid in the administration and enforcement of this

Bylaw. The owner of any lot or property on which a luminaire or sign subject to this Bylaw is located or proposed to be located shall have the burden of demonstrating that the existing or proposed luminaire or sign complies with the standards established by this Bylaw. The manufacturer's specification sheet may be used to establish the lumen level of a luminaire, CCT and, if required, to verify the use of fully shielded fixture design. Illumination levels may be verified through the use of manufacturer's photometric data sheet(s) and/or photometric site drawing or through on-site calibrated light meter light level readings. A site visit at night by a representative of the Town for purposes of a visual observation and/or photograph may be required to determine compliance.

- 7.2. Violations. It shall be unlawful to install or operate any outdoor lighting luminaire in violation of any provision of this Bylaw. This Bylaw may be enforced by the Building Inspector and any Town police officer.
- 7.3. Relief and Penalties. The Building Inspector is authorized and empowered to institute and maintain, in the name of the Town, any and all enforcement proceedings seeking injunctive relief and any other appropriate remedy, including fines and penalties. Violation of this Bylaw shall be subject to a penalty of \$100.00. Each day that a violation exists shall be deemed a separate offense. This Bylaw may be enforced through the non-criminal disposition method as provided in M.G.L. c. 40D, § 21D and/or an order to cease and desist until the violation is remedied.

8. Definitions

- 8.1. *BUG rating system*: A simple lighting classification system (IES TM-15-20 standard or its successor) by the Illuminating Engineering Society (IES) and the International Dark-Sky Association (IDA) to describe the light pollution contributions from outdoor luminaires, including for street and parking lot lighting. Each letter is attached to a number ranging from 0 (ideal) to 5 (unacceptable). B describes backlight that often contributes to *light trespass*. U describes uplight, which contributes to *skyglow*, which limits a person's ability to see the stars. G represents *glare* or "forward light," which makes it difficult for people to see and thus makes roadways more dangerous and security lighting less effective.
- 8.2. *Correlated Color Temperature (CCT)*: A specification of the color appearance of the light emitted by a lamp, measured in Kelvin (K). CCT values are typically provided in lighting manufacturer data sheets. For example, high pressure sodium streetlights are approximately 2000 K and warm-white bulbs are 2700 K.
- 8.3. *Fully shielded*: Means that an outdoor luminaire is constructed so that, in its installed position, all of the light emitted by the luminaire is projected below the horizontal plane that passes through the lowest light-emitting part of the luminaire. See Figures 1 and 2.

8.4.

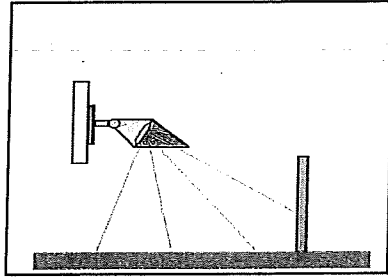


Figure 1: Fully shielded lighting that is not causing light trespass, glare or skyglow for adjacent property. In the absence of a barrier between properties, the luminaire can simply be pointed more towards the ground to satisfy the requirements of the Bylaw.

Examples of Acceptable / Unacceptable Lighting Fixtures

Unacceptable Fixtures that produce glare and light trespass	Acceptable Fixtures that shield the light source to minimize glare and light trespass and to facilitate better vision at night
<p style="text-align: center;">Unshielded Floodlights or Poorly-shielded Floodlights</p>	<p style="text-align: center;">Full Cutoff Fixtures</p>
<p style="text-align: center;">Unshielded Wallpacks & Unshielded or Poorly-shielded Wall Mount Fixtures</p>	<p style="text-align: center;">Fully Shielded Wallpack & Wall Mount Fixtures</p>
<p style="text-align: center;">Drop-Lens & Sag-Lens Fixtures w/ exposed bulb / refractor lens</p>	<p style="text-align: center;">Fully Shielded Fixtures</p>
<p style="text-align: center;">Unshielded Streetlight</p>	<p style="text-align: center;">Full Cutoff Streetlight</p>
<p style="text-align: center;">Unshielded Bollards</p>	<p style="text-align: center;">Fully Shielded Barn Light</p>
<p style="text-align: center;">Unshielded Barn Light</p>	<p style="text-align: center;">Fully Shielded Walkway Bollards</p>
<p style="text-align: center;">Unshielded 'Period' Style Fixtures</p>	<p style="text-align: center;">Fully Shielded 'Period' Style Fixtures</p>
<p style="text-align: center;">Louvered 'Marine' style Fixtures</p>	<p style="text-align: center;">Fully Shielded Decorative Fixtures</p>
<p style="text-align: center;">Unshielded PAR Floodlights</p>	<p style="text-align: center;">Flush Mounted or Side Shielded Under Canopy Fixtures</p>
<p style="text-align: center;">Drop-Lens Canopy Fixtures</p>	<p style="text-align: center;">Shielded / Properly-aimed PAR Floodlights</p>

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Figure 2: Examples of acceptable and unacceptable lighting fixtures / luminaires. The intent of this figure is to demonstrate that "acceptable" lighting eliminates or reduces glare by hiding the light emitting portion of the bulb or lamp, not that the general style of fixture is prohibited.

- 8.5. *Glare*: Intense and blinding light emitted by a lamp that reduces visibility and creates visual discomfort and/or momentary blindness.
- 8.6. *Illuminance*: Density of luminous flux (the rate of transfer of energy) incident on a surface, often measured in foot-candle (fc or lumens/ft²). Example, Full Moon casts 0.01 fc.
- 8.7. *Illuminating Engineering Society of North America (IESNA)*: A recognized authoritative body on the science and application of lighting that publishes and promotes recommended practices for a variety of specific lighting applications.
- 8.8. *Lamp*: The bulb or other light-emitting portion of a luminaire, not inclusive of any reflective or refractive optics used to direct light.
- 8.9. *Light pollution*: Any adverse and/or obtrusive effect of the use of outdoor light at night. Also, any inappropriate or excessive use of artificial light.
- 8.10. *Light trespass*: Any light emitted by a luminaire that shines directly or indirectly beyond the property on which the luminaire is installed and increases the illuminance above the the original (natural) illumination level as measured at the lot line in foot_candles.
- 8.11. *Lumen*: Brightness or unit of luminous flux; the flux emitted within a unit solid angle by a point source with a uniform luminous intensity of one candela (the SI unit of luminous intensity).
- 8.12. *Luminaire*: A complete lighting assembly, consisting of a lamp, housing, optic(s), and other structural elements, but not including any mounting pole or surface.
- 8.13. *Luminance*: The amount of light that passes through, is emitted, or reflected, from a particular area, and falls within a given solid angle. The SI (International System of Units) unit of luminance is candela per square meter (cd/m²), also known as a *nit*.
- 8.14. *Skyglow*: a glow in the night sky deriving from an artificial source.